Cost and Return Comparison between Paw San Rice and Non-Paw San Rice Production in Myanmar

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Abstract

To increase farm income by improving yields and reducing cultivation costs of agricultural production implies suitable crop variety, application of appropriate technology, correct crop management practices, and adequate level of inputs. Myanmar's premium rice, Paw San Mhwe, is awarded the World Best Rice at the World Rice Conference in 2011 in accordance with its distinctive characters such as the excellent eating quality with soft texture, delightful fragrance, white color with wet-polished, and especially elongation (three times longer than the original size after cooking). The domestic prices of Paw San rice in Myanmar are much higher than normal ones because of its preferred quality by Myanmar consumers. Paw San rice cultivation therefore is still preferred by some farmers; however, due to its lower yield than low-quality, high yielding varieties, the cultivation of Paw San Rice may not suggest higher income for farmers. This study aims at comparing the economic conditions between Paw San rice and other rice by using cost and return analysis. It is found that Paw San rice variety receives higher price than non-Paw San varieties. Due to its lower yield and vulnerability to diseases, the revenue and profit can be lower than non-Paw San rice. To improve Myanmar rice farmers' income, this study suggests that improvement of yield and resistance traits of Paw San rice should be considered for Paw San rice breeding research.

Keyword: Paw San Rice, Net Farm Income, Profit, Myanmar

Introduction

Myanmar is an agricultural country, and agriculture sector is the back bone by its economy. Agriculture sector contributes to 30% of GDP in 2012-2013, 13.7% of total export; and employs 63% of the total labor force (Department of Agricultural Planning, 2012). Rice is also being designated as principal national crop, and all efforts are centered to the surplus of rice production. In Myanmar, there are two groups of rice varieties; those are modern rice varieties, and local rice varieties including both of local high quality varieties and local low quality varieties. Paw San rice varieties are considered as high quality rice (Duffy *et al.*, 2001).

Rice prices in the domestic market vary across regions and varieties; price of Paw San rice is much higher (about 2 times) than normal rice as shown in Figure 1.Therefore quality rice cultivation may be one factor contributing to higher income for rice farmers. Almost all of Myanmar farmers barely survive at very low income levels (Stiftung, 2012); part of the reason is because most farmers still produce low quality rice. Among top ten rice varieties, high quality rice cultivated area is only 6% of total monsoon rice sown area (World Bank,

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2014). Besides, Paw San rice is still not significantly leading to the export market. As shown in Figure 2, the share of Paw San rice in total rice exports is only 0.04% in 2013/2014 even though it has more favorable eating characteristics. Therefore, it is important to understand the costs and returns and other economic factors of Paw San rice cultivation as compared to other varieties to examine whether farmers will be more beneficial by growing the high quality varieties.

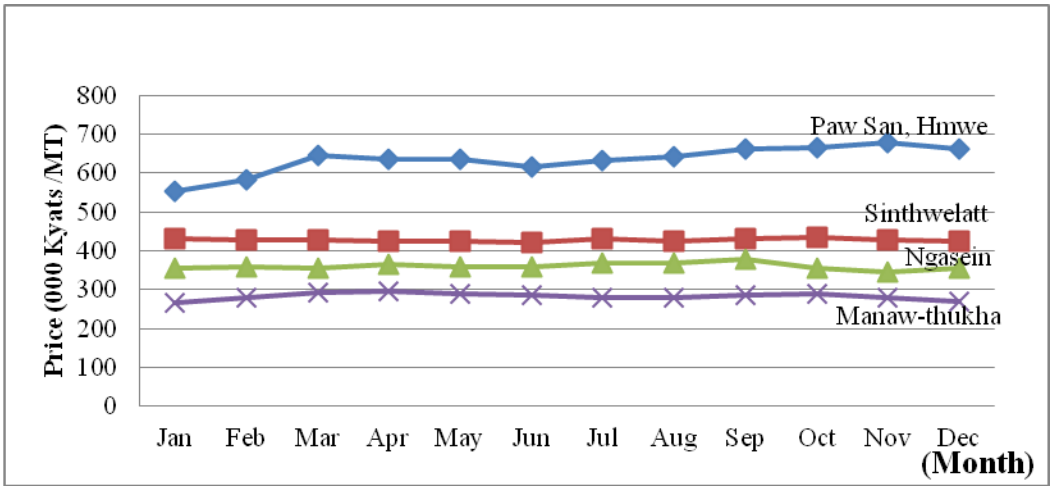

Fig. 1 Monthly rice prices in Yangon Bayintnaung Market, 2012
Note: Sinthwelatt, Ngasein and Manaw-thukha are high yielding varieties.
Source: Market Information Service (2013)

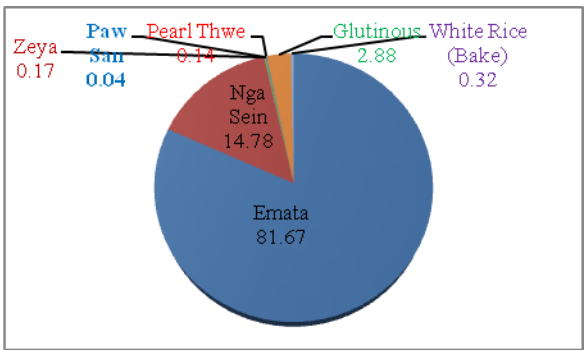

Figure 2 Share of rice exportsfromMyanmar, 2013/2014
Source: Myanmar Agricultural Product Trading (2014)

Materials and Method

Cost and Return Analysis

The relationship between costs and returns is the most important factor in making a wise decision economically (Herbst & Erickson, 1976). Cost and return analysis is the measurement of economic profit. Maximizing economic profit of a firm does not imply only by obtaining high price for commodity, but also minimizing the cost of production. In accordance with Varian (2006), profits can be defined as revenues minus cost. This study focuses on the comparison between Paw San rice and Non-Paw San rice varieties by analyzing net profit per area using cross-sectional data from a farm survey. Suppose that a

farmer produces rice output (y) and uses a vector of inputs (x); let the price of rice output be p and a vector of input prices be$w$, the profit a farmer receives, π, can be expressed as

$$\pi = py - wx \quad (1)$$

where π = net revenue (profit)
py = total revenue
p = output price
y = quantity output
wx = total variable cost
w = price of variable input
x = variable inputs include labor, animal usage, seed, chemical fertilizer (urea, t-super, potash and compound), organic (cow and chicken) fertilizer, pesticides, insecticides, fungicides, herbicides, irrigation, and machinery usage.

This study considers only variable inputs, not fixed input because in short run profit maximization, a farmers can still operate even if the loss incurs from taking into account total cost, but he should not continue to operate if the loss incurs from taking into account only variable costs. In other words, variable profit is calculated to show the short-run profit maximization decision.

Test Statistics

According to Bruning & Kintz (1997), one of the most commonly used tests of significance is the t-test to determine the difference "mean" that statistically independence of each other between two groups. This study uses t-test for testing the difference between two independent means as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left[\frac{\sum X_1^2 - \frac{(\sum X_1)^2}{N_1} + \sum X_2^2 - \frac{(\sum X_2)^2}{N_2}}{(N_1+N_2)-2}\right]\cdot\left[\frac{1}{N_1}+\frac{1}{N_2}\right]}} \quad (2)$$

where $\bar{X}_1$ = mean values(i.e. total cost, total revenue, total profit, yield and yield losses, total farm size and input usage) of Paw San rice
$\bar{X}_2$ = mean values (i.e. total cost, total revenue, total profit, yield and yield losses, total farm size and input usage) of non-Paw San rice
$\sum X_1^2$ = the sum of the squared values of Paw San rice
$\sum X_2^2$ = the sum of the squared values of non-Paw San rice
$(\sum X_1)^2$= the square of the sum of values of Paw San rice
$(\sum X_2)^2$= the square of the sum of values of non-Paw San rice
N_1 = number of observation of Paw San rice
N_2 = number of observation of non-Paw San rice

In accordance with Spence *et al.*(1968), χ^2(Chi square) is to find the goodness of fit, a test for the significance of difference between two or more groups with the choices of some variables, and sometimes said it to be a test of independence. Bruning & Kintz (1997)

suggested that a significant Chi square statistics is interpreted as showing a relationship between the two variables. Therefore, Chi square testis used in this study to compare variables of choices between two groups: Paw San versus non-Paw San.

$$\chi^2 = \sum \frac{(O-E)^2}{E} \quad (3)$$

where O = observed frequency

E = the corresponding expected frequency

Sampling Design

A stratified random sampling method without replacement was used in this study to allocate the total sample into groups. Ayeyarwaddy and Sagaing are chosen for the scope of this study as the majority of Paw San rice is cultivated in these two regions. The sampling technique was based on proportional stratified sampling (Cochran, 2007). Phyapong, Pathein and Maub in district sunder Ayeyarwaddy region, and Shewbo, Monywar, Sagaing and Tamuu districts under Sagaing region are randomly selected based on the cultivated intensity in the first stage and the existence of seed farms in the second stage. In this study, a face-to-face interview was conducted from 370 farmers consisting of 561fields of the rainy season in 2013. Since Paw San rice is mainly photoperiod sensitive, and the non-photoperiod sensitive varieties have longer maturity time, almost all of Paw San Rice is cultivated during the rainy season.

Results and Discussion

There were 24 varieties of rice including four varieties of Paw San group: Paw San Taung Pyan, Paw San Mhwe, Paw San Bay Kyar and Paw San Yin, grown n Ayeyarwaddy region, the most flooding area in Myanmar, and Sagaing region, the Central dry zone of Myanmar, during 2013/14wet season (Figure 3). There were 157 plots of Paw San and 75 plots of non-Paw San in Sagaing region, and 158plots of Paw San and 171 plots of non-Paw San in Ayeyarwaddy region. Over 65% of rice grown in Sagaing region was Paw San Bay Kyar while Paw San Mhwe was not found in this region, and the other two Paw San varieties were under 1%. Except for Paw San Yin, the rest all Paw San varieties in Ayeyarwaddy region were photoperiod-sensitive, and therefore were mostly cultivated because of the favorable weather condition including temperature and rainfall. Chang & Vergara (1985) found that the flowering of the rice plant is mainly controlled by two ecological factors such as day length and temperature. Denning *et al.*(2013) found that farmers often prefer local varieties during the monsoon season, especially in areas that are subject to flooding and to overcome from using fertilizer where there is increased risk both of flood or drought. This finding is mostly consistent with this study because 53%of total rice area in Ayeyarwaddy and 30% in Sagaing region was Paw San rice during the monsoon season in 2013.

Wong & Wai (2013) also suggested that Shwebo and Sagaing areas are expected to benefit most from increasing border trade with China. Zaw *et al.* (2011) proposed that Ayeyarwaddy's rice products can easily be transported to both export and local market through not only highway roads but also quayside. Survey data from this study are consistent with those of Department of Agriculture that 99% Paw San rice cultivated area in Sagaing region was under Shwebo district. Furthermore, Ayeyarwaddy region is where Paw San rice was grown most in the country.

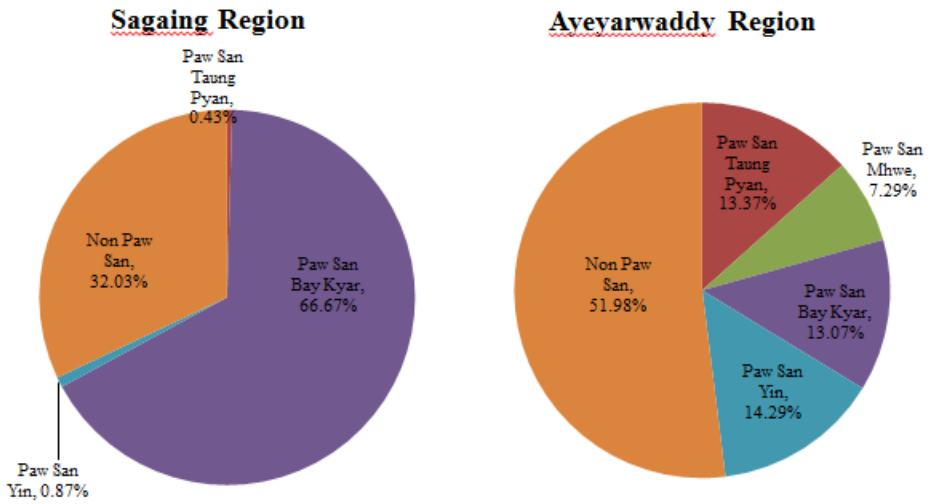

Fig. 3 Share of rice varieties grown in Sagaing and Ayeyarwaddy regions

The government of Myanmar recently permitted a distribution of title-deeds for land utilization so the majority of rice farmers have land ownership while only small numbers have rented land. The results show that Paw San and non-Paw San are not significantly differ by land holding status, crop establishment and preference of soil fertility (Table 1).About 80% of both Paw San and non-Paw San rice uses transplanting rather than broadcasting for crop establishment in Myanmar. Crop establishment appears not depending on the rice variety, but perhaps field situations such as upland or flooding areas. Most soil is moderately fertile in both Paw San and non-Paw San rice production while about one-fourth of the plots is good and small amount of land is poor fertility.

Table 1 Farm characteristics of rice farming in Myanmar, rainy season, 2013/14

Farm characteristics	Paw San	Non Paw San	Overall	Chi-square
Land holding status				0.67
Rent	5 (1.59)	2 (0.81)	7 (1.26)	
Own	310 (98.41)	244 (99.19)	554 (98.75)	
	315 (100.00)	246 (100)	561 (100)	
Crop establishment				0.35
Broadcasting	59 (18.73)	51 (20.73)	110 (19.61)	
Transplanting	256 (81.27))	195 (79.27)	451 (80.39)	
	315 (100.00)	246 (100)	561 (100)	
Soil fertility				3.26
Good	79 (25.08)	66 (26.83)	145 (25.85)	
Moderate	218 (69.21)	157 (63.82)	375 (66.84)	
Poor	18 (5.71)	23 (9.35)	41 (7.31)	
	315 (100.00)	246 (100)	561 (100)	

Note: Numbers in parentheses are the percentage of farm characteristics of Paw San and non-Paw San.

The comparison of input use between Paw San and non-Paw San rice is presented in Table 2. The cultivation practices obviously differ in the two regions. On average the amount of seed usage for Paw San is significantly less than non-Paw San rice, particularly in Sagaing region, but not in Ayeyarwaddy region. Paw San farmers in Ayeyarwaddy region significantly use less urea (N_2) and compound fertilizer for Paw San than for non-Paw San,

but almost the same in Sagaing region. Farmers on average of the two regions also use triple super phosphate for Paw San more than for non-Paw San. This is consistent to the reason that Paw San rice is low responsive to urea(Duffy *et al.,* 2001) than phosphate (P_2O_5).Paw San rice farmers depend on the treatment of pesticides, insecticides, and herbicides more than non-Paw San rice farmers. This is because Paw San rice is more vulnerable to pests and diseases such as rice stem borer. Naing *et al*. (2008) and Morris &Waterhouse (2001) cited Denning *et al*. (2013) concluded that grain yield losses due to diseases and pests were for the most part "insignificant". This conclusion is different from this study because the most it is found that yield losses occurred from the disturbance of rice stem borer more than heavy raining as shown in Table 4.The farmers who grow Paw San rice in Ayeyarwaddy region utilize lower amount of all chemical and organic fertilizer than those in Sagaing region. This might be because Ayeyarwaddy River provides more silt soil which is suitable for Paw San rice cultivation.

When comparing rice price of Paw San rice and non-Paw San rice for both milled rice and paddy as shown in Table 3, it is found that Paw San rice has higher price than non-Paw San rice. This partly is due to the amylose content (AC) which reflects the softness and quality of rice varieties. Myint (2013) found that non-Paw San has higher AC which makes the rice harder. Paw San rice has 21% AC while other popular varieties such as Sinakayi-1, Manawthukha, IR-747, Theehtatyin, Shwewahlay, and Shwewahtun, have 22.8%, 26.5%, 30.4%, 30.4%, 30.8%, and 31.7%AC, respectively. Apart from this, Denning *et al*., (2013) recommended that local varieties, such as Paw San Yin, are typically of higher eating quality and bring as much as double the price of the high yielding varieties. In fact, the prices of paddy of both Paw San rice and non-Paw San rice increase gradually over time of selling while those of milled rice appear to be the opposite. It is observed that for milled rice, farmers generally receive higher price if they sell their products directly to the millers rather than the other sources such as collectors or traders.

The result of cost and returns comparison is shown in Table 4.Total variable cost of Paw San in Sagaing region and on average of the two regions is significantly higher than non-Paw San, but it is a reverse in Ayeyarwaddy region. As seen from Table 2, the costs of pesticides, insecticides, and herbicides are significantly higher for Paw San rice cultivation. Even though prices of Paw San rice is higher than non-Paw San rice, yield of Paw San rice is significantly much lower than non-Paw San varieties. Since there was an outbreak of rice stem in Sagaing region during the survey year, yield losses from stem borers appear to be larger for Paw San rice in Sagaing region and on average of the two region than non-Paw San rice. This is because Paw San rice has longer period and thus is more vulnerable to rice stem borer than non-Paw Sanvarieties. As a result, total revenue and profit of Paw San is significantly higher than non-Paw San rice only in Ayeyarwaddy region, but not in Sagaing region.

Conclusion

Paw San rice is highly preferred by Myanmar consumers for its high eating quality, and after it won the world best rice in 2011, it also has good potential for high quality rice export markets. Paw San rice evidently receives much higher price than non-Paw San rice in Myanmar's domestic market. However, due to lower yield and vulnerability to diseases such as rice stem borer that may create more loss during the devastation than non-Paw San varieties, Paw San rice cultivation depend heavily on insecticides, pesticides and herbicides. The result of cost and return analysis in Sagaing and Ayeyarwaddy regions shows that the profit of Paw San rice cultivation is not necessarily more attractive than non-Paw San varieties, particularly when there is a devastation of rice stem borer. In Ayeyarwaddy region

where rice cultivation generally uses less fertilizer than Sagaing region, and fertilizer usage especially urea and compound fertilizer for Paw San rice is less than for non-Paw San rice due to more nutrients from Ayeyarwaddy river, farmers are more profitable producing Paw San rice than non-Paw San rice varieties. In order to improve the income of Paw San rice farmers and to promote the expansion of Paw San rice production, this study suggests that the breeding program of rice in Myanmar should consider increasing yield and more resistant of diseases for Paw San rice.

Table 2 Input usage and cost of Paw San and non-Paw San Rice in Myanmar, rainy season, 2013/14

Variable	Group	Sagaing Region			Ayeyarwaddy Region			Overall		
		Mean	Std. dev	t-value	Mean	Std. dev	t-value	Mean	Std. dev	t-value
Seed usage (basket/acre)	Paw San	1.31	0.65	-5.039***	2.07	0.71	-1.891	1.69	0.78	-5.909***
	Non Paw San	1.76	0.60		2.23	0.83		2.09	0.80	
Urea fertilizer (kg/acre)	Paw San	55.67	21.80	-0.502	41.46	18.30	-3.197***	48.56	21.32	-1.288
	Non Paw San	57.35	25.10		48.46	20.59		51.00	22.28	
T- superphosphate (kg/acre)	Paw San	53.96	29.18	1.497	25.38	10.92	-0.055	30.54	19.18	2.094*
	Non Paw San	36.43	18.19		25.47	12.16		26.13	12.78	
Potash (kg/acre)	Paw San	27.45	22.97	-0.281	19.17	10.91	-0.187	21.24	15.05	0.096
	Non Paw San	30.14	14.68		19.62	11.74		20.98	12.52	
Compound fertilizer (kg/acre)	Paw San	74.01	37.65	0.709	36.25	15.25	-2.447**	70.09	37.76	1.156
	Non Paw San	70.03	32.82		50.07	18.63		64.50	30.80	
Cow manure (cart/acre)	Paw San	2.37	1.53	-5.140***	1.57	1.13	0.211	2.00	1.41	-3.162***
	Non Paw San	3.85	1.97		1.53	1.01		2.62	1.92	
Chicken manure (basket/acre)	Paw San	n/a	n/a	n/a	9.63	7.67	-0.060	9.63	7.67	-0.060
	Non Paw San	n/a	n/a		9.90	6.09		9.90	6.09	
Pesticides and insecticides costs (kyats/acre)	Paw San	5,855.36	9,084.73	2.679**	2,357.31	3,115.61	1.879	4,100.78	6,994.69	4.152***
	Non Paw San	2,908.67	4,113.24		1,717.22	3,061.86		2,080.47	3,452.15	
Fungicides cost (kyats/acre)	Paw San	261.27	1,243.85	0.791	30.79	287.99	0.075	145.67	907.44	1.299
	Non Paw San	134.93	875.79		28.45	276.88		60.91	535.98	
Herbicides cost (kyats/acre)	Paw San	4,890.57	5,478.31	2.274**	154.75	945.86	0.848	2,507.58	4,575.54	4.375***
	Non Paw San	3,236.40	4,481.60		82.46	568.08		1,044.02	2,899.49	

Note: Seed of paddy in 1 basket = 46 lbs, 1 hectare = 2.471 acre, US$ 1 = 1208 kyats as of 7th, April 2015

*, **, *** are significance at 10%, 5% and 1% level, respectively.

Table 3 Selling price of Paw San rice and non-Paw San rice, 2013/14

Time of sales	Group of rice	Milled rice			Paddy		
		Mean	Std.	t-value	Mean	Std.	t-value
First time	Paw San	18,176	4,919	0.936	7,102	1,628	12.525***
	non-Paw San	15,914	4,083		5,524	1,218	
Second time	Paw san	16,039	6,230	1.793	8,886	1,626	5.491***
	non-Paw San	12,647	4,429		6,657	1,646	
Third time	Paw San	n/a	n/a	n/a	9,522	2,010	3.895***
	non-Paw San	n/a	n/a		7,239	1,499	

Note: 1 basket of paddy = 46lbs, 1 basket of milled rice form = 75 lbs
US$ 1 = 1208 kyats as of 7th, April 2015
*** is significant level at 1%.

Table 4 Total cost, total revenue, total profit, yield, and losses of rice cultivation in Myanmar, rainy season, 2013/14

Variable	Variety Group	Sagaing Region			Ayeyarwaddy Region			Overall		
		Mean	Std Dev	t-value	Mean	Std Dev	t-value	Mean	Std Dev	t-value
Total Variable Cost (kyats/acre)	Paw San	249,886.80	37,133.68	2.608**	162,101.30	25,394.60	-2.223*	205,854.70	54,223.55	4.00***
	Non Paw San	236,258.10	37,410.63		168,259.80	24,824.67		188,991.00	42,828.03	
Total Revenue (kyats/acre)	Paw San	319,371.20	151,240.10	0.239	314,414.10	74,540.80	2.002*	316,884.80	118,946.50	1.454
	Non Paw San	314,526.80	128,515.30		298,830.50	66,632.61		303,616.00	90,120.68	
Total Profit (kyats/acre)	Paw San	69,555.22	153,545.60	-0.426	156,597.80	71,932.56	3.863***	113,214.70	127,280.40	0.145
	Non Paw San	78,120.48	119,093.80		126,611.60	68,844.47		111,827.70	89,849.75	
Yield (bsk/acre)	Paw San	37.20	17.04	-6.048***	50.77	10.22	-3.015***	44.01	15.58	-7.632***
	Non Paw San	52.17	18.82		54.37	11.33		53.70	14.04	
Loss by rain (bsk/acre)	Paw San	n/a	n/a	n/a	7.78	7.26	-0.675	7.67	7.12	-0.686
	Non Paw San	n/a	n/a		9.48	10.19		9.33	10.05	
Loss by stem borer (bsk/acre)	Paw San	34.42	15.30	2.241*	13.50	5.02	-2.486**	32.60	15.83	2.917***
	Non Paw San	28.32	15.10		18.64	5.53		25.85	13.94	
Total farm size (acre)	Paw San	7.99	5.60	3.443***	19.12	21.01	1.196	13.58	16.35	0.123
	Non Paw San	5.93	3.46		16.71	14.83		13.42	13.45	

Note: Total variable cost includes costs of labor, animal usage, seed, chemical fertilizer (urea, t-super, potash and compound), organic (cow and chicken) fertilizer, pesticides, insecticides, fungicides, herbicides, irrigation, and machinery.US$ 1 = 1208 kyats by 7th, April 2015 exchange rate;1 hectare = 2.471 acre, 1 basket of paddy = 46lbs
*, ** and *** are significant level at 10%, 5%.and 1%, respectively.

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