IMPROVEMENT OF THE FARMERS' DIRECT-TYPE COPRA DRYER

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ABSTRACT

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A survey on the farmers' direct-type *tapahan* copra dryer was conducted to monitor the configuration of the dryer, depth of heat source, fuel consumption and time of drying. Three copra dryers with square, parabolic, and rectangular pit configurations were constructed and evaluated at varying depths of heat source of 2.3 m, 1.8 m, and 1.3 m. The performance of the farmers' copra dryer using the 1.67 m average depth of heat source was compared to the performance of the dryers under study.

Results showed that the square dryer at 1.8 m depth performs significantly better compared to the other types of dryer at different depth levels and the farmers' *tapahan* dryers. It has the shortest average drying time of 8.67 h, lowest average fuel consumption of 566.67 husks, and highest averages in drying rate and drying rate per unit fuel consumption of 31.08 kg/h and 0.137 kg/h-kg, respectively. The copra color produced was similar regardless of dryer type.

KEY WORDS: Coconut farmers. Copra dryer. Improvement. *Tapahan*.

INTRODUCTION

Direct dryers are prone to burning because the firing place is immediately under the drying platform on which the coconut meat to be dried is placed. In spite of the hazardous situation, small coconut farmers stick to this type of dryer because of its lower cost compared to the other types of dryer, validating the statement of Valmayor (1978) that small farmers with a gross income of ₱5,000-6,000/yr[1] stick to the old method of drying. In Eastern Visayas where 72.2% of the total number of farms planted to coconut

[1]US$ 1.00 = RPP 25.00 (appx.)

occupy only 0.5-5 ha (Santos, 1986), farmers were observed using direct type dryer.

Dryers better than the old types have been developed. Lozada (1987) designed a portable and improved direct-type dryer; Escalante et al (1977) developed a *kukum* hot air dryer or the indirect-type dryer which produced white copra; Sudaria (1993) designed a semi-direct type copra dryer that can accommodate a maximum of 2,000 nuts at a time, consumes only 60% of the husk as fuel, with less risk of burning the load. Yet, most farmers still use the old direct-type dryer.

In order to help the farmers reduce efforts and economize on copra drying even with the use of the direct-type copra dryer, this study was conducted to determine the best combination of the plenum chamber configuration and depth of heat source from the drying platform.

MATERIALS AND METHODS

Survey, design and construction

A survey on the farmers' direct-type copra dryer was conducted to have a benchmark information on their dryer configuration, depth of heat source, fuel consumption and time of drying. Three copra dryers of square, parabolic and rectangular pit configurations were designed and constructed under one shed to eliminate variation due to climatic conditions (Figure 1). The distance of the heat source and the drying platform was at 2.3 m for the first depth level and then adjusted to 1.8 m and 1.3 m after evaluation of each depth was completed.

Evaluation of the dryers

Each copra dryer was evaluated at four levels of distances (1.67 m [farmers' dryer average depth], 1.3 m, 1.8 m, and 2.3 m) between the drying platform and the bed of heat source. Each level evaluation was replicated 3 times with 1,000 nuts per replication. Matured nuts of Baybay Tall variety were used in this study. The split nuts were arranged using the farmers' practice and then dried during the day. After removing the coconut shell, the coconut meat were re-dried until a 12% moisture content was reached. The

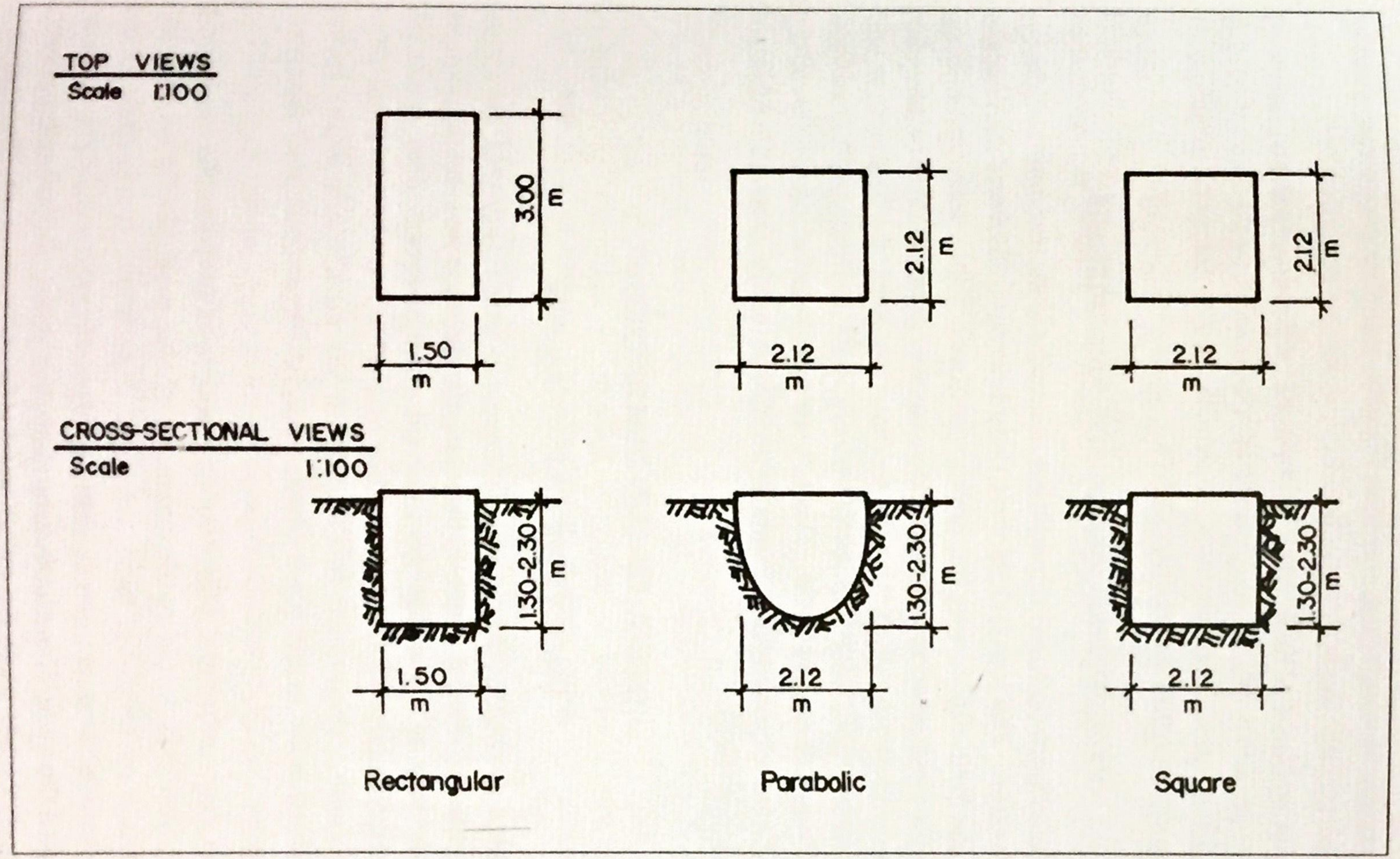

Figure 1. Top and cross-sectional views of the direct-type copra dryers.

fuel used was the coconut husk removed from the sample nuts and the quantity was monitored until the copra reached 12% moisture content.

Equal amounts of husk were fed to each of the dryers at an interval of time. This was done in order to produce approximately equal amount of heat in the three dryers. This practice is similar to the farmers' practice of processing copra using direct-type dryers.

Experimental design and data analysis

A two-factor factorial experiment in a completely randomized design (CRD) was used. The two factors were the pit configuration and the distance between the heat source and the drying platform. There were three levels under the pit configuration factor, namely: square, parabolic and rectangular. For the second factor which was the distance between the heat source and drying platform, there were four levels, namely: 1.67 m (farmers' dryer average depth), 1.3 m, 1.8 m, and 2.3 m. There were three replications in this study. The significant experimental means were tested using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Drying time and drying rate

Table 1 shows that the closer and deeper the heat source was, the longer the time it took to dry the copra. In this case, the distance that had the shortest drying time was at 1.8 m for the three pit configurations. The square pit configuration had the shortest drying time of 8.67 h. It is also shown in Table 2 that the same configuration at 1.8 m depth has significantly higher drying rate than those at 2.3 m and 1.3 m which were the deeper and closer distances, respectively.

This may be because when the heat source is far from the meat being dried, the heat that would get in contact with the meat would be of lower heat intensity; on the other hand, when the heat source is too close to the meat, higher heat intensity would get in contact with the meat, causing case-hardening of the meat. Case-hardening is evident in the charred outer portion of the coconut meat while the inside portion is still uncooked. The moisture

Table 1. Average drying time of copra (h) in different pit configurations and depths of heat source.

	Depth of heat source (m)				
Pit configuration	1.67	2.3	1.8	1.3	Mean
Square	10.50bcd	9.33ab	8.67a	12.33efg	10.21a
Parabolic	11.50cdef	10.67bcde	10.33bc	13.00fg	11.38a
Rectangular	12.00def	10.33bc	9.33ab	14.00g	11.42a
Mean	11.33b	10.11ab	9.44a	13.11c	

cv = 9.2%

Table 2. Average drying rate of copra (kg/h) in different pit configurations and depths of heat source.

	Depth of heat source (m)				
Pit configuration	1.67	2.3	1.8	1.3	Mean
Square	22.79bcd	24.49bc	31.08a	21.76cd	25.03
Parabolic	23.96bc	20.96cd	23.67bc	20.69cd	22.32
Rectangular	27.49ab	23.16bcd	27.38ab	18.52d	24.14
Mean	24.75ab	22.87b	27.38a	20.32b	

cv = 10.0%

inside the case-hardened coconut meat is trapped and would take time to pass through the hardened layer and evaporate freely. Thus, a longer time is needed to move the moisture out of the coconut meat.

Fuel consumption and drying rate

The husks of the nuts under study served as the fuel in drying the coconut meat. Moisture content ranged from 35 to 45% (wet basis) with an average weight of 0.42 kg/husk (1,000 husks weighed 423.5 kg).

Table 3. Average fuel (husks) consumption of copra (pieces) dried in different pit configurations and depths of heat source.

	Depth of heat source (m)				
Pit configuration	1.67	2.3	1.8	1.3	Mean
Square	787.33bcd	607.67ab	566.67ab	532.67a	623.58
Parabolic	900.00cd	674.33abc	620.00ab	566.00ab	690.08
Rectangular	1000.00	684.00abc	596.67ab	621.00ab	725.42
Mean	895.78b	655.33ab	594.44a	573.22a	

cv = 12.2%

Table 4. Drying rate per fuel (husks) consumed (kg/h-kg) in copra dryers with different pit configurations and depths of heat source.

	Depth of heat source (m)				
Pit configuration	1.67	2.3	1.8	1.3	Mean
Square	0.071	0.096	0.137	0.103	0.102
Parabolic	0.064	0.074	0.095	0.089	0.081
Rectangular	0.067	0.081	0.116	0.080	0.086
Mean	0.067b	0.084ab	0.116	0.091ab	

cv = 13.5%

Table 3 shows that the closer the heat source, the lesser the fuel consumed. The square pit configuration at 1.3 m depth consumed significantly lesser amount of fuel (532.67 husks) compared to the other configurations at different depth levels. This result may have been due to the fact that when the heat source is deep enough, more husks could be fed; likewise, when it is closer to the drying platform, less number of husks could be fed to keep the fire from reaching the platform. The heat intensity emitted by the fuel would be higher at a closer distance compared to a deeper level or far distance.

When the heat source is too close to the coconut meat being dried, there is high possibility that the outer surface of the meat dries quickly and forms a skin which checks the evaporation of moisture from the interior part of the meat, thereby decreasing the drying rate. However, a closer heat source would not be advantageous since the possibility for the flame to reach the drying platform and eventually burn the whole dryer is also greater. Table 4 shows that the drying rate per fuel consumed at a depth level of 1.8 m was significantly higher at 0.116 kg/h-kg compared to the other depth levels.

Physical characteristics of copra produced

Generally, copra produced from direct-type copra dryer was discolored (dark brown). This discoloration was caused by the smoke emitted by the coconut husk used as fuel. The copra produced was usually case-hardened or scorched when heat source was in the 1.3 m depth level.

RECOMMENDATION

The recommended plenum chamber or pit configuration for a direct-type *tapahan* copra dryer is a square, with a depth of 1.8 m from the heat source to the drying platform.

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