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TRIALS FOR VILLAGE SOLAR DRIERS IN THE SOUTH PACIFIC

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I. TIP-UP COPRA SOLAR DRIER FOR COPRA

Introduction

During 1979, the South Pacific Commission made contact with the Groupe de recherche sur les techniques rurales (GRET), rue Dumont d'Urville, Paris, which does interesting work in technology for development. The group's technical design No. T176, which is annexed to the present document, struck the SPC Tropical Agriculturalist as potentially useful.

The tip-up solar drier, commonly used for drying cocoa beans or okra *(Hibiscus esculentus)*, was designed by the Institute of Technology and Industrialisation for Tropical Countries in Abidjan, Ivory Coast.

The last two South Pacific Conferences directed the SPC Secretariat to concentrate on action at 'grass roots level' of direct benefit to the family, and for the past two years SPC has been implementing an extension and advisory services project for coconut smallholders. It appeared that this tip-up solar drier, after certain modifications and improvements, could be of great benefit to coconut smallholders in the Pacific for drying copra.

Fig. 1: The tip-up solar drier for copra. Half-nuts are being dried in the passage on the right.

Construction of the first tip-up solar drier in the Pacific region

In October 1979, the SPC Tropical Agriculturalist directed a training course on atoll cultivation in Majuro, Marshall Islands. Coconut and copra production are still the principal activity of these islands, but the copra is of very poor quality since it is often smoke or sun-dried without any precaution being taken for protection against dust and rain. The construction of a prototype of this tip-up solar drier for copra production was therefore recommended as part of the trainees' practical work (See Annex).

(i) Modifications

a) Air vents were made 15 cm wide to enable dried copra to be slid out directly into a bag or basket.

b) Brackets at both ends of each passage to prevent produce from sliding off were made detachable to allow discharge of copra.

c) The strong wooden prop was given a sufficiently large notch at either end to support the axle attached to the drier for rotation when drier is tipped.

d) The base of the drier was made of plastic sheets, since no bamboo slats exist locally and trainees had too little time to use local substitutes (palm leaves, wooden slats, etc.).

(ii) Operation of tip-up solar drier

The drier was fed with fresh kernels from 600 coconuts. One passage was reserved for drying 112 half-nuts whose kernels were positioned with the kernel facing the sun.

After two days of drying, the 'fresh kernel' copra was stirred and turned. The kernels were removed from their shells and placed to dry in the drying passage. The plastic cover, 300 microns thick, was then attached.

(iii) Results

After three days of drying, the copra was dry and of good quality. The 600 coconuts gave 112 kg of copra, or 186 g per nut. Unfortunately, the moisture content could not be measured. The following observations were however, made: after an initial 'drying-off' in the half nuts the copra was of excellent quality and light in colour; the kernel pieces were large and even in size. The plastic sheeting which was used as the base of the drier was impermeable and a light film of moisture settled on it. Wooden or bamboo slats, as specified in the G.R.E.T. technical design, would therefore be better.

Construction of similar driers in the New Hebrides and Western Samoa

In December 1979 and January 1980, the Tropical Agriculturalist organised training courses on coconut production in the New Hebrides (for French-speaking countries) and in Western Samoa (for English-speaking countries), in co-operation with local agricultural officers and coconut production specialists. Two tip-up solar driers for copra were built as part of practical work of the trainees.

(i) IRHO Station, Saraoutou, Santo, New Hebrides

This time the base of the drier was made of bamboo slats, and the drier was built to the measurements prescribed.

On Monday 10 December at 2 p.m., the drier was loaded with:

- fresh kernels (green copra)		77 kg 175
- half-nuts (number)		184

On Thursday 13 December at 2 p.m., the following results were obtained:

- copra from fresh kernels		47 kg 800
- copra from half-nuts		27 kg 240
	Total	75 kg 040

The moisture content was:

- copra from fresh kernels	7 - 8%
- copra from half-nuts	7.5%

After 72 hours of drying the yield:

$$\frac{\text{dry copra}}{\text{green copra}} = 62\%$$

27.7 hours of sunshine were recorded.

(ii) Nafanua Agricultural Station, Western Samoa

A similar drier was built in Apia in January 1980. Because of the season and the location of the agricultural station of Nafanua, where skies are often overcast, the width of the black painted heat absorbers was increased to 40 cm. The base of the drier was made of bamboo slats.

Green copra, which could not be weighed, was placed to dry exactly as in Majuro and Santo. After three days of drying, identical results were obtained: the copra was dry and of good quality, but the kernel, pre-dried in the half-nut, produced a pale coloured copra of even better quality.

Advantages of the tip-up solar drier for copra

On certain islands, especially on atolls where firewood is scarce and becoming scarcer, coconut husks are used as fuel for home cooking and for hot air copra driers. With the solar drier, these husks could be put to other uses: mulch, soil cover and even compost making if they were shredded and well moistened. Since the coconut grower's work would be simplified, he could spend more time on other agricultural activities, such as better maintenance of his plantation and increasing the quantity of copra sold.

In any case, since copra produced in the solar drier is of very good quality, it should fetch a higher price.

In areas where copra is initially dried in the half-nuts, recovering the shells could lead to charcoal production for local use or export. Charcoal from coconut shells is currently in high demand on foreign markets because, after activation, it is an excellent absorbent of industrial gas and vapours.

Lastly, since it is so simple to set up and light in weight, this type of drier can be used anywhere in the coconut plantation and considerably reduces the tedious task of transporting coconuts or fresh kernels from production sites to driers.

Improvements to be made to the tip-up solar drier for copra

In the light of these first tests in the Pacific islands, it seems that some improvements could be made to the original drier:

(i) Height of boards: from 18 to 20 cm.
(ii) Width of heat absorbers: at least 40 cm in areas with little sunshine.
(iii) Wooden slats measuring 3.5 cm in width and spaced at 0.4 - 0.5 cm from the base of the drier.
(iv) Wood protected by a coat of paint or insecticide treatment.
(v) Use of a reinforced plastic cover 225 microns thick, allowing 82% of light to penetrate (or use of a plexiglass sheet).

It might be useful to construct a false bottom of strong wire netting and to place the green copra on this. This would allow air to circulate both above and below the layer of copra.

Future of the tip-up solar drier for copra in the South Pacific

It is still too early to predict the future of this type of copra drier in the South Pacific because, as we have seen, the first one was built and tested only a few months ago (Majuro, Marshall Islands, October 1979). However, many countries of the region have shown an interest in it especially:

- New Hebrides - 2 driers in operation
- Western Samoa - 1 drier under trial
- Niue - interested in constructing 3 driers
- Tuamotu (French Polynesia) - construction of 12 driers planned
- Loyalty Islands (New Caledonia and Dependencies) - construction of 12 driers was recommended by Mr Manciot, IRHO expert, following a mission in New Caledonia in November 1979.

It should be noted that after the training course on coconut production held in Apia, Western Samoa, in January 1980, Dr Mendoza, assistant to the Director of the Philippine Coconut Authority, decided to test some prototypes in the Philippines.

II. SOLAR DRIER FOR FISH

During the same training course on atoll cultivation, a small solar drier for fish was constructed by participants from Truk in the Federated States of Micronesia.

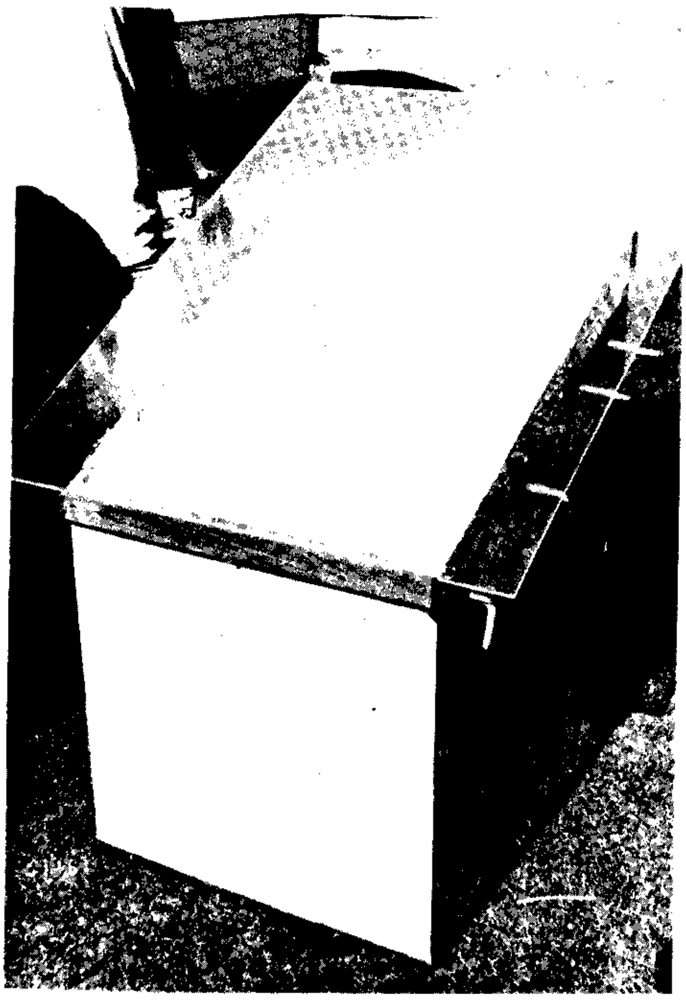

Fig. 2: Solar drier for fish, constructed by participants from Truk.

This was a wooden or plywood box with a slightly sloping top covered with white plastic or plexiglass. Two vents approximately 2 cm wide on the side at both ends allowed adequate ventilation for drying the fish which was hung on cross-rods inside the drier. These vents were covered with mosquito netting to prevent flies, attracted by the fish odour, from entering. A dish or removable base made it possible to clean and wash the drier, which proved necessary after each operation.

Trials conducted on Majuro produced excellent results: the fish was completely dry and had suffered no deterioration in three days of exposure to the sun.

III. SOLAR DRIER FOR BANANAS, BREADFRUIT AND OTHER FRUITS

Fig. 3: The solar fruit drier. Above, the breadfruit slices are dry and of fine appearance: below, the ripe bananas have turned dark brown during the drying process.

Description

As part of practical work organised during the training course on atoll cultivation held in Majuro in October 1979, participants also built a solar fruit drier suitable for use at family or village level. This was simply a big box with a wooden frame and walls made of plastic 200 microns thick. A set of removable trays made of fine wirenetting was placed inside to hold the fruit. Very small vents at the top and bottom of the drier walls allowed sufficient ventilation to remove moisture from the products to be dried. These vents were covered with mosquito netting to prevent insects from getting into the drier. The plastic was made to jut out a little over the vents to stop rain from entering.

Results

The chopped or sliced fruit (bananas peeled and cut in two lengthwise; breadfruit cut into slices approximately 1 cm thick) were placed on the trays. Under trial conditions in Majuro, after three days of drying, the breadfruit was completely dry and stayed white; the bananas on the other hand, although dry and sure to keep well, turned a little too dark.

Recommendations for drying fruit

Fruit must be healthy, fresh, and quite ripe but still firm on the day drying is begun. The inside temperature of the drier must be sufficient to prevent mould or bacteria from damaging the fruit. Each piece must be placed on the tray in such a way that the warm air can circulate freely all around it and escape easily through the upper vents with the moisture it has absorbed. In some cases it is advisable to turn the drying whole or chopped fruit once a day.

IV. CONCLUSION

No feasibility study has as yet been made, but it seems certain that as far as copra production is concerned, this new method of drying will prove profitable because of the fuel saving, speed of operation and the improved quality it entails.

Solar driers for fruit should be further investigated, as SPC has often been requested to deal with the problem of drying and preserving breadfruit for use in human or animal diets in periods of food shortage. This type of drier appears very suitable also for bananas, taro, pawpaws and sweet potatoes.

Results obtained for fish drying are also very promising.

It would seem therefore, that these trials should be followed up, especially for the benefit of atoll dwellers. On these islands, a day without sunshine is rare indeed, and several days without sun are unheard of. Sunshine often exceeds 2,400 hours/year, or roughly averages seven hours a day, which is more than 65 per cent of the total possible. In addition, relative humidity is low during the hot part of the day.

Although we are not yet at the stage of recommendations, these solar drier trials for direct drying are promising and are likely to lead to improved living conditions for the rural populations of some Pacific islands.

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ANNEX

CONDITIONING - STORAGE - CONDITIONING FOR CONSERVATION OF MATERIALS

TIP-UP SOLAR DRIER - ROUTINE USE - (Classification C.D.U.) G.R.E.T. - T176

Groupe de recherche sur les techniques rurales
34 rue Dumont d'Urville, 75116, PARIS.

BACKGROUND

This solar drier was designed by the Institute of Technology and Industrialisation for Tropical Countries in Abidjan for the purpose of drying cocoa beans. Other uses included the drying of agricultural products such as okra in Togo, where this vegetable is an important staple food.

ADVANTAGES

In comparison with natural drying, the solar drier offers several advantages:

- products are protected from dew and rain
- they are kept free of dust and predators
- the temperature inside the drier is higher, thus making drying time shorter.

Protection from rain is especially useful for cocoa since it is often dried during the rainy season.

Description (see diagram - proportions are not true to scale)

A wooden frame measuring 550 x 150 cm (approximate surface area 7.5 m^2) is made up of 4 boards 14 cm wide and 2.5 cm thick. Three additional boards measuring 500 cm in length subdivide this frame into passages to facilitate air circulation.

A base made out of bamboo matting leaves both ends free for ventilation. The black plates which raise the temperature inside the drier should constitute one seventh of the useable surface (i.e. area where products are placed). Brackets measuring 32 x 5 x 2 cm at both ends of each passage prevent the products from sliding off when the drier is tilted.

A plastic cover measuring 4.75 m x 1.85 m is attached to both sides of the drier and kept in place by a cover stop which can be easily removed (for stirring the product). Made out of PVC and with a thickness of 300 microns, the cover is resistant to both heat and small predatory animals.

A wooden stand is set up at a height to form an angle of about 30° between the drier and the ground.

A wedge supports the drier when it is tilted in either direction.

Mode of operation

Loading - cocoa beans: under favourable conditions 45 kg of fermented cocoa can be loaded onto each m^2, totalling 270 kg per drier. The beans are spread in the drying passages, not more than half way up the frame boards.

Under unfavourable conditions (humidity, little sunlight), the maximum load of beans should not exceed 20 - 25 kg/m^2 (or 120 kg in all) and be spread out to a quarter of the way up the frame boards.

- *Okra:* the pods are cleaned and spread out evenly. Average load= 50-100 kg of pods.

Positioning: the drier is placed in an east-west direction: in the morning it is tilted eastwards and in the afternoon westwards. Where humidity is high, the plastic cover should be wiped with a sponge to remove condensation and dust.

Stirring: products (cocoa beans or okra pods) must be stirred at least once daily, preferably at midday when the drier is being tilted westwards. This allows even drying and prevents mould from developing.

The drying process may be considered complete once the moisture content of the okra pods falls to five per cent. Three to four days are usually necessary for drying.

Cost: the cover (800 F CFA in 1969 i.e. 16 French francs) is the only piece of equipment which cannot be made locally. According to ITIPAT, construction costs in 1971 for a drier measuring 5,4 m^2 and made from local materials were in the order of 2,500 F CFA (50 French francs)[1].

For a typical Ivory Coast cocoa plantation with a total production of 1 000 kg/ha, three driers per hectare would be required.

ADDITIONAL INFORMATION

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1. 1 French franc =approximately 21 cents Australian.

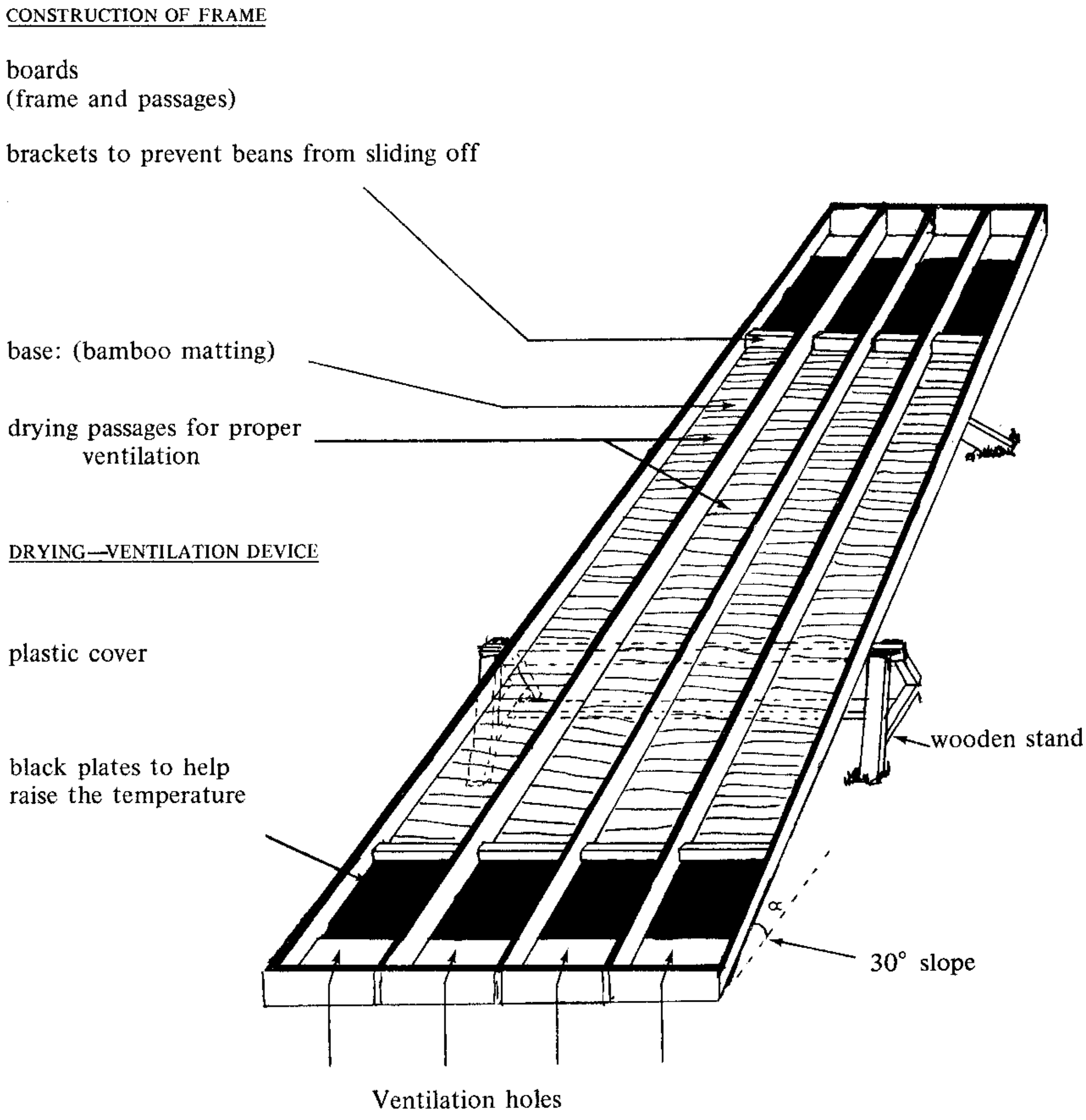

DIAGRAM OF TIP-UP SOLAR DRIER

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