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TECHNO-MANAGERIAL STUDY OF THE UPLB FLATBED DRYER

by

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INTRODUCTION

Background of the Technology

Sired in the USA; born in UPLB. In the 60's the UPLB engineers developed the earliest and simplest commercial drying technology, the flatbed dryer. It became the grandmother of all the dryers introduced in the ASEAN, IRRI, and Vietnam by UPLB graduates (De Padua, 2008).

The low yield of paddy harvested during the rainy season when the traditional sun drying practices can not be relied upon has prompted the development of the flatbed dryer. Dr. Dante B. Padua, a Civil Engineer by profession and a former Associate Professor at the College of Agriculture-UPLB, is credited as the proponent of this technology. The flatbed dryer was developed at the Department of Agricultural Process Engineering and Technology (AGPET), INSAET, University of the Philippines at Los Baňos. In a seminar on the Philippine's Post-harvest System given in July 2008 at CEM, UPLB, Dr. de Padua said that the flatbed dryer was the only post harvest technology of that kind available during the time it was developed.

Prior to the development of the UPLB flatbed dryer, mechanical drying was already resorted to by rice millers. The heated-air convection type dryers were imported from the West and thus, were designed for Western farms. These were large, very expensive, sophisticated in controls, and required a certain level of expertise to operate. Because of these, centralized drying was most appropriate. Unfortunately, such set-up was not for many of the farmers. The farmers, the supposed beneficiaries of the technology, have small and fragmented farms such that use of this kind of dryer is impractical. They do not anymore dry their paddy but sell right away to some middlemen/traders immediately after harvest to avoid spoilage especially during the rainy season. Selling palay during this time, a number of kilos are deducted from the palay's gross weight in addition to a lower than market price it could command. This situation worked against the very purpose of centralized plant dryers and therefore present a challenge to develop a low cost, simple to manufacture, simple to operate, portable, and effective in drying the grains right on the farm, hence, the UPLB Flatbed Dryer.

Blueprints of the technology were furnished to government agencies responsible in the country's rice production, thus vigorous use of flatbed dryers was put in place from right after its development. According to Dr. de Padua, one thousand units were fabricated for the National Food Authority (NFA) and exports were made to Malaysia, Indonesia, Thailand and Vietnam from 1962 to 1965. Other state universities like the Mindanao State University

[1]This paper draws heavily from insights and materials of lectures delivered by Dr. Dante B. de Padua in various workshops and conferences.

and Central Luzon State University received orientation on the technology for them to help in the promotion of the product and in training the farmers. Some private fabricators/manufacturers in the vicinity who had expressed interest on the product were also given copy of the product design for free.

The Drying Process

Drying is the process of removing available water from the grains through evaporation by applying heat from the radiation of the sun or combustible fuel to bring the grains (such as rice and corn grains) to safe storage level (Resureccion, undated). It is a major post-harvest operation intended to prevent seed germination, suppress biological deterioration of grains in order to retain optimum seed quality. Research has further shown that drying should not only be timely but should be done under a controlled process to preserve its milling quality. Improper drying procedures or conditions are the primary causes of poor milling quality, such as low head rice yields. There are other drying techniques being practiced by farmers and traders but this paper will only deal with the two post-harvest drying systems as follows: sun drying and mechanical drying using the UPLB Flatbed Dryer.

Sun drying is the conventional and an age-old drying technique. Though highly laborious it is preferred by many farmers because it is the least costly and at times requires no cash outflow at all if done only by family members. However, the conditions that the grains are subjected to in sun drying cause deterioration in the quality of the grains (FarmFriday, August 2007). Small stones and other contaminants could mix with the grains and are carried through the milling. On top of this, sun drying is very critical and almost impossible during rainy days.

One of the harvest seasons occur during the rainy months of October to November. According to Rodulfo (1995), the farmers' failure to immediately dry the wet paddy results to an income loss to as much as 35%. Under a worst situation, more than half of the farmers harvest is lost due to spoilage caused by delayed drying. In a study done by Dr. A.N. Resurreccion, a year-round assessment on the probability of success of paddy sun drying in three representative sites was made. These sites were located in: 1) Echague, Isabela 2) Munoz, Nueva Ecija and 3) Los Banos, Laguna. From these data, an average recovery of 87% and 58% was used in computing the estimated financial returns during dry season and wet season respectively. The average was based on a ninety day period though in the financial projections a sixty-day harvest period was used to be more conservative. The findings are tabulated in the following page.

Another major advantage of mechanical drying over sun drying is its capability to provide uniform and controlled temperature for the grains. Grain is very temperature sensitive. One hundred ten degrees Fahrenheit or 43.3 degrees centigrade is the desired temperature for drying without damaging the grains. This requirement can not be attained through sun drying.

Table 1. Probability of success of paddy sundrying for any given harvest period for any given harvest period in three representative sites. Paddy layer thickness = 2 cm.

Selected Sites-->	Echague, Isabela			Munoz, N. Ecija			Los Banos, Laguna			Ave. per mo.	90-day Ave.
Initial MC(wb.)->	28	24	20	28	24	20	28	24	20		
Month of Harvest	Percent Probability										
March	60	70	90	90	90	90	90	90	90	84	
April	80	90	90	90	90	90	90	90	90	89	
May	90	90	90	80	90	90	80	90	90	88	87%
June	70	80	90	70	70	80	70	70	90	77	
July	60	60	80	60	70	80	70	70	80	70	
August	40	50	80	40	50	60	60	70	90	60	
September	60	70	80	40	40	60	70	70	80	63	
October	20	20	40	60	70	80	60	60	80	54	
November	20	20	40	60	70	80	60	70	80	56	58%
December	10	10	40	80	80	90	50	60	80	56	
January	20	30	50	90	90	90	60	70	90	66	
February	70	80	90	90	90	90	80	80	90	84	

Source: A. N. Resurreccion, Grain Drying Equipment, CEAT Library, UPLB

Moisture content[2] of newly harvested grains during rainy days ranges from 20 to 26 percent wet basis[3] which is too wet for milling and storage. Moisture content must first be lowered to an average of 13 percent before grains can be stored for future use and milled. Good quality milled rice as described by De Padua and Andales (1987) requires the following characteristics: long grain, well-milled, white and crystalline, high head or whole grain percentages, medium to soft texture, and clean – free of contaminants such as stones, husk or bran, and weed seeds. These requirements are difficult to attain even during non-rainy days though moisture content of grains averages at only 17% because most of the farmers resort to sun drying done by spreading the grains on every available concrete surface including the highways and by-roads. Aside from being a hazard to motorists, the grains get mixed with little stones in the streets. Moreover, drying on the road is wasteful as it can result to rice losses estimated by the Bureau of Postharvest Research and Extension (BPRE) to range from 0.7 to 8.7%.

Description of the Flatbed Dryer

The UPLB Flatbed Dryer is compact in design and portable (Figure 1). Unlike the huge units patterned from the US and Europe, the flatbed dryer can be transported and brought near the farms. It has a capacity of 40 cavans of paddy which dries in eight hours for heavily wet paddy during rainy season and only four hours during the dry season. The dryer needs little maintenance and easy to operate. The flatbed dryer has three components, namely: a bin to hold the grain on a perforated or lanced sheet metal floor above a plenum,

[2]Moisture Content is measured in terms of wet basis (wb) and dry basis (db)

[3]MC_{wb}={Wm / (Wm + Wdm)} x 100; MC_{db} = (Wm/Wdm) x 100

a fan to force the drying air from the plenum through the grains, and a burner to heat the air (De Padua, et al., 1976).

1. Grain holding bin. The grain compartment is 18 inches deep to hold 40 cavans (2 tons) of palay. Its floor is a perforated steel sheet gauge 22 with 2mm perforation measuring 6 feet wide and 12 feet long which separates the grain compartment from the plenum. The sides of the bin can be made of ¾ inch plywood. Two or three side ports or windows where dried grains can be unloaded should be provided. The bottom floor is a ¼ inch thick plywood.

2. Fan or blower driven by an engine. The blower is a 23-inch diameter fan adapted from a truck radiator fan to force the heated air powered by a 2.5 hp-electric motor or by a 5 hp-diesel engine. Alternatively, a 6 – 8 HP engine that powers tiller can be used to drive the fan. This means another saving for the farmer/operator. The fan can push 3,000 cubic feet per minute (CFM) of air against a total pressure of one inch water column. The size of the grain bin was based on this fan characteristic. A 3,000/40 or 75 CFM per cavan air to grain volume ratio is the minimum tolerable value. This ratio results in a final moisture gradient of 12% at the bottom and 14% at the top of the 18-inch deep grain bed. This is an acceptable gradient and will not necessitate mixing of grain during drying.

3. Burner. A drying temperature of 43.3^{o}C (110^{o}F) is prescribed for the grain so as not to induce thermal stress on the grain and thus damage its milling quality. A direct flame kerosene burner of the vaporizing pot type and gravity-fed was developed. The primary air for combustion is sucked through the holes on the base of burner pot. The temperature of the drying air is regulated by the needle valve and the distance between fan housing and burner housing.

Rice hull fired furnaces were also developed by local manufacturers. This makes the dryer flexible for the farmers who can choose between using kerosene or farm wastes like rice hull, coconut husks, corn cobs, coir dust, etc. or a combination of these as fuels.

Accessories. A simple water manometer made of ¼" diameter plastic tubing is installed at the front end of drier to indicate static pressure. One end of the manometer is inserted through a hole on the plenum part of the front end. A thermometer (preferably dial type) is used to measure temperature is also inserted through a hole in the plenum part of the front end near the manometer.

Operating procedures. To protect the dryer and grains from the elements, a shed may be built to serve as cover. The unit can be assembled easily by two men in about an hour. Forty cavans of wet grains are loaded and level off. Then engine is started with the manometer as guide in setting engine speed. Next, the burner or furnace is ignited. An operating temperature of 110^{o}F must be established and maintained. Depending on the initial moisture content, a batch dried continuously takes 4 to 8 hours to bring down the moisture to 13% average. Drying is stopped when the top layer is at 14% moisture. In the absence of a moisture meter, an experienced operator can discern the moisture by cracking the grain between the teeth. Dried grain is tough and will fracture, slightly wet grain is mushy. The dried grains are unloaded on the side ports provided.

Nature of the Research Conducted & Methodology

The flatbed dryer was developed to address a post harvest critical problem, drying the grains and became a hit. However, more than thirty years later the product was almost forgotten. Thus, in year 2000 Pamplona first conducted this study to assess the extent of adoption of the UPLB flatbed dryer and to determine the reason or reasons inhibiting sustained and material utilization of the technology by farmers and by traders/millers.

A number of farmers and traders in Calauan and Bay, Laguna were selected to determine present drying practices, advantages in using, and factors hindering them from actively using the flatbed dryer as a post-harvest equipment. Frequency Distribution Table (FDT) was used to analyze the data gathered from the interviews while qualitative analyses consisted of the evaluation of experiences, comments, suggestions, and reactions from the respondents.

Supplementing the above data gathered initially in year 2000, updates were obtained by Ragudo during the first semester of 2008. Problems related to post harvest system in the country were taken from the lecture given by the technology proponent, Dr. Dante De Padua at the College of Economics and Management, UP-LB on July 23, 2008. The technology's current state was sourced from Engineer Edgardo V. Casas of the Department of Agricultural and Bio-Process Division, from a manufacturer of dryers in Pila, Laguna, and from a rice miller of Calauan, Laguna. Furthermore, a trader from Calaca, Batangas who is presently using flatbed dryer to dry corn grains was asked to participate in the study. Secondary data from the Internet provided information on the current post harvest program of the government through the Bureau of Postharvest Research and Extension (BPRE) of the Department of Agriculture.

Summary of Findings

A. Based on 2000 Survey

There were two groups of respondents purposely selected to participate in the study namely: (1) the farmers who are members of Hangan-II Development Cooperative and Lamot Multi-Purpose Cooperative (LMPC) both located in Calauan, Laguna and (2) grains traders/millers from Bay and Calauan, Laguna. The five traders chosen to participate were users of the flatbed drier while the forty farmers belong to two cooperatives that were utilizing flatbed dryers as a post harvest mechanism.

Farmers Profile

The youngest farmer respondent was 30 years old while the oldest was 77 years old. The highest number of respondents (15) belongs to 46-55 age bracket while the average age of farmers was 55.2. Thirty- three out of forty or 82.5% farmers reached high school level though only four were able to complete the secondary course. On the average, most households have six members. Majority of the respondents claimed to have engaged in farming for about 4 – 6 years, nine of them had farming as means of livelihood in the last 7 – 9 years while eight farmers were on farming for 10 – 12 years. Only two out of forty are relatively new to the practice of farming. With regards to size of farm holding, 62.5% of the farmers own a less than one hectare farm, 7% have one to two hectares, and 5% have two to three hectares while 30% have farm size ranging from three to four hectares. From these holdings, the estimated net annual income from rice production for all forty respondents averaged at P70,500. Fourteen respondents (35%) said they earned about P90,000 net annually, 6% were only earning about a third of that or a meager amount of P30,000, 10% claimed an average P42,000 yield, another 10% reported an average earnings of P54,000, 13% averaged at P66,000, 5% have average income of P78,000 while five of them or 13% were lucky enough to reach the P100,000 income level. These data revealed that almost fifty percent of all the respondents are languishing at poverty level (below P60,000 annual mark) in spite of the fact that they have farms to work on and are producing the staple food.

Farmers' Views on the Flatbed Dryer

It was through their membership in cooperatives that farmers came to know about the product and were able to witness product demonstration. Though the farmers were convinced of the usefulness of the product they were not inclined to use it to dry their produce because they were not willing to pay for the custom-drying cost being charged by the cooperative for the use of the flatbed dryer. For farmers, sun drying is still the most viable system because even if their grains are still very wet, the traders/millers still buy them buy but at a lower price.

Traders' Profile

Five traders who were users of flatbed dryer were chosen as the second group of respondents. Four of them were from Bay and the other one was from Calauan. In terms of educational attainment, two were college level while the rest were high school graduates. The youngest of the traders was twenty six years old and was already two years in the business. The oldest among the group was a 55 year old who has been in the business for 17 years.

Traders' Views on the Flatbed Dryer

Traders have a more positive regard on the use of mechanical dryers like the flatbed dryer than the farmers. The traders claimed that mechanical drying is far better than sun drying to achieve desired quality of milled rice even if the grains were brought in by farmers/sellers at high moisture content. If not dried immediately the grains will be damaged, discolored and the resulting rice is of low quality, thus lower income for the traders/millers.

All the traders were convinced of the worthiness of investing on flatbed dryer however, the two-ton capacity of the dryer per eight-hour shift is a problem since the traders are handling large volumes of palay for drying particularly during rainy season. This limitation of flatbed dryer paved the opportunity for electric dryers with bigger capacities to invade the market contributing to the low utilization of the flatbed dryer.

B. Updates on the Technology, 2008 Survey

Key informants included Engineer Edgardo V. Casas, Affiliate Professor of AGPET now DABPD (Department of Agricultural and Bio-Process Division) who gave the current state of the technology in an interview with the principal author on July 10, 2008. The fabricated sample of the flatbed dryer found at the grounds of DABPD appeared exactly the same as it was about forty years ago. There was no change made in the design of the product though the bin has already undergone some repairs due to wearing out caused by the passage of time. As a minor improvement from the original design, the furnace use in heating the air could utilize agricultural wastes such as coconut husks and rice hull alternatively with kerosene. The latest inquiry DABPD has received was in March 2008 from a trader of grains from Calaca, Batangas. The trader was referred to Mariňas Engineering, a dryer manufacturer/fabricator at Pila, Laguna that was also benefited with a copy of the product design. The one unit flatbed drier was built at a current price of P80,000 but with plywood bin sidings. With an all-steel bin, the price is pegged at P110,000 from only P80,000 about ten years ago.

The installation at Calaca, Batangas was then visited and important new information from the owners, Mr. & Mrs. Juan Pacis were obtained. The unit is intended to dry corn grains supplied to corn snacks manufacturers like "Boy Bawang" in Valenzuela, Bulacan while the rejects are sold to animal feed manufacturers in Batangas. The couple has been utilizing the flatbed dryer for many years already through the unit installed at the barangay for a fee but only when sun drying is not possible. The buyers are claiming that sun dried grains are of better quality than mechanically dried grains. But since the only unit at their locality had been disposed, they searched for a supplier and came to UPLB. They were then referred to Mariňas Engineering at Pila, Laguna. Now they are operating their own 40-cavan capacity unit purchased at a cost of P80,000 to dry their own corn produce as well as to dry the produce of others for a fee. Drying time ranges from 3 to 8 hours depending on the wetness of the grains. So far no repairs were done yet on the unit since its installation. Some minor inconveniences were experienced though like coconut husk soot sometimes go with the air blown and smoke generated by husks discolor the grains. In renting out the unit, a drying fee of P0.70 per kilogram is charged. Fuel for furnace is to be supplied by renters who are also charged for electric power usage for blower at P0.50 per kilogram. There are two corn croppings that run about 2 months each: 1) from the last week of January until March- "tag-araw", and 2) from last week of August to November – "tag-ulan". Dried good quality corn is sold at P14.00 per kilo. Acquisition cost is at P5.00 for fresh and P10.00 for skin dry. Loss in weight from fresh to dry is about 50% while skin dry grains result to about 20% loss in weight when dried.

Problems Faced by the Technology

In his lecture at CEM, UPLB in July 2008, Dr. de Padua cited the problems faced by the Philippine Post-Harvest System which the author regards as the leading reasons to the low adoption of the UPLB Flatbed Dryer. Among these is the land reform program. Under the Comprehensive Land Reform Program, seven hectares (and eventually three hectares) is the largest parcel of land a farmer can own and this fact ignores economies of scale. Small-sized farms even if some would aggregate would not be enough to justify an acquisition of a dryer. To resolve the problem, cooperatives were formed. However, many cooperatives failed because of mismanagement. The most serious though is the policy of the government. In contrast with Thailand that restricts imports for agriculture, our country is not only importing rice but also dryers. The imported dryers our country is now distributing were adoptions of the UPLB Flatbed Dryer. Circulating dryers having a capacity of 6 tons (three times bigger than the UPLB dryer) cost P450,000. The author inquired if the product is still available in the market and where it could be possibly procured. Dr. de Padua responded that he is not aware since his concern was just the development of the technology. He however pointed to people from AGPET for the needed information.

Another key informant, Mildred Mejino, a rice trader/miller of Calauan, Laguna who made an industry analysis of rice milling in Laguna said that none of the twenty three rice millers she had interviewed in 2007 is still using the flatbed dryer. What they now have are the convection type of circulating dryers imported from Taiwan and China.

Bay and Calauan towns were also revisited in July 2008 to search for the two cooperatives cited in the 2000 survey. However, it was found out that none now exists. Thus recommendations and conclusions were based in large part on the current information gathered. During the initial assessment by Pamplona in 2000, the use of the flatbed dryer has waned to an almost negligible level. However, from the last quarter of 2007 and up to this time of writing (July 2008), the Department of Agriculture through its various agencies has been distributing flatbed dryers to remedy the aggravating problem on rice shortage. This could be considered a rebirth of the technology. Unfortunately though, the flatbed dryers were not manufactured here in the Philippines but rather imported from Vietnam. Vietnam was one of the early recipients of the flatbed dryer technology from the Philippines. According to Dr. de Padua, a student from the University of Agriculture and Forestry in Ho Chi Minh City, Vietnam introduced some improvements to the original product design such as increase in capacity from two tons to six tons, the provision of a moisture meter, and a shed built into the concrete drying bin. BPRE has already installed 200 units since last year (2007) and another 500 units were for distribution in 2008. These dryers are distributed for free to the irrigation associations and big cooperatives in various provinces as these are the most organized cluster of farmers which applied and complied with the requirements (*By Admin, May 23, 2008 in Farm Technology, News Clippings).*

It was also learned that the DABPD tested two of these units and found them having the same functionality with the UPLB unit though the drying capability was not tested fully well according to Engineer Casas because the moisture content of palay used was already quite near the desired level.

Costs and Benefits From Operating a Flatbed Dryer

Eight years ago, a flatbed dryer with all-steel bin would cost around P80,000 including freight and installation expenses. In early 2008, DABPD facilitated an inquiry on the product from a trader of corn grains from Batangas. The person was referred to Marinas Engineering in Pila, Laguna which fabricated the product at a cost ex-factory of P80,000. At this price, the sidings of the bin are made of plywood. An all-steel bin would now cost P100,000. The unit has an estimated economic life of five years under proper operating condition and maintenance. Dryer's capacity for its entire useful life of five years is estimated at 72,000 cavans or three thousand six hundred metric tons of palay. Details are presented below (Table 2).

Table 2. Dryer's estimated total capacity

Particulars	Wet Season	Dry Season
Drying time	8 hours	4 hours
Dryer's Capacity:		
16 hours daily operation / drying hours		
= number of batches per day	2	4
x number of days in operation per season	60	60
= total batches dried per season	120	240
x estimated economic life of dryer in years	5	5
= total batches dried in 5 years	600	1200
x number of cavans per batch	40	40
= total capacity in cavans in 5 years per season	24,000	48,000
= total capacity in cavans in 5 years 72,000		

Operating expenses estimated per batch of forty cavans amounted to P1,435.00 and P717.50 for wet and dry season respectively. A five peso mark-up on total cost was imputed resulting to a drying fee of P40.00 during wet season and P23.00 during dry season. Details of these are presented in Table 3.

Cost and Benefits for the Farmers

As reflected in Tables 4 and 5, selling dried grains using the dryer is not convincing enough. From the analysis, sun drying appeared to be still the best option to farmers during dry season under normal conditions. Common sense dictates not to sun dry during the wet season. Nevertheless, the use of this dryer is still not justified well during rainy days. The income difference in selling in dried form is not very material for the farmers for them to buy and utilize the product. To avoid losses and be compensated immediately for their harvest, farmers would sell right away to traders rather than resort to mechanical drying.

Table 3. Estimated operating expenses per batch of forty cavans (in Philippine pesos)

Particulars		Wet Season	Dry Season
Drying time		8 hours	4 hours
Labor Cost (pay for an eight hour work is P250.00)		250.00	125.00
Energy cost:			
Kerosene: 2.0 liters/hr x P30/liter x no. of hrs.		480.00	240.00
Gasoline : 1.5 liters/hr x P35/liter x no. of hrs.		420.00	210.00
Oil & Lubricants (1/3 of cost of kerosene)		160.00	80.00
Depreciation:			
Cost of the dryer (including installation)	100,000		
Estimated useful years	5		
Annual depreciation	20,000		
Depreciation charge per season	10,000		
Depreciation cost per batch		83.33	41.67
Maintenance overhead:			
10% of machine cost per annum	10,000		
Divided by number of batches per season: 120, 240		41.67	20.83
Total cost of drying per batch of 40 cavans		1,435.00	717.50
Cost of drying per cavan		35.88	17.94
Add: Mark-up per cavan (14% and 28% respectively)		5.00	5.00
Drying fee charged by operators per cavan, rounded amount		40.00	23.00

Note: If the grains are to be truck-hauled, a charged of P7 per cavan is added

Table 4. Projected income of farmers during dry season

Particulars		Dry Season		
		Fresh Form	Dried Form	
			Sundried	Mechanical
Gross proceeds from sale of palay				
Average yield per hectare in cavans		96	96	96
Average recovery		100%	87% [a]	92% [b]
Net weight		96	84	88
Less: Deduction by buyer for wetness content		2	0	0
Net salable weight in cavans		94	84	88
Price per cavan [c]		325	450	450
Gross proceeds		30,550	37,600	39,744
Less: Drying and hauling expenses				
Drying fee charged by operator per cavan[d]	23.00	0	0	2,208
Hauling expenses from farm @ P7/cavan[e]		0	585	618
Total expenses		0	585	2,826
Net proceeds		30,550	37,015	36,918
Net advantage in selling in dried form over wet form			6,465	6,368

Table 5. Projected income of farmers during wet season

Particulars		Wet Season		
		Fresh Form	Dried Form Sundried	Dried Form Mechanical
Gross proceeds from sale of palay				
Average yield per hectare in cavans		70	70	70
Average recovery		100%	58% [a]	75% [c]
Net weight		70	40	53
Less: Deduction by buyer for wetness content		5	0	0
Net salable weight in cavans		65	40	53
Price per cavan		275	450	450
Gross proceeds		17,875	18,200	23,625
Less: Drying and hauling expenses				
Drying fee charged by operator per cavan [d]	40.00	0	0	2,800
Hauling expenses from farm @ P7/cavan [e]		0	283	490
Total expenses		0	283	3,290
Net proceeds		17,875	17,917	20,335
Net advantage in selling in dried form over wet form			42	2,460
Total net advantage in selling in dried form over wet form per year			6,507	8,828

Sources: 2000 and 2008 Field Surveys, and A. N. Resurreccion, Grain Drying Equipment, CEAT Library, University of the Philippines, Los Banos, Laguna

Notes to Tables

[a] Please see Table 3.

[b] According to the 1996 report of the Bureau of Postharvest Research and Extension (BPRE) palay drying on the road resulted to 0.7 to 8.7 percent losses. (Therefore average advantage of mechanical drying over sun drying is about 5%).

[c] Field Survey 2000

[d] Field Survey 2008, Table 2.

[e] Farmers sell their wet grains to traders at farm site thus, no hauling cost when selling in wet form.

a) For Operators

Custom drying seems to be lucrative for individuals who have money to invest in a mechanical dryer and offer its services to the farmers. Analysis showed (Table 6) that an operator could recover his investment in a matter of one and a half years or two and one half croppings. However, the big question remains, that is, whether there are farmers who would want to use the facility. As explained above, mechanical drying at this time is not yet a good option for individual farmers.

Table 6. Projections for Flatbed Dryer Operators (custom drying operations only)

Particulars	Wet Season	Dry Season
Maximum volume of fresh palay processed in 60 days	4,800	9,600
Custom drying fee per cavan	40.00	23.00
Gross income	192,000	220,800
Less: Operating expenses		
Labor cost: P5 per sack	24,000	48,000
Kerosene for furnace (2 liters/hr x 16 hrs/day x P25 x 60 days)	48,000	48,000
Gasoline for blower (1.5 liters x 16 hrs/day x P35 x 60 days)	50,400	50,400
Oil & Lubricants (1/3 of cost of kerosene)	16,000	16,000
Maintenance (at 10% of cost per year/2 seasons)	5,000	5,000
Depreciation (P100,000/5 years/2 seasons)	10,000	10,000
Total operating expenses	153,400	177,400
Net Income per season	38,600	43,400
Return on Investment (net income / P100,000)	39%	43%

Sources: A. N. Resurreccion, Grain Drying Equipment, CEAT Library and 2000 & 2008 Field surveys

c) For Traders

In the analysis below, investment in the dryer could be easily recovered many times over under both drying systems during dry season. However, when the sun is up, mechanical drying even for traders who have access to drying pavements is not very appealing. Recovery could be higher in mechanical drying (Table 3), but the bottomline figure for mechanical drying is not much versus sun drying to justify acquisition of a dryer.

During the wet season on the other hand, where sun drying is almost impossible, a meager 8% is earned from mechanical drying. Though the amount invested in the dryer could be recovered at the end of the season, the net margin is not significant enough compared with the total amount involved in buying wet grains and selling dried grains to millers and final processors.

To improve traders' income from mechanical drying and encourage its adoption, a two-stage drying scheme could be installed. As shown in Table 8, volume handled during wet season is only half to that of dry season's volume. The long hours of drying during wet season reduced by half the dryer's capacity. Under a two-stage drying there will be preliminary drying and final drying. Pre-drying is accomplished at a moisture content of 18%. Under this condition, the grains can already be stored temporarily for up to two weeks. The final drying can be carried out during the off-peak hours within the two-week period to bring down moisture content to a safe level of 14%. At 14% or less, wet basis, the grains' shelf life is prolonged and quality preserved,

Table 7. Projected income of traders during dry season (drying time is 4 hours per batch)

Particulars	Sun Drying	Mechanical Drying
Gross proceeds from selling palay		
Maximum volume (in cavans) of fresh palay processed in 60 days	9,600	9,600
(based on max. capacity: 40 cavans per batch x 4 batches/day)		
Average recovery (Notes a and b, above)	87%	92%
Net weight in cavans	8,356	8,836
Price per cavan	450	450
Gross proceeds	3,760,000	3,976,000
Less: Cost of Operations (for 60 days)		
Maximum volume of palay purchased from farmers in cavans	9,600	9,600
Less: Deduction buyer for wetness content (2 kgs./cavan)	384	384
Net weight paid - in cavans	9,216	9,216
Cost of fresh palay per cavan	325	325
Total cost of palay	2,995,200	2,995,200
Labor cost: P5 per sack	48,000	48,000
Overhead Expenses:		
Hauling (160 cavans per day x P7 x 60 days)	67,200	67,200
Kerosene for furnace (2 liters/hr x 16 hrs/day x P25 x 60 days)	0	48,000
Gasoline for blower (1.5 liters x 16 hrs/day x P35 x 60 days)	0	50,400
Oil & Lubricants (1/3 of cost of kerosene)	0	16,000
Maintenance (at 10% of cost per year/2 seasons)	0	5,000
Depreciation (P100,000/5 years/2 seasons)	0	10,000
Total overhead expenses	67,200	196,600
Total cost and expenses	3,110,400	3,239,800
Net Income	649,600	736,200
Net advantage in drying using Flatbed Dryer		86,600
Mark-up percentage on total cost and expenses	21%	23%
Return on Investment (net income / P100,000)		736%

Sources: A. N. Resurreccion, Grain Drying Equipment, CEAT Library and
2001 and 2008 Field surveys

Table 8. Projected income of traders during wet season (drying time is 8 hours)

Particulars	Sun Drying	Mechanical Drying
Gross proceeds from selling palay		
Maximum volume (in cavans) of fresh palay processed in 60 days	4,800	4,800
(based on max. capacity: 40 cavans per batch x 2 batches/day)		
Average recovery (Notes a and c above)	58%	75%
Net weight in cavans	2,773	3,600
Price per cavan	450	450
Gross proceeds	1,248,000	1,620,000
Less: Cost of Operations (for 60 days)		
Maximum volume of palay purchased from farmers in cavans	4,800	4,800
Less: Deduction for wetness content (5 kgs./cavan)	480	480
Net weight paid - in cavans	4,788	4,788
Cost of fresh palay per cavan	275	275
Total cost of palay	1,316,700	1,316,700
Labor cost: P5 per sack	24,000	24,000
Overhead Expenses:		
Hauling (80 cavans per day x P7 x 60 days)	33,600	33,600
Kerosene for furnace (2 liters/hr x 16 hrs/day x P25 x 60 days)	0	48,000
Gasoline for blower (1.5 liters x 16 hrs/day x P35 x 60 days)	0	50,400
Oil & Lubricants (1/3 of cost of kerosene)	0	16,000
Maintenance (at 10% of cost per year/2 seasons)	0	5,000
Depreciation (P100,000/5 years/2 seasons)	0	10,000
Total overhead expenses	33,600	163,000
Total cost and expenses	1,374,300	1,503,700
Net Income/(Loss)	(126,300)	116,300
Mark-up percentage on cost	-9%	8%
Return on Investment (net income / P100,000)		116%

Sources: A. N. Resurreccion, Grain Drying Equipment, CEAT Library and
2001 and 2008 Field surveys

Conclusions and Recommendations

Proper education through intensive information dissemination on the usefulness of mechanical dryers is foremost in increasing and sustaining utilization of this very important technology. As asserted by Dr. de Padua, this sun drying myth is the classic case of the frog whose legs were removed and ordered to jump. The economists concluded that removing the frog's legs made it deaf. For farmers, adoption of the UPLB Flatbed Dryer is hindered in both seasons thus, government intervention is critical.

Subsidizing the price of produce and cost of the dryer is a key to commence the widespread use of the technology. As reflected in the financial analyses selling dried grains using the dryer does not really pay well enough. There is not much advantage in using the product even during the wet season as the little differential it offered could be easily overcome with the risk in keeping the harvest even for a day to dry. Thus, farmers would always opt to dispose right away their harvest to traders because of the need for cash. In dry months, the cost of mechanical drying has wiped out the advantage of selling dried grains at a higher price so that sun drying would still remain a practice for many of the farmers.

The product has a drying capacity of 80 cavans per day or two batch loads of 40 cavans per load during wet season. At an average yield of 80 cavans per hectare it can accommodate the harvest from one hectare per day. However, for individual farmers the unit is not affordable, from P80,000 in Year 2000 to P110,000 at present As a remedy however, a unit could be cooperatively owned by a group of farmers. The cooperative must be formally organized though in order to avail of financing from lending institutions. In this endeavor, government help is vital. The technicians of the DA assigned to the barangays may be in the best position to help organize the farmers. Where clustering of farmers may not be possible because of distance or for any other reason, dryers may still be installed in barangays under the management of the barangay council. The operation of these units could be subsidized by the government and the farmers charged with a minimal fee for dying.

For traders, purchasing wet grains and selling dried grains could be a lucrative business. However, in terms of profits mechanical drying is not much compared with sun drying during the dry months while during wet months, the product's capacity is not sufficient to provide safe margins. Under such situation, traders become mere conduits for millers and final processors. They would also sell to millers and other commercial entities in wet form to bypass drying. For some who have capital, circulating driers from Taiwan and China at a cost of P450,000 but having a capacity of 6 tons were utilized. Dryers should come in variant sizes depending on the need of the intended users. Dr. de Padua revealed that IRRI has already fabricated a smaller dryer with half the capacity of UPLB's unit. The cost was then much lower making the product affordable to individual farmers or to a group of small farmers at barangay level. The DA-BPRE and PhilRice model of six tons are suitable for millers and traders. In addition, a two-stage drying scheme could be also considered where traders could play as extensions of millers. The product would be used as pre-dryers to accommodate larger volumes during wet season while final drying would be taken at the millers' site or in centralized drying centers (De Padua, 2008).

The next area to be looked into is the hardware support. Recall that that grains dealer from Calaca, Batangas was at first unaware of where to buy a unit. Furthermore, even the proponent of the technology did not have a ready answer where to procure one. This means that our local production of the product has not been formalized after all these years. Again, the government is in the best position to spur production locally by giving its most valued orders to local entities. Instead of importing from Vietnam, we must source locally to save cost and promote our own manufacturing capability. However, for this scheme to work, government initiative is indispensable. Importing these units must be avoided if not totally eliminated.

There is a need to maximize the use of investment. Considering a two to three month usage of the dryer each harvest season would result to under utilization of at least six months every year. This could be another drawback in the acquisition of dryers. Therefore, an integrated drying system must be developed. Other grains or nuts could be included in the drying cycle to keep the investment in effective use year round so that the design of the dryer should be looked into for it to accommodate other produce in between rice harvest seasons.

Another scheme that maybe adopted is for the state universities, with UPLB at the forefront, to give support or take the lead role in implementing its own developed technology. State universities could set-up drying centers within their campuses for closer management of experts. The units maybe acquired through the help of grants, could be sourced directly from government agencies, maybe purchased outright using its own funds or could be manufactured by UPLB under the guidance of the product proponent himself. The drying facility maybe offered for free or at a minimal fee for farmers. This may prove to be one of the universities' extension projects that have a national impact. Further, it maybe utilized as an income generating project to augment university funds. The production and disposal system employed by the UPLB-Biotechnology on the Virgin Coconut Oil could be adopted for the flatbed dryer.

As a last note, it is worthwhile to argue that if the government aims self-sufficiency in rice, it owes it to the people to patronize Filipino technology already proven effective like the UPLB Flatbed Dryer. To illustrate the point, we have a law prescribing the use of Philippine made fabrics for uniform of public officers and employees. This law is backed-up with a budget to support local fabric production through the Fabric Industry Development authority or FIDA. We MUST do the same for our agricultural technologies. We could take Thailand as a model. Thailand rice so far is the best in the world but imports no farm implements; everything is local. Ironically, the so called Maharlika Dryer our country is importing from Vietnam is only an adoption of the technology developed right here in our own premises. As Dr. de Padua pronounced, adoption of the product requires colossal political vigor.

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