Field Application of Modified Low Cost Dryer for Rice Seed Drying - A Case Study in West Java and Central Java, Indonesia

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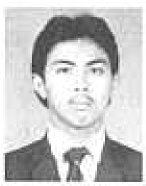

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Abstract

An overview has been given of the research and development in rice handling and processing that was carried out as a case study at the farmer level in West Java and Central Java, Indonesia. The objective of this research was to improve the efficiency and profitability of rice seed processing. Attempts were made to improve rice seed quality at the farmer level by focusing on the drying with the modified IRRI low cost dryer (LCD). The measurement parameters were moisture content, sound seed, and germination rate. Results indicated that seed drying by LCD had significant quality with normal seedling (95.0-97.0 %), sound seed (98.7-99.4 %) and insect infestation (0-9 %).

Introduction

During the past three to four decades, Asian farmers have dramatically increased rice yields through the adoption of modern rice varieties. During this time, Asian consumers have also become more discriminating in terms of rice quality. Consumers in many countries of the region are now willing to pay a higher price for the specific rice quality that they desire. However, the adoption of modern post harvest technologies and practices that are needed to produce better quality rice has not kept pace with the increased demand for rice with high quality. Inappropriate technologies, unsuitable management techniques and lack of knowledge during grain harvesting, drying, storage and milling often result in quality deterioration and physical losses. Rice quality deterioration can be in the form of high grain breakage, incomplete milling, yellowing or discoloration, impurities or undesirable odors or taste.

Historically, research on rice quality improvement has largely focused on changing quality characteristics by means of genetic improvement and evaluating the effect of component technologies on qualitative changes in the grain.

So far, research on grain quality management throughout the entire post-production system has taken a backseat (Bell et al., 2000). As stated by de Datta (1981) more than two decades ago, attempts that have been made to improve rice processing have often not focused on the total system but have taken a piecemeal approach resulting in little impact on the quality of the rice that arrives at the consumer's table. It was, therefore, important to consider the entire post-production systems and its various players as a system, an approach taken in most temperate-climate rice-growing countries. The objective of the recent research on a component of the rice postproduction system was to evaluate the modified IRRI low cost dryer (LCD), a model dryer with appropriate technology.

Fig. 1 Schematic diagram of heated air flow in low cost dryer

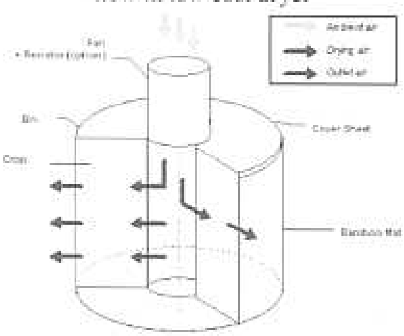
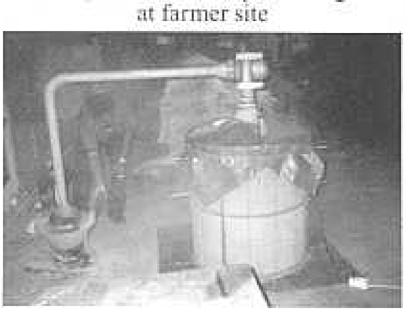


Fig. 2 Low cost dryer testing at farmer site



Research Methods

The LCD with one ton maximum capacity was investigated at a farmer's site who was also a rice seed producer. The characteristics of the modified IRRI-LCD were identified. The standard operational procedure, moisture content, drying rate, air temperature and germination rate were examined during the drying process. The heat source used raw husk and was compared with husk charcoal and husk briquettes. A schematic diagram of the heated airflow in the Low Cost Dryer is shown in **Fig. 1**.

The LCD model dryer (**Fig. 2**) is a multi-crop dryer and can be used for paddy, corn, soybean, and other crops but it has been tested only for rice seed drying. The performance of this dryer is affected by the relative humidity of the ambient air, moisture content of the paddy, and the available electrical power source. This dryer utilizes the principle of a low temperature in-bin drying system and, therefore, cannot dry paddy as fast as sun drying. The dryer itself can serve as temporary storage of paddy after drying.

a. Specifications of the Low Cost Dryer (LCD)

Capacity of the dryer is one ton but adjustable for less quantities. The operator requirements are two persons for loading and unloading. The power requirement is a 0.5 hp, 3450 rpm, 220V, single phase, 60 Hz electric motor. The dryer is 150 cm long, 150 cm wide, 120 cm high with a weight of 25 kg and two 1000 W heating elements 15 cm long. The operational heater management in drying from very wet paddy to normally wet during dry and rainy seasons are shown in **Tables 1** and **2**.

The original LCD seed dryer was made from nylon wire and was not very robust. Loading and unloading paddy damaged the sidewalls and made it difficult to get a central position of the air chamber and keep the outer walls concentric in the shape. The nylon wire mat was replaced by steel matting, which improved rigidity and shape.

Aeration holes in the original husk stove were 5 mm in diameter. This caused problems with combustion. Enlarging the holes to 10 mm in diameter and adding a number of holes in the wall and the bottom of the stove significantly improved the performance.

b. The LCD Capacity

The holding capacity of the LCD is one ton but it can be used for lower capacities by adjusting the circumference of the drying bin (as mention in **Table 3**).

c. Moisture Content

One of the drying conditions mentioned here is the data from the rice seed drying process that began

Table 1 Operational LCD heater management in drying very wet paddy during rainy and sunny days

Heater settings and duration	
Rainy days	Sunny days
Low: 4 hours	Off: 3 hours
Medium: next 4 hours	Medium: 3 hours
Off including blower: 1 hours	Off including blower: 1 hours
Medium: until paddy is dried to desired moisture (normally 14 % MC)	Medium: until paddy is dried to 14 % MC

Table 2 Operational LCD heater management in drying normally wet paddy during rainy and sunny days

Heater settings and duration	
Rainy days	Sunny days
Low: 2 hours	Off: 3 hours
Medium: next 4 hours	Medium: 3 hours
Off including blower: 1 hours	Off including blower: 1 hours
Medium: until paddy is dried to desired moisture (normally 14 % MC)	Medium: until paddy is dried to 14 % MC

Note: Blower must always be on except as specified for tempering purpoes with the initial moisture content at 20.9 % and the drying process was stopped when the grain reached 13 % moisture. The drying process (**Fig. 4**) took 14 hours and the average drying rate was 0.60 %/hr. There were differences in moisture content (moisture gradient) from 0.5-1.8 % between the front side and rear side of grain chamber.

d. Air Temperature and Humidity

The air temperature in the plenum chamber was held at 50 °C constantly, while the temperature inside the grain chamber varied between 28-32 °C. The relative humidity of the air was 95-98 %, and the humidity gradually dropped to 44 % after the grain was dry (**Fig. 3**).

e. Germination Rate

The grain dried in the LCD dryer had a germination rate of around 96 % and contained 3 % dormant seed and 1 % dead seed. Drying seed using low temperature (32-44 °C) resulted in a higher initial level of germination rate that increased even further after the dormancy period (**Table 4**).

f. Fuel Consumption

The LCD used raw husk as the source of heating air. The consumption of raw husk was 105 kg for 1000 kg of rice seed. While the husk was often free at the rice mill, the cost was up to 2.3 US$/ton in more remote areas. Additional heat sources for the LCD were husk briquettes and husk charcoal (**Table 4**) that gave less smoke than raw husk but made the operation cost more.

Conclusion and Suggestion

The low cost dryer had simple construction and an adjustable capacity that enabled it to be applied for both individual and farmer groups especially for rice seed drying. The characteristics of the dryer were influenced by the atmospheric humidity, thus, indoor utilization is suggested.

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Table 3 Determing the LCD capacity

Capacity, kg	Circumference, cm	Bin diameter, cm
1000	450	145
900	430	138
800	411	131
700	396	126
600	361	115
500	333	106

Table 4 Germination kernel against the various biomass fuel rice husk base

Treatment biomass fuel	Moisture content, %	Rough rice, %		Germination kernel, %		
		Good	Empty/dirty	Normal	Abnormal	Dead/spoil
Raw husk	13.73	94.12	5.88	96.67	2	1.33
Husk briquette	13.77	89.81	10.19	96.67	2.33	1
Husk charcoal	13.57	92.66	7.34	95.33	3.67	1

Fig. 3 Grain moisture changing during drying

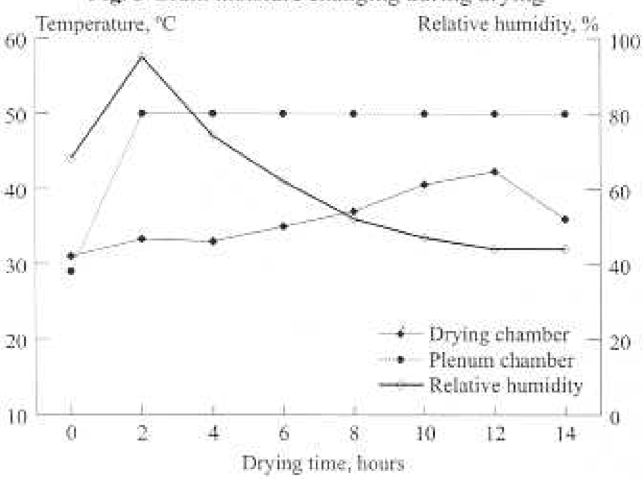

Fig. 4 Average condition at air during drying process