Factors Affecting the Decision-Making of Farmers on Rice Storage in Selected Areas of Ayeyarwaddy Region, Myanmar

Yin Yin Nwet*, Flordeliza A. Lantican, Corazon T. Aragon, Zenaida M. Sumalde

ABSTRACT

Storage is an important component of the postharvest handling operations of agricultural products. Identification of the postharvest activities in rice farmers has been the focus of continuing study by agricultural economists. However, the individual characteristics and other socioeconomic factors that affect the farmers' decisions on rice storage are not well understood, especially in Myanmar. This study examines the factors affecting the decision making of farmers on rice storage in Pyar Pon District, Myanmar. Qualitative choice model (binomial logit) was used to determine whether farmers' choices of storing and non-storing options were significantly affected by their individual characteristics and other socio-economic factors. The factors found to be significantly affecting the farmer's decision on rice storage were price of rice after storage, storage costs, education, and availability of equipment. Other factors like rice production, annual gross income, experiences in rice trading and gender were insignificant.

Key words: Binomial logit model, rice storage, socio-economic characteristics of farmers, Pyar Pon District.

INTRODUCTION

Storage is an important component of the postharvest handling operations of agricultural products. Under trade liberalization, the role of the marketing system and postharvest activities become more important. Agricultural production can only be really efficient if the accompanying marketing and postharvest systems are also efficient (FAO, 1999). Well-functioning marketing systems are thus essential to develop production, thereby increasing household income and promoting food security.

In the past, postharvest activities of the major grain crops in Myanmar were mostly handled by government agencies. However, in 1989, the government initiated an open economy which allowed private sector activities and encouraged foreign trade and investments under its avowed economic objective of gradually transforming the economy towards a market oriented economic system. Agriculture changed from a cooperative and state farm production system to a system based predominantly on production by individual farmers. The household became the basic unit of agricultural production with the farmers deciding which crops to grow based on market signals. This change in agriculture production along with institutional and policy reforms, made the volume of rice exports of Myanmar to reach approximately 1 million tons in 1994-95, though this record of export could not be sustained in the following year. The old postharvest system has changed to a new system where private traders buy crops from farmers, transport these crops to the cities and sell them to processors, millers and consumers. Because of these changes, it is important for the farmers to know which crops to grow, how and where to sell and

how to store their crops. They should also be aware of the current market prices of their produce as well as the proper timing of selling these crops, and whether to store or sell them immediately.

The intensification of rice production in Myanmar, especially in the Pyar Pon Township, Pyar Pon District, has led to many problems in the post-harvest phase, particularly in storage. This situation is further aggravated by the growing attention devoted to the maintenance of buffer stocks to continuously provide food security for the country. Further, storage of seasonal or operational stocks is needed to meet seasonal demand and to stabilize prices which subsequently establish a strategic or long-term reserve against crop failure.

Rice prices are influenced by the demand and supply situation during the harvest and non-harvest periods. The producers and consumers are faced with a situation wherein rice prices are low during the harvest periods and high during lean months when planting season begins. And since there is a continuous demand for rice all-year round, then a farmer who chooses to store during the months when there is plenty of harvest and sell when prices reach its peak during the non-harvest periods, earns adequate incentive for performing the storage activity. In effect, the farmers gain more benefits by storing some of their produce and procurements, respectively during the time of harvest and selling after sometime when market supply declines and prices are high. Rice-millers, processors, and retailers on the other hand, will benefit from a continuous supply of rice in the market.

According to rice production in Myanmar, Ayeyarwaddy Region is the largest producer, producing 6.78 million tons, which accounted for 34.2% of the Union's rice production of 19.8 million tons (FAO, 2004). In terms of resource endowment, it has the highest share in population, which suggests abundant labor supply. Similarly, average rainfall is twice that of the national average hence, water supply is highly conducive to growing rice. Since Ayeyarwaddy Region is the rice bowl of the country for domestic rice supply and a strategic region for foreign export, sustainability of rice production in this region is vital for Myanmar. With respect to region-wise rice production, domestic utilization and surplus and deficit, the delta region had huge surplus of rice, the coastal region had smaller amount of rice surplus while the central dry zone and hilly area showed rice deficit (FAO, 2004). Therefore, at present, Ayeyarwaddy Region is a highly commercialized region

This study addresses two main areas related to storage. First, farmers who store rice are sometimes facing insufficient information on their storage operation and practices. Second, the decision of the farmers on rice storage was influenced by several factors. There is a need for both farmers for more updated marketing information in order to make appropriate decisions about marketing produce right away or store it for later disposal. The general objective of this study is to determine the factors affecting the decision-making of farmers on rice storage in Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar.

The rest of the paper is organized as follows: In the next section a brief literature review of the rice storage industry is given. The following section presents the methodology. The next section describes the data and model specification. The section after that offers the empirical results and the final section offers concluding remarks.

REVIEW OF LITERATURE

Conceptual issues regarding grain storage

On the basis of foregoing developments, the problem of efficient distribution of rice has become pronounced more than ever before. Even at self-sufficiency levels, storage of rice will inevitably

be a very important economic activity because rice must be distributed efficiently from surplus to deficit areas.

Storage is an important marketing function because it reduces price fluctuations, makes agricultural products available even during off-seasons, and stabilizes farmers' income. Lack of proper storage facilities leads to attack by pests and other organisms. The damage caused through such infestations leads to a reduction in market value depending upon the extent of damage. In some cases, the produce is declared unfit for consumption and has to be dumped. This leads to a huge loss for the farmer. Sensible farmers should take pains to store their agricultural produce carefully so as to command the most optimum price in the market.

Storage facilities not only offer the opportunity to reduce hunger between staple crop harvests but farmers are possibly able to improve farm incomes by storing and selling crops at premium prices when demand outstrips supply late in the postharvest period (Florkowski and Xi-Ling, 1990; Hofstrand and Wisner, 2006). As quality is an important determination of crop retail prices, effective storage is crucial to improve agricultural incomes and food security for small-scale farmers (Kohls and Uhl, 1998).

In agricultural production, it is necessary to store products since the price is often low during harvest time but high during the off-season period. Although crops can be sold immediately after harvest and drying, storage for later marketing can be advantageous. Sufficient and continuous supply of rice, like other commodity goods, has to be provided into the market during the off-season of the year. A year-round supply of rice is necessary because of the high demand for rice for human consumption throughout the year. The demand for rice will not be met without storage (Naphire, 1990).

Iman and Kilin (1973) reported that annual losses of global stored grains due to insect damage are approximately 5%. Some investigations in brick storehouses near Taichung (central Taiwan) have shown that weight losses of rough rice due to insect damage of the Japonica, Indica, and Shen varieties were 1.67, 1.57, and 1.43%, respectively, in one year of storage. In Southeast Asia, quantitative losses of rice during the handling and processing stages were estimated at 10-37%; of these, storage losses were 2-6% (de Padua, 1975).

The marketing system is said to be productively efficient if it performs its processing, transportation and storage function at minimum costs. The industry's production efficiency can be evaluated by two factors such as load factor efficiency and scale factor efficiency. Huyen (2009), in the analysis of productive efficiency of the corn industry using load factor method revealed that corn farmers in the province utilized 63% of their storage facilities with excess capacity of 37%. And in terms of storage loss, storage losses of corn farmers were 35%. In monetary terms, the value of storage losses incurred by corn farmers amounted to 101,000 VND (US$4.45) per ton.

Briggs and Johnston (1991) examined the economic factors influencing grower decisions about on-farm grain storage and made several inferences of relevance to this study. They pointed out that while decisions about on-farm grain handling and storage seemingly involve a large number of variables, many of which are uncertain, in reality the number of variables facing an individual grower at a particular point is far fewer. Most of the farmers make decisions about adjustments at the margin. Complete replacement of such systems is rarely cost-effective given the large capital component of such systems and the gap which invariably exists between the purchase price and the salvage value of such equipment. This, they argued, has two effects. First, it makes the decision problem a lot simpler and they described a step-by-step approach to analysis to make it even easier to grapple with. Second, it makes the decision problem facing an

individual grower concerning on-farm grain handling quite personal and different from his or her neighbor.

THEORETICAL AND CONCEPTUAL FRAMEWORK

Seasonal price

Storage, from the economic point of view, is defined as a productive activity that is created to utilize a time lag between production and consumption. In rice, storage can be performed both at on-farm and off-farm levels. The off-farm storage involves procurement from sources such as farmers and middlemen. The usual price pattern for a seasonal crop harvested within a brief period, but then sold throughout the year, is for the price to rise through the year as a function of the cost of storing the commodity. If farmers correctly anticipate future demands relative to supplies and hence store the "correct" quantity, the price will rise from a low point at harvest by just enough to cover storage costs from the time of harvest to subsequent points in the year. The price changes must be sufficient to induce some to sell and others to continue holding the commodity. Thus, the seasonal product is allocated through the year by the relationship of current price and expected price to storage costs. As the next crop year approaches, price declines rather abruptly to the next seasonal low.

Right at the farm level, a rational farmer would want to maximize profits or minimize losses so as to achieve the highest possible income. Essentially, a farmer will store a commodity if he expects the profits from storage to equal or exceed the costs of storage (Tomek and Robinson, 1981). Assuming P_f is the expected price, P_c is the current price, and M is the storage cost between two time periods, then storage of a commodity will take place if:

$$Pf - P_c \geq M$$

Moreover, degree of storability of current supplies and the volume of production may affect the seasonal price pattern. If supply towards the end of the length of storage is short, prices may rise drastically. But if supply is abundant at the time of the new harvest, the seasonal price will rise less than the normal or even decline.

Productive efficiency

Key players in the industry are productive-efficient if they perform their storage at minimum cost. The industry's productive efficiency can be determined using the following measures: (1) load factor efficiency and (2) content of storage losses. Load factor efficiency is described by the extent to which firms in the industry make reasonably full use of their storage facilities. The extent of storage losses at the farmer's levels could be determined and analyzed using the data collected in the rice storage in selected areas. If the storage losses are low, the marketable surplus of rice farmers and traders will increase.

Factors affecting decisions making of farmers on rice storage

There is a continuous demand for rice all throughout the year. Hence, there are enough profits in storing this commodity, until such time when new supplies are made available. These profits will

be accounted by the increase in price of the rice grains as supply at both on-farm and off-farm levels decreases.

After harvest, rice farmers are faced with two options, that of selling their produce immediately or storing it for some time. Bearing this concept in mind, the farmers will now decide on what to do to his produce and stock, respectively. The decision to store rice will occur when the farmer has incentives to perform the rice storage and at the same time overcome the constraints to realize storing. The review of relevant studies on rice storage gives a huge body of information on factors affecting farmer's decision on rice storage. These factors have been classified into three categories, namely; physical, economic, and social presenting how they interact to influence farmers' decisions to store rice and determining whether storage activities would be profitable or not. Moreover, profitability and economic performance also affect decisions on rice storage.

METHODOLOGY

The study was conducted in the villages of Tha Main Taw Khone Tan/Tein Khone and Maw Bi in Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region in Myanmar. The study sites were chosen for the following: (1) the villages were major rice-producing and rice-trading areas; (2) the community members from the villages have long-established traditions of rice cultivation; and (3) the farmers from the villages have well-established storage practices. Each group of farmers consisted of those who stored rice and those who did not. Enumerators collected the data from the households through stratified random sampling. Descriptive statistics and multinomial logit regression model were used to analyze the data.

Determination of factors affecting the decision-making of farmers and traders on rice storage

The logit function model was used to measure the effect of socio-economic and physical variables on farmers' decisions to store rice. To estimate the empirical models of decision on rice storage for farmers, the STATA7 program was used. The probability of decision to store rice was calculated for each of the models, and then compared and evaluated. Following (Pindyck and Rubinfeld, 1981) the functional form of logit model was specified in equation 1:

$$Z_i = Ln[\frac{P_i}{(1-P_i)}]$$

$$= \alpha_0 + \alpha_1 \text{production} + \alpha_2 \text{price} + \alpha_3 \text{storage cost} + \alpha_4 \text{gross income} + \alpha_5 \text{experience} + \text{education} + \beta_1 \text{availability of equipment} + \beta_2 \text{availability of capital} + \beta_3 \text{gender} + \beta 4 \text{season} + \mu_i \quad (1)$$

Where:

$\mathbf{Z_i}$	=	the sum of the value of all regressors in independent variables.
$\mathbf{p_i}$	=	the probability of decision to store rice for the i^{th} farmer
$\boldsymbol{\alpha_0}$	=	intercept;
Production	=	quantity of rice produced (kg);
Price	=	selling price of rice (Kyat thousands per kg);
Storage cost	=	costs of rice storage (Kyat thousands);

Gross income = annual household gross income (Kyat thousands)
Experience = number of years the household head is engaged in rice farming;
Education = number of years of schooling;

Availability of equipment (dummy) = { 1 if equipment for storing is available; 0 if not }

Availability of capital (dummy) = { 1 if the farmer borrowed capital for rice farming; 0 if the farmer did not borrow }

Gender (dummy) = { 1 if the head of the family is female; 0 if the head of the family is male }

Season (dummy) = { 1 if rainy season; 0 if summer season }

α_i **(i = 1 to 6)** = the coefficient of independent variables

β_j **(j = 1 to 3)** = the coefficient of dummy variables

e = the base of natural logarithms and is approximately equal to 2.718;

u_i = Error term .

Expectation: The directions of relation between dependent and independent variables are as follows: production (+), price (+), gross income (+), experience (+), education (+), availability of equipment (+), availability of capital (+), storage cost (-), gender (-), season (+ or -).

To determine partial effect of factor Xi on Pi, the marginal effects of Xi on Pi is calculated by taking partial derivative of Pi with respect to Xi. In logit model, marginal effect represents the change in probability caused by a unit change in Xi, ceteris-paribus.

Marginal effect $\frac{\partial P_i}{\partial X_{ij}} = \beta_i P_i (1-P_i)$ (3)

$P_i = \frac{1}{1+e^{-z}}$ (4)

$Z_i = \ln \frac{P_i}{1-P_i}$ (5)

$Z_i = \Sigma (\beta_i \text{ coefficient})$ (6)

Where:

P is the vector of probabilities of behavior option;
X is the vector of independent variables;
e is the base of natural logarithms;
Z_i is the standardized normal variable; and
β is the vector of other estimated coefficients of corresponding X in the model.

Analysis of economic performance of rice storage facilities

The economic performance of storage facilities were assessed by using the percent of storage losses and the productive efficiency (i.e., load factor efficiency) as indicators.

Percent of storage losses. The level of storage losses were determined and analyzed using the data collected in a rice storage project. These losses were compared with the standard losses set by an authorized agency in Myanmar.

$$\textbf{\% of storage losses} = \frac{\textbf{Volume before storage} - \textbf{Volume after storage}}{\textbf{Volume before storage}} \times \mathbf{100}$$

Load factor efficiency. The firms in the industry are productively efficient if they can make reasonably full use of their available storage facilities. The load factor efficiency determines the full use of the firm's available storage facilities. If storage facilities are fully utilized then firms are productively efficient. Mathematically, the capacity utilization of the rice storage facilities was measured using the formula:

$$\text{Capacity Utilization (\%)} = \frac{TVOL}{TCAP} \text{ X } 100$$

Where: TVOL = total annual volume of rice stored: and

TCAP = total capacity of the rice storage facilities

If capacity utilization is less than 100%, it means that storage facilities are under-utilized. A 100% capacity utilization implies that storage facilities are fully utilized while capacity utilization greater than 100% implies over-utilization.

RESULTS AND DISCUSSION

Farm characteristics

Majority (72%) of the farmers opted to keep their harvest in storage houses for some time after harvesting and delayed selling while the remaining farmers (28%) sold the rice immediately after harvesting. There were two cropping seasons– the summer and rainy seasons in the study area, part of the Ayeyarwaddy Delta which was rich in alluvial soil.

In Myanmar, the dry season rice farming program was launched in 1992 with an initial coverage of 0.3 million ha. Between 1995 and 1996, rapid expansion sharply increased the program coverage but between 1996 and 1997, the program was drastically reduced for unknown reasons. In later years, the dry season rice farming program was revived and the area covered was again expanded. The MOAI also made an effort to expand the program's coverage. Within a period of 40 years, Myanmar increased its rice production area to 2.2 million ha, wherein only 45% of this area was planted in 1964. This resulted to a 69% increase in rough rice production and 119% increase in total yield (FAO, 2004). As part of the country's rice granary due to topography well-suited for rice and favorable climate, rice production in the study area was significantly large. Production volume during summer months also increased significantly. This resulted to an increase in Pyar Pon's market share of the total rice production in the district as well as the whole Ayeyarwaddy Region.

The 70 respondents planted high yielding varieties particularly Manathukha, Shwewartun, Thehtetyin and Sintwelatt, as well as some well-known good quality fancy rice varieties like Paw San and Lone Thwe Hmwe.

All the 70 farmers had storage houses ranging from as little as 4 meters to as long as 23 meters in length, from 3 to 12 meters in width, and from 3 to 4 meters in height with 21.3 and 18.8 square meters of the floor area. The non-storing group can only accommodate a maximum volume of 102 tons while the storing group's have a 513-ton capacity. The storage houses had floorings and walls made with either soft wood, hard timber, cement, bamboo or a combination of the materials, and had roofing materials of galvanized iron sheets or thatched roof with tiling or cement tiles. Most storage houses were dilapidated, generally unsanitary nor well-maintained and a few storage houses were newly constructed due to destroyed by the Nargis Cyclone, a strong tropical cyclone that caused the worst natural disaster in the recorded history of Burma, which hit the area in 2008. However, there were no signs that can provide the difference of this indicator between the two farmer groups.

Financing of the rice farmers

More than half (53%) of the farmers did not avail of loans, whether from formal sources like banks or informal sources like private individuals. These farmers preferred to borrow from government institutions but they complained of the seeming inability of the government to efficiently extend agricultural loans. To compensate, farmers plowed back their income and profit from the past season into their livelihoods as operating capital. Only 47% of farmers borrowed from lending institutions like the Myanmar Agricultural Development Bank (MADB), Myawaddy Bank (MWDB), or friends and relatives to finance production. However, these loans were not used for rice storage. Farmers who stored rice were self-financed.

Production and disposal of rice

Rice production during the rainy season was higher than during the summer season (Table 1). The average rice productivity in Pyar Pon during the 2010 rainy season was 3.1 tons per ha, which was 0.8 times higher than the summer season. Total farm productivity (income) and rice production (yield) for the storing group was higher than the non-storing group.

All farmers sold most of their harvest (88%) and kept only 8% for home consumption, which was either consumed as cooked rice or processed further into rice-based products such as rice noodle, rice vermicelli, or other forms. The remaining 4% of the harvest was set aside as alternative seeds only because all farmers used hybrid varieties available in agricultural cooperatives and seed companies, which produced high yield. Very few farmers used local rice varieties which were of high quality but resulted to very low productivity. These varieties were only for home consumption. All things considered on a per farm basis, the storing group had bigger sales volume than the non-storing group.

Table 1. Production and disposal of rice by farmer group and season, 70 farmers, selected areas in Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

ITEM	FARM GROUP				BOTH GROUPS	
	Without storage		With storage			
	Rainy	Summer	Rainy	Summer	Rainy	Summer
Cultivated area(ha)	10.28	2.86	24.46	5.50	17.37	10.11
Productivity(kg/ha)	2,375.70	1,588.10	3,916.81	1,074.23	3,146.26	2,367.18
Production(kg)	22,658.21	10,261.90	44,096.91	25,113.44	33,377.56	21,819.70
Seeds(kg)	976.03	335.44	1,784.44	228.22	1,380.23	857.84
Home consumption(kg)	1675.13	1,285.35	2,992.46	372.02	2,333.79	1,809.57
Sold(kg)	20,007.05	8,641.10	39,320.01	24,513.19	29,663.53	19,152.32

Source: Computed on the Basis of Household Data Survey, 2010

Of the 50 storing group farmers, only 11 stored all their harvest and 39 kept only a portion for storage and sold the remainder. The immediate income earned was used to cover for the expenses incurred during production. The rice kept in storage served as safety nets and considering the price cycle of rice, were sold when prices were more favorable. These 39 farmers constituted 55% of the total respondents (Table 2).

Table 2. Number of farmers who immediately sold, stored and who partly sold and stored rice, 70 farmers, selected areas in Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

ITEM	Rice Farmer	
	Number	Percent
Farmers who sold immediately	20	29
Farmers who partly sold & partly stored	39	55
Farmers who stored	11	16
Total	70	100

Source: Computed based on Household Data Survey, 2010

About 29% of the farmers sold their produce immediately after harvest mainly to cover production expenses as well as to supplement their cash needs, while the remaining 16% chose to put everything in storage and waited for more favorable market prices before selling.

NATURE AND EXTENT OF RICE STORAGE

The nature and extent of storage refer to the operation and practices employed in the storage of rice itself. It includes discussions on when, where, how and how long rice is kept in the storage houses.

Nature of storage

Based on the interviews with the rice farmers, there were mainly two cropping seasons for rice in one whole year– from October to March where there was considerable abundance, and from April to September where harvest was relatively low. The two seasons were further divided into periods, namely harvest and non-harvest periods. The first two months of each season accounted for the harvest period and the remaining four months for the non-harvest period.

All the farmers used sun-drying for lower cost because sun-dried rice is considered good quality. Rice was gradually dried in open fields before the farmers brought it to their houses. The rice farmers performed this function as a marketing activity before selling or storing which enabled them to command for a higher price. Once fully dried, rice was either sold or stored in warehouses or in a specific place in the farmers' house. Most of the farmers sold their produce to local traders directly from their house because the volume was not large enough for them to deliver it. The farmers also did not have the means to transport their produce to commercial markets such as the ones in Pyar Pon and Bogalay.

Period of storage

The period of storage refers to the amount of time the farmers thought it best to store rice during each cropping season, with respect to prevailing price in the market. The farmers stored rice immediately after harvest during the winter and summer seasons (October and April, respectively) until the third and second month of the non-harvest period of the said seasons (February and July). This was the time when they anticipated the prices to go down because of the arrival of new harvests. Rice prices normally reached its peak in July and August due to the requirement of the export market and the farmers also believed that there were already large price differences at this point.

Method of storage

The ideal moisture content for rice is 14% at an average relative humidity of about 78%. This prevents discoloration on grain surfaces caused by microbial development abetted by the presence of moisture. Farmers took extra precaution on this aspect because it was what buyers initially measured before purchasing. The buyers used traditional ways of checking for quality like touching and pressing paddy with their bare hands to determine moisture content. These buyers claim that they can determine the quality by using traditional methods and by relying on their own experiences.

For storage materials, most of the farmers used polypropylene or plastic sacks as substitute for expensive jute sacks. These plastic sacks were also very easy to handle and transport. It also provided good aeration. The sacks were then piled one on top of the other, with spaces in between that allow aeration. Farmers checked if there were some stored chemicals near the rice stocks because the chemicals could accidentally get mixed with or spill on the rice.

Length of storage

The length of storage in this context refers to the period between the time a sack of rice is placed in the storage house and then taken out. There is no definite length of storage time because as long as the price of rice increases through time, the more profitable it becomes for the farmers to

keep it in storage. In Pyar Pon, the average length of storage for the rice farmers was three months. These were mainly due to their need of cash and feared that stocks would build-up until the next cropping season when prices started to fall.

Farmers were also cautious in maintaining the 14% moisture content because buyers were very keen on this. All the farmers did not store for more than four months since this would have cost them an approximately five to ten kilograms decrease in weight per sack attributable to moisture loss. A minimal drop in moisture content consequently led to rice weight loss which produced lower sales revenues. However, 16% of large farmers stored monsoon rice for seven (7) or eight (8) months in order to supply the export demand of rice around July and August, allowing for a 1.3 to 2.1 kilogram weight loss per sack attributable to moisture loss.

Half of the rice farmers (50%) stored their produce for one to two months while 34% stored for three and four months (Table 3). The rest stored for more than five months. However, most of farmers in the 1 and 2 months group and 3 and 4 months group continuously stored half or one-third of monsoon rice until 7 or 8 months (July or August) when the export market normally opened.

Table 3. Average length of storage by farmers who stored rice, 50 farmers, selected areas in Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

LENGTH OF STORAGE	FARMER	
	Number	Percent
1 and 2 months	25	50
3 and 4 months	17	34
5 months and above	8	16
Total	50	100

Source: Computed based on Household Data Survey, 2010.

Place of storage

Rice was either stored in a place in the farmers' house, in private warehouses, or in commercial warehouses (Table 4). Majority of the farmers (86%) stored rice in a private warehouse while 11% stored in a place in their house. Only a few (3%) rented storage houses. Most farmers chose to build warehouses separate from the main house where they could store grains to prevent house pest contamination. For those few who stored inside their houses, (i.e. old stock room or granary called ''poke''), they covered the sacks with black plastic bags.

It is important to note that a few of the respondents had separate storage houses in the field and in their houses. Although the farmers already dried the rice in the field before storage, there were instances when drying was still needed while the rice was in storage. If the produce or procurement volume was large, sun-drying cannot be done inside the farmers' home lot which usually had small areas. For this reason, storage houses were also built in the fields.

Table 4. Place of storage by farmers who stored rice, 70 farmers, in selected areas, Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

PLACE OF STOAGE	FARMER	
	Number	Percent
Place in the house	8	11
Own warehouse	60	86
Commercial warehouse	2	3
Total	70	100

Source: Computed based on Household Data Survey, 2010.

Volume of Rice Stored

Table 5 shows the volume of rice handled by the farmers' category classified according to the storage duration. On the average, the returns of rice sold by farmers who stored for 1 and 2 months was 12.92 tons per farmer with a selling price of 185,817 Kyats per ton. Seven farmers sold their produce at 3 and 4 months after storage which showed that the returns of rice sold and the selling price were 86.88 tons per farmer and 230,656 Kyats per ton, respectively. It should be noted that those farmers who stored for 3 and 4 months had the maximum average ex-storage volume (sold) among the three groups. The average ex-storage volume of rice sold by 39 farmers who stored rice for at least 5 months had 53.54 tons per farmer with selling price of 283,985 Kyats per ton. It should be noted that the average selling price of the group who stored for at least 5 months was the highest. The reason can be that most of the farmers in this group waited for the month of April which was when prices went up as a result of increasing consumer demand, and the months of July or August which was when the export market for rice normally opened which resulted to increasing rice prices.

Regarding the trend in the selling price on farmers' category, the best time to sell rice was 5 months after storage. However, they always anticipated unfavorable weather conditions and unfavorable consumer response that stemmed from fear that rice stored at the farm could be contaminated with pest after a two-month harvest period. Although they mentioned that these factors can drastically reduce price, their sales depended largely on the demand in the domestic and export markets.

Table 5. Average volume stored, sold and selling price by farmers' category classified according to the storage duration, 50 farmers, in selected areas, Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

CATEGORIES	NUMBER OF FARMER-RESPONDENTS	AVERAGE VOLUME STORED	AVERAGE EX-STORAGE VOLUME	AVERAGE SELLING PRICE
		(ton)	(ton)	Kyats/ton
1 and 2months	4	13.11	12.92	185,817
3 and 4 months	7	88.96	86.88	230,656
At least 5 months	39	55.18	53.54	283,985
Total	50	2,827.38	2,198.88	700,459
Average		56.55	43.98	233,486

Source: Computed on the Basis of Household Data Survey, 2010

For the farmers who sold rice immediately after harvest, the average volume sold was 28.15 tons per farm with a selling price of 215,804.31 Kyats per ton (Table 6).

Table 6. Average volume sold and selling price by 20 farmers who sold rice immediately, in selected areas, Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

TYPE OF RESPONDENTS	AVERAGE VOLUME SOLD (ton)	SELLING PRICE (Kyats/ton)	AMOUNT (Kyats)
Farmer	28.15	215,804.31	6,074,593

Source: Computed on the Basis of Household Data Survey, 2010

MARKETING PRACTICES

This section discusses briefly the marketing practices for rice as they relate to storage practices. As evident in the earlier sections, the farmers mainly sell their produce to the traders.

Mode of sale

Rice for sale were either picked-up by buyers or delivered to their homes (Table 7). Only 19% of the farmers delivered their produce to their buyers. These farmers usually had their own service vehicles used for delivery. The remaining 81% had their rice picked-up from their farms. Additionally, some of the large farmers milled their surplus paddy and delivered it back to the village where rice was sold to land laborers and small farmers who were in short supply of stored rice supply during the wet season.

Market outlet

Traders were the main buyers of rice produced by farmers. On the part of traders, rice-millers and processors were the most preferred market outlets. Food processors accounted for 20% of the marketable supply while rice millers accounted for the remaining 80%.

Mode of payment

Sixty-three percent of the farmers were paid in cash for their produce (Table 7). This was preferred by farmers who wanted cash for household needs. Around 24% of the marketable surplus was sold on credit to fixed or regular buyers payable in one week with no interest charged or buyers would provide inputs in the next cropping season such as seeds, fertilizers and pesticides. Meanwhile, the remaining 13% of farmers gave their product to the traders who provides advanced payment right after harvest.

Source of price information

Rice farmers obtained information on prevailing market price basically from their buyers, like traders, and from other farmers.

Table 7. Selling practices by farmers who stored rice, 70 farmers, selected areas, Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

PRACTICE	FARMER	
	Number	Percent
Method of sale		
Picked-up by buyers	57	81
Delivered to buyers	13	19
Total	70	100
Method of payments		
Cash on delivery	44	63
Credit	17	24
Payback for advanced cash	9	13
Total	70	100

Source: Computed on the Basis of Household Data Survey, 2010.

FACTORS AFFECTING DECISIONS ON RICE STORAGE

Analysis of factors affecting decisions on rice storage

The logit equation was estimated using parcel-level data from the 70 sample respondents which was used in estimating the model to explain farmer's decisions on storing rice. On average, the likelihood of the logit model for the farmers is estimated at 99.97%, holding other things constant. It can be explained that the higher the value of logit model, the higher the probability of decision on rice storage by 99.97%. These indicators are statistically significant at 1% level. Coefficients are estimated through the maximization of a likelihood function. It is weighted by factors that depend on the values of all regressors in independent variables. Table 8 shows the estimated coefficients of the logit model on rice storage for farmers using all the sample farms.

To measure the goodness of fit of the model, ratio of LR chi^2 reflected was used to test the estimation of the parameters in the logit model. Logit model on rice storage for the farmers is statistically significant at 1% level. This could be used to show that the existing variables in the model can be accepted.

Of the factors considered in the logit model for the farmers, only five were found to have significantly influenced the probability of decision on rice storage–price of rice, storage costs, the number of years in schooling (education), availability of equipment required for performing rice storage and season. The results indicated that price of rice is positively influencing the decision of farmers to store rice at 1% significant level. If the rice price is high, the farmers are likely to store more rice. The farmers always consider the price of rice in deciding to sell or store their produce. They will sell their paddy when the price is high and continuously store their produce if they believe the price will further rise.

Storage cost variable is negative and significant at 1% level, indicating that the farmers will likely store less rice when the storage cost of rice is high. The number of years in schooling has a positive impact on farmers' decision-making on rice storage, indicating that highly educated farmers are likely to store more rice. The availability of equipment dummy has also a positive influence on the decision to store rice with 1% level of significance. When the farmers have available equipment for rice storage, they are likely to store more rice. On the other hand, the season dummy has a negative impact on the decision for rice storage implying that if the farmer stores during both seasons, the farmer is more likely to store more rice during summer than during the rainy season.

Table 8. Estimated coefficients of the logit models on the decision-making of farmers and traders on rice storage, in selected areas in Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

FARMER	
Variables	**Coefficients**
Constant	-19.6201***
Production('000 kg)	.0540252NS
Price('000 kyat)	2.851308***
Storage cost (mil. Kyat)	-2.225044***
Gross income (mil. Kyat)	.077814NS
Experience (years)	.0322721NS
Education(years)	.52773*
Availability of Equip: dummy	4.084124***
Gender dummy	.3751068NS
Season dummy	-2.919154*
Pseudo R2	0.6417
LR chi2(11)	53.74***
Number of obs	70
Probability of storage	0.999746

***, ** and * refer to significant at 1%, 5% and 10% probability levels, respectively
NS refers to not significant

Marginal effects refer to the changes in probability given a unit change in the independent variable and are more useful basis for interpreting the results of the multinomial logit model. The estimated marginal effects are shown in Table 9.

The number of years in schooling appeared to have a positive impact on the probability of decision of farmers on storing rice. This is consistent with the expectation of the hypothesis. For example, a one-year increase in education level will increase the probability of decision on storing rice by 3.19%. However, the price of rice and storage cost are not statistically significant

on the probability of decision on rice storage with marginal effect analysis although these two variables are statistically significant in logit regression.

Table 9. Marginal effects of the logit models on the decision-making of farmers on rice storage, selected areas in Pyar Pon Township, Pyar Pon District, Ayeyarwaddy Region, Myanmar, 2010.

FARMER	
Variables	**dy/dx**
Education	.0319478*
Production	.0032706 NS
Price	.172613 NS
Storage cost	-.1347001 NS
Experience	.0019537 NS
Gross income	.0047107 NS

***, ** and * refer to significant at 1%, 5% and 10% probability levels, respectively
NS refers to not significant

PRODUCTIVE EFFICIENCY

Load Factor Efficiency

The load factor efficiency was determined by taking the ratio of the total annual volume of rice stored by rice farmers to the total storage capacity. Results showed that rice storage facilities at the farmer's level in the Region were underutilized at 42% during the winter season with excess capacity of 58 percent while during summer season, it was more underutilized at 27%. On the average, the capacity utilization of storage facilities at the farmer's level was 35% (Table 10).

Table 10. Capacity utilization of storage facilities used by farmers in Pyar Pon Township, Pyar Pon District, Myanmar, 2010.

ITEM	TOTAL VOLUME OF RICE STORED	TOTAL CAPACITY OF RICE STORAGE	CAPACITY UTILIZATION	LEVEL OF UTILIZATION
	(tons)		(%)	
Farmers	57	167		
Rainy season	35	83	42	Underutilization
Summer season	22	83	27	Underutilization
Average per season	28	83	35	Underutilization

Source: Farmers' Survey, 2010.

Storage Losses (%)

The percent of storage losses for rice was determined by getting the ratio between the total volume of rice lost during storage and the total volume of rice stored, and then multiplied by 100 to express in percent. For farmers, the total volume of rice stored reached 57 tons, of which 12

tons were incurred as total losses. This shows that storage losses were 21% on the part of the farmers.

PROBLEMS ENCOUNTERED ON RICE STORAGE

A number of farmers cited drying and rodents as the two most common problems of warehousing. Insufficient drying leaves rice with high moisture content, thus making them more susceptible to rotting and discoloration. Storage pests like birds and rats, caused the loss of a substantial volume of rice stored, thus explaining its large contribution to storage costs. Furthermore, the farmers reported that after the Nargis cyclone, the weather pattern in Myanmar is not normal like before.

A few of the farmers complained that at the time after the third month of storing paddy, paddy moths sometimes formed but it was not a serious problem and a number of the respondents are not used to spraying chemicals, which adds to the decrease in weight due to moisture loss. They attribute the formation of paddy moths to changing weather condition and pest contamination. More than half of the farmers (62%) cited storage pests like rats and moths as their main problem in storage.

With inadequate and antiquated storage facilities, the farmers experienced great losses due to pests like rats and birds. Some experienced less problems in pests but with their relatively higher volume of produce stored, they could not dry them all sufficiently especially during the rainy season. Finally, farmers cited that there are no technical training conducted by the government for a systematic storage system and on the ways to protect stored rice from pests and other problems.

CONCLUSIONS

The study was conducted primarily to:(1) describe the storage practices of rice producers; (2) determine the physical and socio-economic factors that influenced the decision-making processes of farmers on storing rice; (3) evaluate the economic performance of rice storage facilities of the farmers; and (4) identify and analyze the problems encountered by farmers in storing rice and suggest policy directions to improve the rice storage in research sites.

The study showed that majority of the farmers (71%) decided to either store all the rice harvested, or sell a portion and put the rest in storage. On the contrary, 29% of the farmers opted to sell their produce immediately after harvest for a faster return on their investment. Majority of the farmers did not pay storage fees except compute for depreciation cost because they own the land it was built. However, there were eight farmers (11%) who kept rice in storage facilities inside their houses, while only 3% of the farmers rented the storage houses that they use. The average floor area of storage houses for the farmers was 20 meters in length and 8 meters in width.

The rice farmers adopted the traditional practice of storing rice wherein after harvest; rice was placed inside plastic sacks or to bare then stored in a place in their houses or warehouses, respectively, for one to seven months, depending on the needs of the farmers. The average volume handled by the farmers were classified into storage duration and financing source. For the farmers, the average volume sold and stored was 43.98 tons per farmer and 56.55 tons per farmer, respectively, at a selling price of 233,486 Kyats per ton. For an entire year, the average

volume handled by farmers who stored for 3 to 4 months was the highest among the three groups with 88.96 tons stored and 86.88 tons sold.

In selling, majority (81%) of the farmers delivered the rice to the buyers and only 19% had the rice picked-up from their storage houses. During payment, 63% of the farmers were required to pay cash on delivery while only 24% were allowed to buy on credit terms and the remaining 13% were required to pay in advance.

The logit models were employed to determine the relationship between the probability of decision to store rice and a set of socioeconomic variables for both the farmers and traders. Econometric estimates of the factors determined the likelihood of decision on rice storage for both farmers in Pyar Pon Township. The empirical findings indicated that the factors found to be significantly affecting the farmer's decision on rice storage were the price of rice after storage, storage costs, education of household head, and availability of equipment and season. Finally, in terms of problems encountered in storing rice, most farmers complained about the incidence of rodents and grain pests during the storing period while some farmers cited drying as a big problem of warehousing.

The most relevant ingredients to ensure increased rice storage are incentive public programs that can encourage rice farmers to engage in long-term rice storage. It is clear from this study that the farmers will store more rice until the end of non-harvest periods only in response to positive incentives or opportunities in storage. The success of rice storing for farmers will therefore require government programs that help farmers to overcome the constraints they face as well as creating incentives that will encourage them to change their current storage practices in order to improve their income as well as eliminate the rice availability-gap in the non-harvest periods.

While most of the interventional activities may be provided by local farmers themselves, there will be a need for a complementary role of the government. Access to the farmer's decision on rice storage, easy access to inventory capital, improvements in communication infrastructure to assist in effective dissemination of market information and predicting future prices and extension training are factors that national policies can play a key role in encouraging rice storage among farmers. Therefore, in order to improve the rice farmer's income in Pyar Pon Township, and the whole country in general, government policies should give top priority to the following recommendations: (1) provision of accurate and timely price information, (2) provision of basic adult education, (3) improvement in the delivery of extension services, (4) increasing access to credit, (5) improvement of transportation, and (6) improving the pre-processing operation.

Finally, farmers should be catalyzed to form strong marketing associations so as to enjoy economies of scale in accessing market information and related marketing services.

REFERENCES

De padua, D.B. 1975. University of Philippines, Los Baños, College, Laguna, Philippines, personal communication.

FAO. 2004. Integration of Myanmar Agriculture into ASEAN, TCP/MYA/2902.

FAO. 1999. A Guide to Maize Marketing for Extension Officers. Food and Agriculture Organization of United Nations. Rome.

Florkowski, J. and W. Xi-ling. 1990. Simulating the Impact of Pecan Storage Technology on Farm Price and Grower's Income. Southern Journal of Agricultural Economics. 22(2): 217-222.

Hofstrand, D. and B. Wisner. 2006. Cost of Storing Grain, Available online at http://defiance.osu.edu/agriculture_natural_resources/agriculture_natural_resources/agnr-newsletters/jan-feb-06-newsletter.doc.

Huyen, V.N. 2009. Marketing Efficiency of the Corn Industry in Ha Noi Province, Vietnam, Unpublished M.S. Thesis, University of the Philippines Los Baños, College, Laguna.

Iman, I. M. and Kilin, I.D. 1973. Insecticide Screening. Min. Agr. Centr. Res. Agr., Bogor, Indonesia.

Kohls, R.L. and J.N. Uhl. 1998. Marketing of Agricultural Products, Eighth Edition. Prentice Hall, 1998, USA.

Naphire. 1990. Annual Report in 1990. National Post Harvest Institute for Research and Extension, Philippines.

Pindyck, R. S. and Rubinfeld, D.L.1981. Econometric Models and Economic Forecasts. Second Edition. McGraw Hill, Inc., New York.

Tomek, S.R and K.L. Robinson. 1981. Agricultural Products and Prices. Ithaca, New York. Cornell University Press (Second edition).

Briggs, D. and J. Johnston. 1991. Economic Issues Influencing Grower Decisions about Farm Grain Storage. Paper Presented at the Farm Grain Storage Workshop held at the University of Queensland.

Thompson, S.R and R.P. Dahl. 1979. The Economic Performance of the U.S Grain Export Industry, University of Minnesota, United State. Pp. 1-36.

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