

CHAPTER V

PROFITABILITY OF MAIZE PRODUCTION IN STUDY AREA

This chapter analyses the profitability of survey households in two townships regarding the adoption of chemical fertilizers in maize cropping systems. The results are shown the following figures and tables.

5.1 Cost of production

5.1.1 Cost of production between two Townships

Seeds, chemical fertilizers, compost and pesticides are the main inputs used in maize production. Operating costs include land preparation, ridging, weeding, threshing and transportation and labor costs including sowing, thinning, weeding, ridging, fertilizer application, harvesting, husking, threshing, drying and finally bagging are also the production costs in maize.

The results of Figure 5.1 show that none of the households in Yatsauk used hybrid 3 and local maize varieties except CPDK 888 maize variety but all kinds of maize varieties were used by households in Pindaya. According to this Figure, cost of maize seed varied in the study area regarding to CPDK 888; households in Yatsauk spent two times higher than households in Pindaya for seed because they bought true hybrid one (F_1) but households in Pindaya did not purchase this kind of seed and they purchased not true hybrid seed (F_2 or Thantae seed) and cheaper than F_1 seed but not good quality. So,

it was another reason for losing yield by households in Pindaya. Some households in Pindaya used hybrid-3 maize variety and a few households used local maize variety. This hybrid maize seed was cheaper than CPDK 888 variety because hybrid-3 maize variety had released by Department of Agricultural Research, Myanmar.

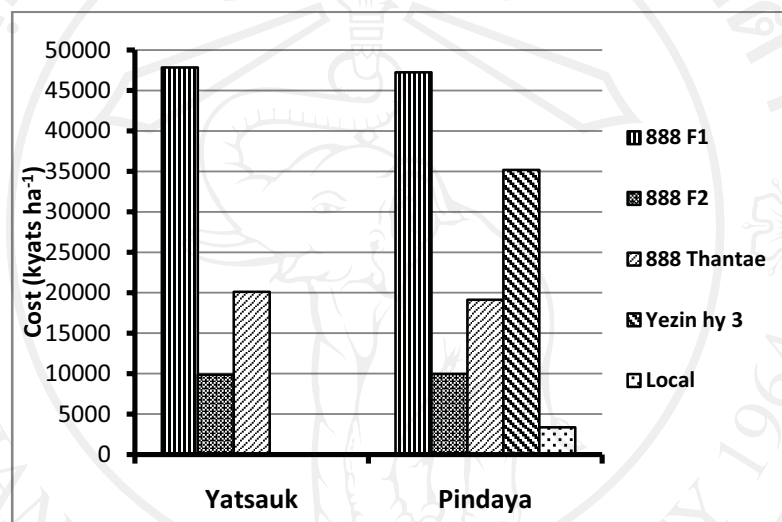


Figure 5.1 Average seed cost of five maize varieties in two townships.

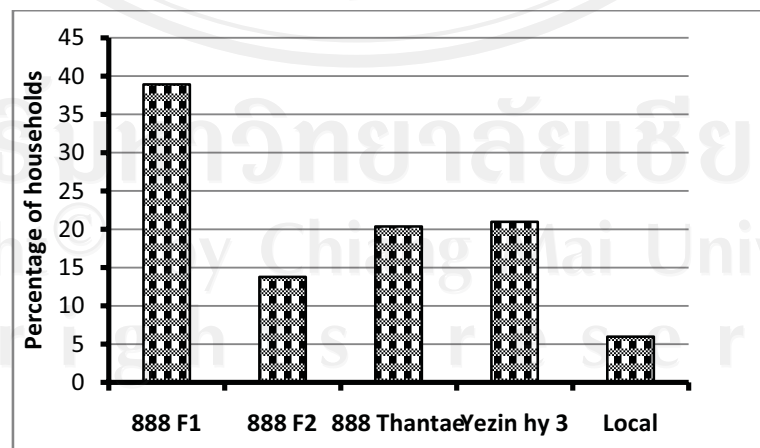


Figure 5.2 Percentage of households using different varieties in the study area.

According to the Figure 5.2, there are 38.9 percent of households using CPDK 888 F₁, 13.8 percent of households used CPDK 888 F₂, 20.4 percent and 20.9 percent of households used CPDK 888 Thantae and Yezin hybrid 3 respectively but only 6 percent of households used local maize variety in the study area. So, many households applied CPDK 888 F₁ variety while CPDK 888 Thantae and Yezin hybrid 3 varieties were the same proportion used by households in the study area.

The detailed cost of chemical fertilizer per hectare by different varieties was shown in Figure 5.3. In this figure, the households who use CPDK 888 F₁ spent so much money for purchasing chemical fertilizers and Yezin hybrid 3 and local variety growers used money about one-third of CPDK 888 F₁ growers. But the households who apply CPDK 888 F₂ and CPDK 888 Thantae used higher cost than that of local maize variety in case of chemical fertilizer.

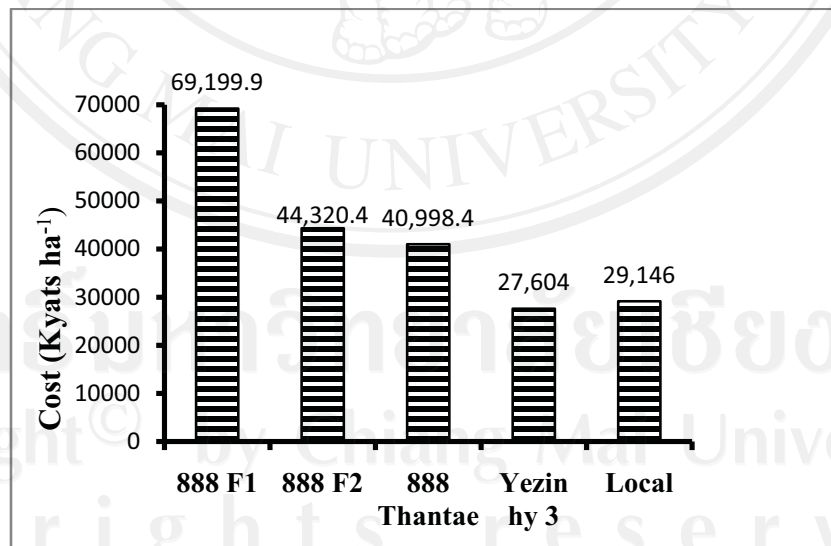


Figure 5.3 Cost of chemical fertilizer by different varieties in the study area.

Average cost of production was calculated in order to get an idea about the cost that farmers have to bear under the major cost components to produce one kilogram of maize in two different study areas; considering with or without the opportunity cost of family labor and with or without borrowed money and also considering the chemical fertilizer adoption.

Survey results with regard to the average cost of production described above; are presented in the following Table 5.1 and 5.2. Farm level data showed that maize households in Yatsauk township had to bear higher cost of production compared to the households in Pindaya township. The average cost of production per kilogram of maize grain for the households in Yatsauk township was 122.59 kyats and 143.38 kyats while it was 99.02 kyats and 127.91 kyats for Pindaya township excluding and including the opportunity cost of family labor respectively.

Table 5.1 Average cost of production per kilogram of maize grain between two townships

Average cost of production	Yatsauk Township	Pindaya Township
Excluding family labor (ks/kg)	122.59	99.02
Including family labor (ks/kg)	143.38	127.91
Households who did not borrow money (ks/kg)	120.45	118.98
Households who borrowed money (ks/kg)	159.17	139.13

Source: Survey data (2009)

There is no evidence yet to indicate that increased land area under cultivation reduces the unit cost of production. This may be due to the cost of input in case of chemical fertilizers.

On the other hand, households who borrowed money or not in Yatsauk had to bear higher cost of production compared to the households in Pindaya township in case of households who borrowed money or households who did not borrow money. The average cost of production for the households in Yatsauk township was 120.45 kyats and 159.17 kyats while it was 118.98 kyats and 139.13 kyats for Pindaya Township according to the households who did not borrow money and households who borrowed money respectively in Table 5.1.

According to the results, households who borrowed money cost more than households who did not borrow money in both townships because of very high interest rate. In these areas, interest rate varied from 1.25 percent to 10 percent depending on the source of money.

Table 5.2 shows that the average cost of production per hectare between two Townships. In Yatsauk, seed, chemical fertilizer, fuel, machinery, hired labor cost and interest were higher than those in Pindaya while pesticide and other operating costs were higher in Pindaya than those in Yatsauk. Moreover, the cost of compost in Pindaya was four times higher than the cost of compost in Yatsauk. Therefore, average total production cost (314,756.6 kyats ha⁻¹) was higher in Yatsauk than in Pindaya (221,409.2 kyats ha⁻¹).

Table 5.2 Average cost of production per hectare between two Townships

Average cost of production	Yatsauk Township (ks ha ⁻¹)	Pindaya Township (ks ha ⁻¹)
Seed	34,903.8	14,380.1
Chemical fertilizer	59,632.2	36,285.5
Compost	5,337.2	22,924.1
Pesticide	28.2	903.5
Fuel	4,406.2	18.7
Machinery	3,741.3	118.8
Other operating costs ¹	20,116.9	22,233.2
Hired labor	89,710.1	52,800.4
Interest	52,381.0	21,751.1
Total production cost	314,756.6	221,409.2

Source: Survey data (2009)

¹ = land preparation, threshing, transportation

5.1.2 Cost of production between chemical fertilizer adopters and non adopters

Usage of maize seed varied between households who adopt chemical fertilizers and households who not adopt chemical fertilizers although they utilize the maize variety CPDK 888 because of seed cost in Figure 5.4. In addition, both adopters and non adopters used hybrid-3 and then used local maize variety.

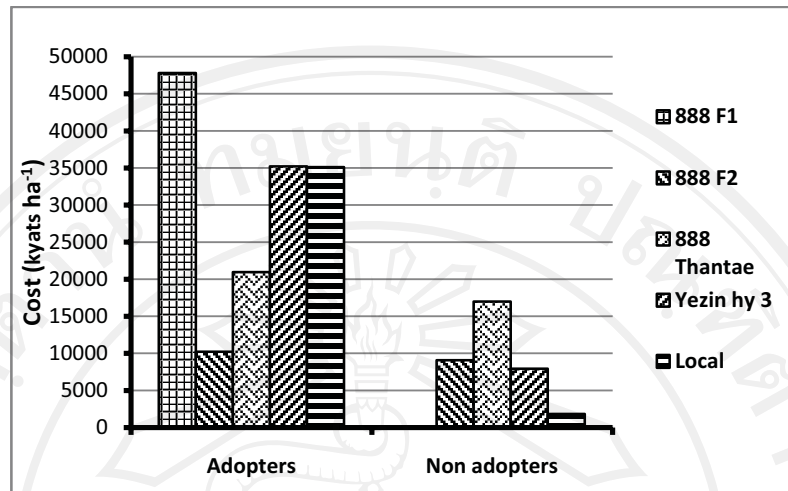


Figure 5.4 Average seed cost of three maize varieties between adopters and non adopters.

Interviewed households believed that they were able to get higher yield by using true seed (F_1) and chemical fertilizer but they have not enough money to purchase this kind of seed and fertilizers also. Therefore, they bought the seed (F_2 or others) that are cheaper than F_1 seed and they did not use chemical fertilizers to apply in their fields especially non adopter households.

Table 5.3 shows the comparison of average cost of production between chemical fertilizer adopters and non adopters in two study areas. It indicated that the chemical fertilizer adopters had to bear higher cost of production compared to the non adopters in both Townships. In average, the cost of production of chemical fertilizer adopters was 112.41 kyats kg^{-1} , while it was 76.81 kyats kg^{-1} for non adopters if family labor is not included.

Households who borrowed money had higher cost than households who did not borrow money. In Table 5.3, in average, cost of production of chemical fertilizer adopters

was 155.47 kyats kg⁻¹ and it was 127.21 kyats kg⁻¹ for non adopters in case of households who borrowed money. However, it was 120.68 kyats kg⁻¹ for adopters while it was 115.09 kyats kg⁻¹ for non adopters in case of households who did not borrowed money.

Table 5.3 Average cost of production between chemical fertilizer adopters and non adopters

Average cost of production (ks/kg)	Yatsauk township		Pindaya township	
	Adopters	Non adopters	Adopters	Non adopters
Excluding family labor	123.98	57.26	100.83	96.35
Including family labor	144.08	110.29	130.69	123.78
Households who did not borrow money	123.07	110.29	118.29	119.89
Households who borrowed money	160.28	-	150.66	127.21

Source: Survey data (2009)

5.1.3 Contribution of cost of major components in maize production

Average cost of production was calculated under each cost component of maize production using the data of field survey. This result showed that 53.5 percent, 33 percent and 13.5 percent of the production cost were labor and machinery, input and interest cost respectively (Figure 5.5).

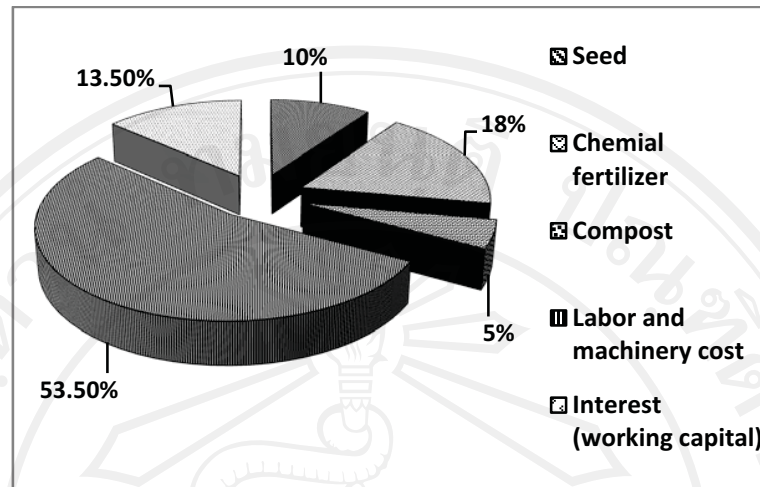


Figure 5.5 Contribution of cost of major components in maize cultivation.

Cost of input constituted by 10 percent of seed, 18 percent and 5 percent were under chemical fertilizer and compost respectively. It can be seen that the detailed cost of major components in maize production in the study area as shown in Table 5.4.

Table 5.4 Contribution of cost of major components in maize production

Cost of components	Average cost (kyats ha ⁻¹)	% of average cost
Seed	25,461.3	10.0
Chemical fertilizer	48,588.1	18.0
Compost	13,656.6	5.0
Labor and machinery	75,948.5	53.5
Interest	37,891.5	13.5
Total	201,546.0	100.0

Almost all of the surveyed households were found to be sowing by line and some households grew twice in this particular year. So, it had created a high cost for them by resowing because of drought at sowing time and improper maize seed. Therefore, access to high quality maize seed will have a good contribution for increasing profit as it

constitutes a major item in the cost of inputs. Some households used to apply compost in maize fields. Households who borrowed money also had a considerable amount on interest as a result of very high interest rate and it varied from 1.25 to 10 percent by monthly. However, households used very small amount of pesticide and it was just 0.2 percent in the study area.

Labor and machinery cost for maize production was 53.5 percent in the study area and the contribution of the various processes for cost can be seen in Figure 5.6.

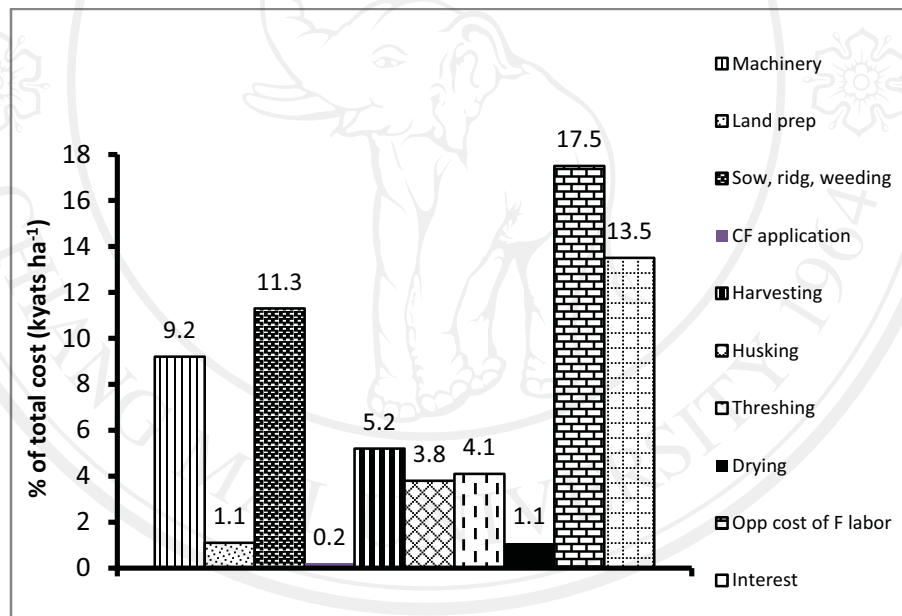


Figure 5.6 Cost of production (kyats ha⁻¹) in maize production.

Within the cost of production, interest used by households was the second largest amount compared to opportunity cost of family labor. Hired labor cost in land preparation and drying was also high in surveyed data while sowing, ridging and weeding were spent 11.3 percent, machinery, harvesting, husking and threshing were spent 9.2, 5.2, 3.8 and

4.1 percent respectively in study area (Figure 5.6). In the study area, cost of production by interest, labor and machinery was expressed in kyats in Table 5.5. Therefore, there were 67 percent of total production cost including interest, labor and machinery cost in the study area.

Table 5.5 Breakdown of interest, labor and machinery costs in the study area

Cost of production	Average cost (kyats ha ⁻¹)	% of total production cost
Machinery	3,698.6	9.2
Land preparation	2,893.8	1.1
Sowing, ridging and weeding	30,483.0	11.3
Chemical fertilizer application	524.6	0.2
Harvesting	14,097.5	5.2
Husking	10,389.3	3.8
Threshing	10,971.5	4.1
Drying	2,890.1	1.1
Opportunity cost of family labor	47,385.5	17.5
Interest	37,891.5	13.5
Costs of interest, labor and machinery	161,225.4	67

Source: Survey data (2009)

1 US\$ = 1000 Kyats

Farmers borrowed money from various sources such as creditors, Agricultural Development Bank and UNDP. The amount of borrowed money varied within the range of 3,750 to 500,000 kyats per household. Interest cost was relatively high by households who borrowed money regarding in maize production. Therefore, making credit available

to farmers is an important way of increasing the adoption of improved maize technologies and improving the level of production (Salasya *et al.* 1998).

5.1.4 Cost of production between different varieties

There are three kinds of maize varieties that were grown by households in the study area namely CPDK 888, Yezin hybrid 3 and local maize variety but in CPDK 888, there are 3 types used by households as CPDK 888 F₁, CPDK 888 F₂ and CPDK 888 Thantae. Therefore, households in the study area used 5 kinds of maize varieties and then the cost of production varied according to the different maize varieties as shown in Figure 5.7. Total cost of production by using CPDK 888 F₁ variety was the largest amount in the study area but it was the lowest amount by using local maize variety.

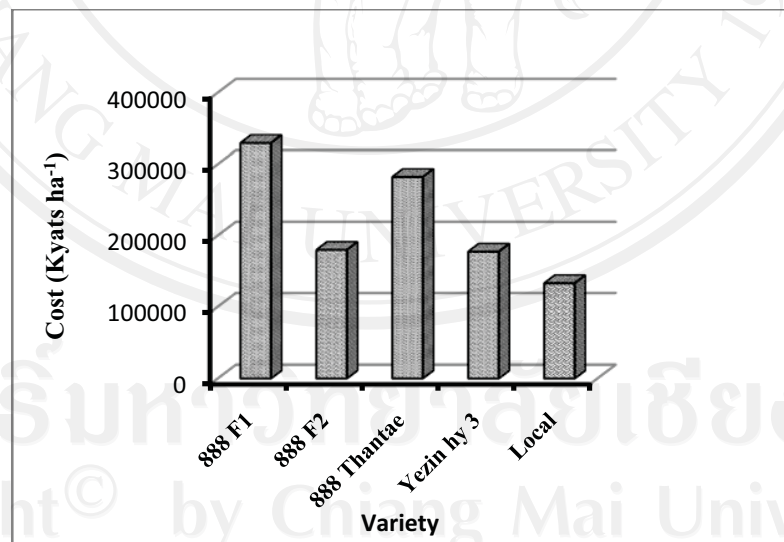


Figure 5.7 Total cost of production (kyats ha⁻¹) in different varieties in the study area.

Table 5.6 showed the detailed cost of production and total cost of production between 5 maize varieties among adopters in the study area. According to the survey data, all input and all hired labor costs by using CPDK 888 F₁ were highest among the different maize varieties except cost of compost. Chemical fertilizer cost was also the highest among the households who grow CPDK 888 F₁ maize variety. Therefore, households have knowledge of chemical fertilizer application technology regarding to using CPDK 888 F₁.

On the other hand, in case of opportunity cost of family labor, households used their family labor in the maize field was highest in local maize variety. Therefore, these households were not likely to rent labor and apply hybrid maize varieties. Among adopters, were various interest rates that were paid by households who grow with the 5 different maize varieties in the study area (Table 5.6). In terms of total cost per kilogram of grain, households spent the maximum cost (187.4 kyats kg⁻¹) by growing CPDK 888 Thantae because of higher interest rate and lower yield than the households who used by other varieties especially in CPDK 888 F₁. By using CPDK 888 F₁, cost of production for 1 kilogram of grain was not high (127.4 kyats kg⁻¹) because these households gained higher yield than other households; even though they spent the highest cost for production among all varieties used (Figure 5.8). But the production cost was the lowest (110.7 kyats kg⁻¹) in households using local maize variety because these households used their family labor instead of hired labor in most of the production process and none of the households used machinery and then no fuel cost for production.

Table 5.6 Cost of production between different maize varieties in adopters

Cost of production (kyats ha ⁻¹)	888 F ₁	888 F ₂	888 Thantae	Yezin Hy 3	Local
Input					
Seed	42,461.2	10,221.4	20,961.7	14,118.3	3,211.0
Chemical fertilizer	68,358.2	59,962.9	60,606.3	43,915.5	58,292.0
Compost	5,760.8	7,489.9	8,054.3	11,923.4	9,880.0
Pesticide	855.0	0	2,706.3	415.4	0
Fuel	5,254.6	0	2,008.2	350	0
Operating					
Land preparation	13,683.8	20,787.2	16,304.0	15,398.2	15,477.2
Threshing	2,990.6	755.5	2,792.2	561.4	1,086.8
Transportation	1,970.3	2,833.2	4,156.0	1,291.1	3,803.8
Machinery	3,236.5	0	5,436.1	694.1	0
Hired Labor					
Land preparation	2,975.4	217.9	4,977.6	2,020.9	0
Sowing, ridging and weeding	39,626.4	32,442.9	31,084.4	18,620.4	9,040.2
Chemical fertilizer application	920.6	624.8	343.7	1,094.7	0
Harvesting	20,489.6	10,621.0	10,475.1	8,341.9	2,519.4
Husking	17,202.6	5,089.7	11,233.1	2,245.5	3,062.8
Threshing	10,951.2	7,170.3	10,835.8	12,692.4	1,304.2
Drying	4,072.7	1,351.2	4,400.4	3,528.1	3,655.6
Opportunity cost of family labor	43,500.3	45,294.0	49,859.7	52,783.8	59,354.1
Interest rate	43,772.3	17,590.2	74,395.1	11,694.3	1,642.6
Total cost	328,082.1	222,452.1	320,630.0	201,689.4	172,329.7
Yield (kg ha ⁻¹)	2,585.5	1,437.3	1,710.9	1,530.8	1,486.6
Total cost (kyats kg ⁻¹)	127.4	154.8	187.4	131.8	110.7

Table 5.7 Cost of production between different maize varieties in non adopters

Cost of production (kyats ha ⁻¹)	888 F ₁	888 F ₂	888 Thantae	Yezin Hy 3	Local
Input					
Seed	0	15,663.9	16,986.9	13,885.2	741.0
Chemical fertilizer	0	0	0	0	0
Compost	0	4,116.7	12,406.1	14,345.0	0
Pesticide	0	0	0	0	0
Fuel	0	0	0	0	0
Operating					
Land preparation	0	5,763.3	15,269.1	25,308.0	11,979.5
Threshing	0	1,358.5	3,869.5	950.0	988.0
Transportation	0	1,646.7	471.5	2,242.0	1,976.0
Machinery	0	0	0	0	0
Hired Labor					
Land preparation	0	0	2,245.5	8,360.0	0
Sowing, ridging and weeding	0	18,401.5	17,896.3	21,907.0	21,834.8
Chemical fertilizer application	0	0	0	0	0
Harvesting	0	7,711.6	7,041.7	9,310.0	6,979.3
Husking	0	3,869.7	6,197.5	6,783.0	5,532.8
Threshing	0	5,001.8	16,459.2	17,549.4	16,845.4
Drying	0	0	3,424.3	4,140.0	0
Opportunity cost of family labor	0	576.8	52,766.6	38,821.4	52,557.6
Interest rate	0	6,519.9	91,811.0	553.4	9,366.2
Total cost	0	70,630.4	246,845.2	164,154.4	128,800.6
Yield (kg ha ⁻¹)	0	1,260.7	2,166.9	1,561.6	1,723.2
Total cost (kyats kg ⁻¹)	0	56.0	113.9	105.1	74.4

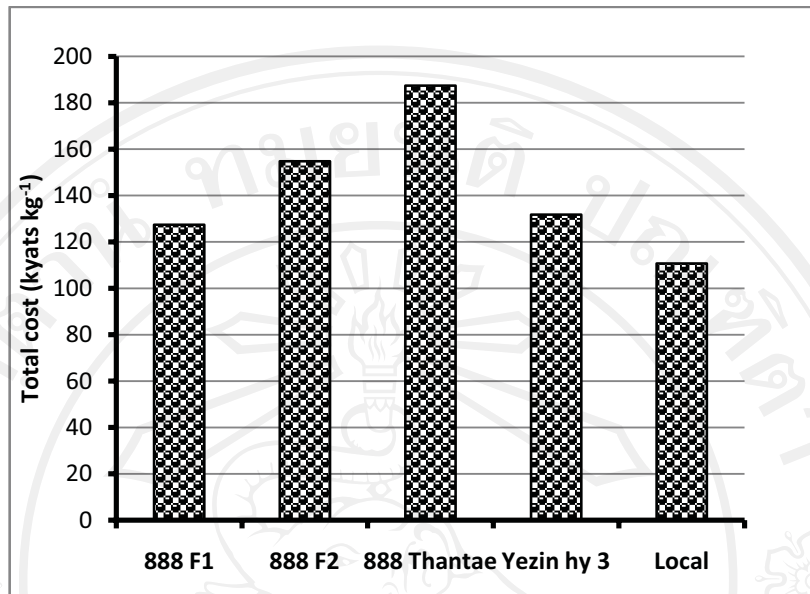


Figure 5.8 Total cost (kyats kg⁻¹) by using different varieties in adopters.

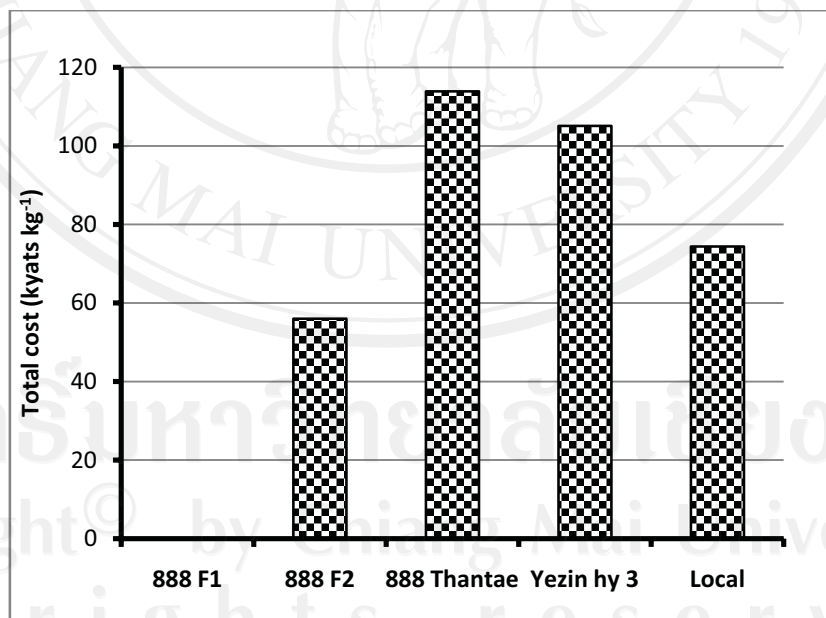


Figure 5.9 Total cost (kyats kg⁻¹) by using different varieties in non adopters.

Among the non adopters' households, they did not use the variety as CPDK 888 F₁ but the households who applied Yezin hybrid 3 maize variety cost the largest amount (14,345 kyats ha⁻¹) in compost used (Table 5.7). According to this table, total input cost, opportunity cost of family labor and interest rate were highest in household who used CPDK 888 Thantae variety. Therefore, the total production cost (246,845.2 kyats ha⁻¹) was the largest in the households who used CPDK 888 Thantae variety; even though these farmers gained the highest yield (2,166.9 kg ha⁻¹) among the non adopters, cost of production (113.9 kyats kg⁻¹) per kilogram of maize was highest to compare other varieties. However, the households had the lowest cost (56 kyats kg⁻¹) of production per kilogram of maize according to the surveyed data (Figure 5.9).

5.2 Profitability of maize production in two townships

Gross margin was used as a measure of profitability and was varying in two townships based on yield, price and cost of production. On average, 48 percent and 50 percent of the operating costs was spent on cost for inputs in Yatsauk township and Pindaya township respectively. These input costs and other operating costs varied according to the labor, machinery and interest costs.

The result in Figure 5.10 revealed that households in Yatsauk gained higher yields than households in Pindaya. The price of maize grain obtained by households was not significantly different in both townships (Figure 5.11). Price was fluctuated every week after harvesting of maize in the study area and some households sold their products recently after harvesting. Generally, the initial price was lower than the middle and final

price by marketing economy. Interviewed farmers responded that they wanted to store their product to get higher price but they needed to pay back for loans seven month after borrowing money. Otherwise, the interest rate will be higher than before in both townships. Moreover, the reason that the households in Yatsauk got lower price than in Pindaya was the amount of interest that was higher in Yatsauk (21,206.9 kyats) than in Pindaya (8806.1 kyats) because on average, the households in Yatsauk (35,548 kyats) borrowed much money than in Pindaya (29,022 kyats). That is why the households sold their maize early and a few households could store the product to catch the higher price in Yatsauk.

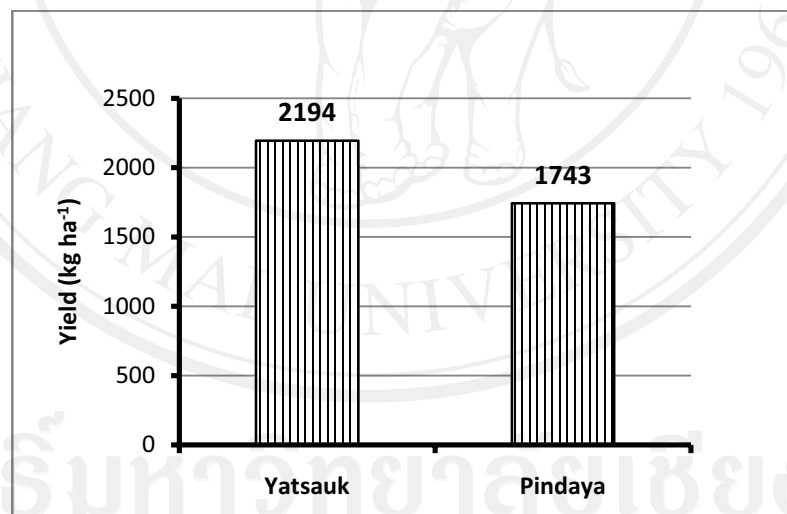


Figure 5.10 Average yield (kg ha⁻¹) of maize in two townships.

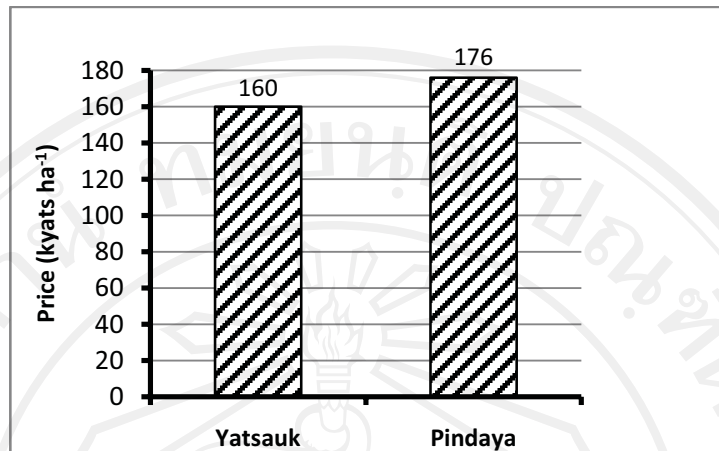


Figure 5.11 Average prices (kyats kg⁻¹) of maize in two townships.

According to Figure 5.12 and 5.13, households in Yatsauk were able to get higher total revenue than households in Pindaya townships. Therefore, the results of Figure 5.14 confirmed the average total revenue and total variable cost of households in maize production in the study area. The most profitable region was created in Yatsauk that is 16 percent higher than Pindaya.

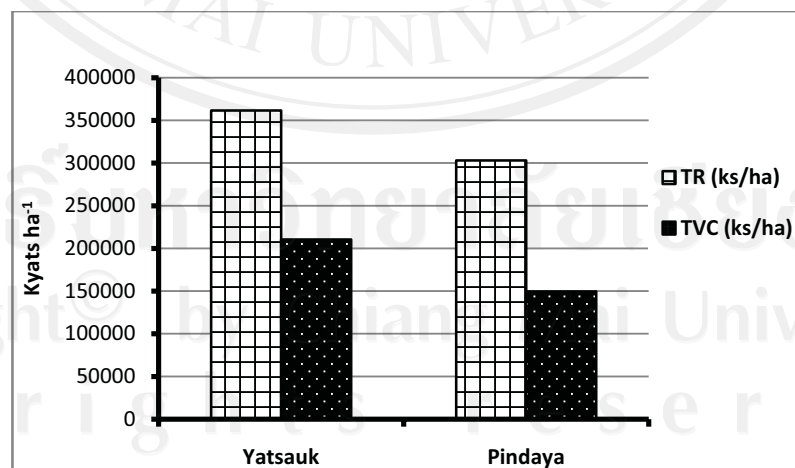


Figure 5.12 Total revenue (kyats ha⁻¹) and total variable cost (kyats ha⁻¹) in two townships

Gross margin was varying between households who borrowed money and households who did not borrowed money according to the Figure 5.13 and it revealed that in both townships, households who did not borrow money had higher gross margin than households who borrowed money. It was because of very high interest rate. In these areas, interest rate varied from 1.25 percent to 10 percent depending on the source of money.

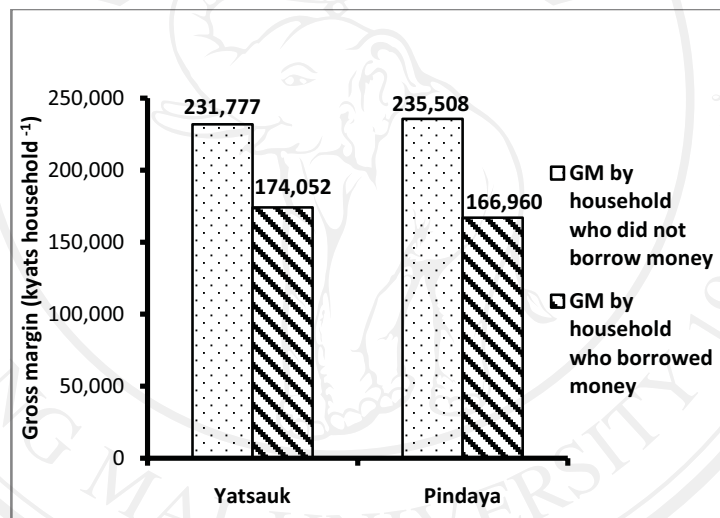


Figure 5.13 Gross margin (kyats household⁻¹) between different households in two townships.

5.3 Profitability among chemical fertilizer adopters and non adopters

Figure 5.14 shows the effect of the adoption of chemical fertilizer on yield in maize cropping system according in this study area. Every household adopter gained higher yield in both townships but in Yatsauk, non adopter households obtained very low yield compared to adopters. On the other hand, no significant effect on adoption of chemical fertilizer appeared in adopters and non adopters in Pindaya.

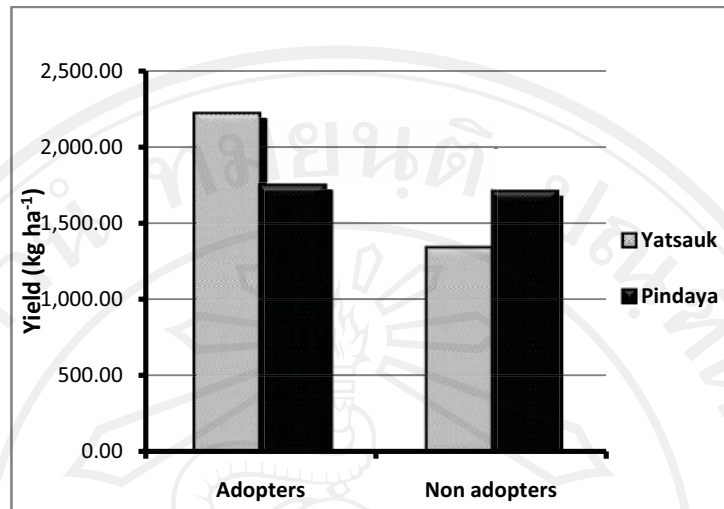


Figure 5.14 Average yields (kg ha⁻¹) between adopters and non adopters in two townships.

The price of maize grain was not much different in chemical fertilizer adopters and non adopters in both townships (Figure 5.15). In average, households who adopt chemical fertilizers got 170 kyats kg⁻¹ of maize grain while households who not adopt chemical fertilizers obtained 163 kyats kg⁻¹ of maize grain in study area.

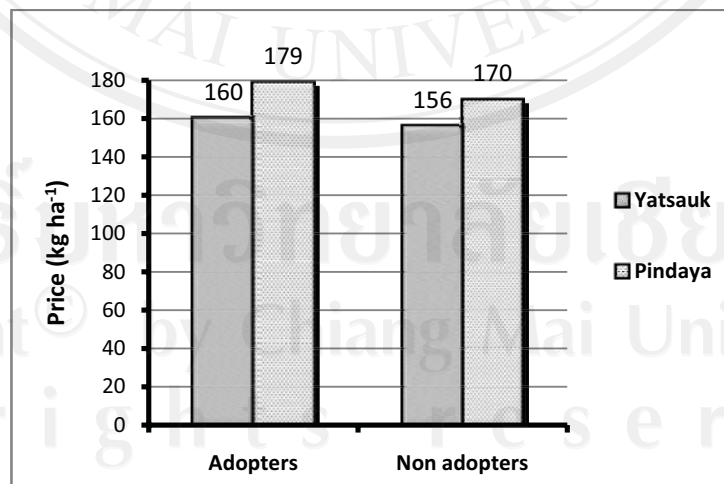


Figure 5.15 Average prices (kyats kg⁻¹) between adopters and non adopters in two townships.

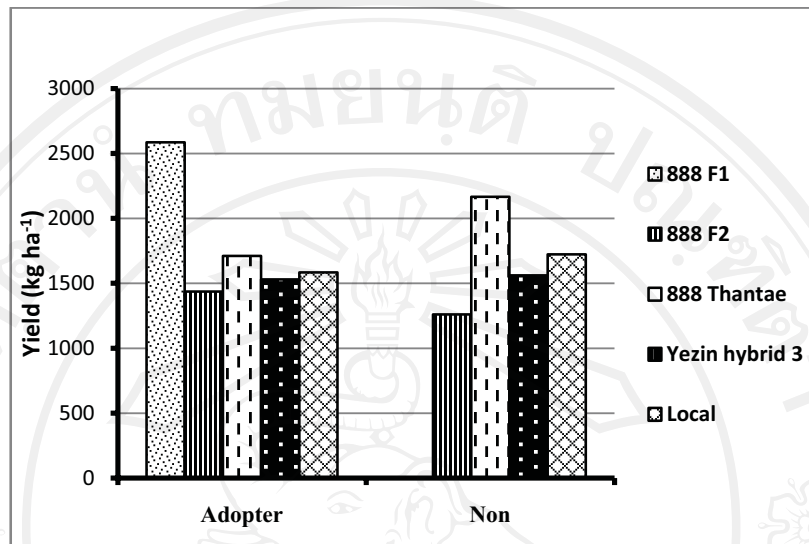


Figure 5.16 Average yields by different varieties between adopters and non adopters

Average yield of five different varieties varied between chemical fertilizer adopters and non adopters in the study area in Figure 5.16. In table 5.6, the chemical fertilizer non adopters did not use CPDK 888 F₁ variety in the study area but the chemical fertilizer adopters gained highest yield (2,585.5 kg ha⁻¹) when they used this variety. Although the average yield of Yezin hybrid 3 is not significantly different between adopters (1,530.8 kg ha⁻¹) and non adopters (1,561.6 kg ha⁻¹); the households who adopt chemical fertilizer by using CPDK 888 Thantae obtained lower yield (1,710.9 kg ha⁻¹) than the non adopters (2,166.9 kg ha⁻¹) according to the Figure 5.16. It may be due to the large amount of compost application in maize field by non adopters. It was mentioned by the cost of compost by different varieties between adopters and non adopters in Figure 5.17. Chemical fertilizer adopters spent a little for compost application but non adopters use much money for cost of compost especially in Yezin hybrid 3

variety. Then, non adopters did not spend money for compost in growing local maize variety. But in the point of view of the adopters for chemical fertilizers who used CPDK 888 F₂ variety, they gained higher gain yield (1,437.3 kg ha⁻¹) than non adopters (1,260.7 kg ha⁻¹) for chemical fertilizers. In general, households used CPDK 888 F₁ maize variety gained the highest yield among other households who used different varieties in the study area. Moreover, if households apply chemical fertilizer in maize field, they got the higher yield than the households who did not apply chemical fertilizer.

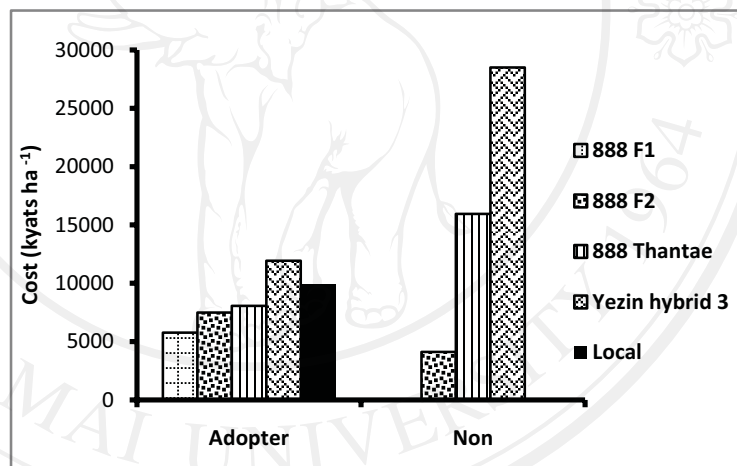


Figure 5.17 Average cost of compost (kyats ha⁻¹) by different varieties between adopters and non adopters

On average, maize grain prices varied within the range of 148 to 186 kyats per kilogram of maize grain by the households who use different maize varieties in the study area. In both chemical fertilizer adopters and non adopters, since the cost of production in CPDK 888 F₁ was highest (328,082.1 kyats ha⁻¹) among all other varieties; gross margin

of the households who use this variety was not the highest (179,114.6 kyats ha⁻¹). In non adopters, the households who used any variety spent fewer charges for cost of production but they got larger total revenue than the adopter households in table 5.8. Therefore, every non adopter's households got more profit than the adopters' households in the study area. Because the adopters apply low dosage of chemical fertilizers compared with the recommended fertilizer rate for study area and it was difficult to gain potential yield in maize production by using inadequate chemical fertilizer, then the adopters spent less money for compost application than non adopters. In these regards, the adopters got lower profit than non adopters although they use chemical fertilizers in maize field. Moreover, in terms of interest rate of adopters, it was more than non adopters who use any maize variety (Table 5.8). This was another reason of adopters gained less profit than non adopters.

Among non adopters, they gained the maximum profit by using CPDK 888 F₂ (163,859 kyats ha⁻¹) and local (160,697 kyats ha⁻¹) maize varieties. In case of chemical fertilizer adopters, the households who utilize CPDK 888 Thantae lose their profit although they gained gross margin because of highest interest rate and machinery cost among the adopters (Table 5.8). Figure 5.16 showed the gross margin between chemical fertilizer adopters and non adopters by using different maize varieties in the study area. By this figure, the growers using local and CPDK 888 Thantae varieties gained maximum gross margin while the gross margin was not significantly different between the adopters and non adopters using Yezin hybrid 3.

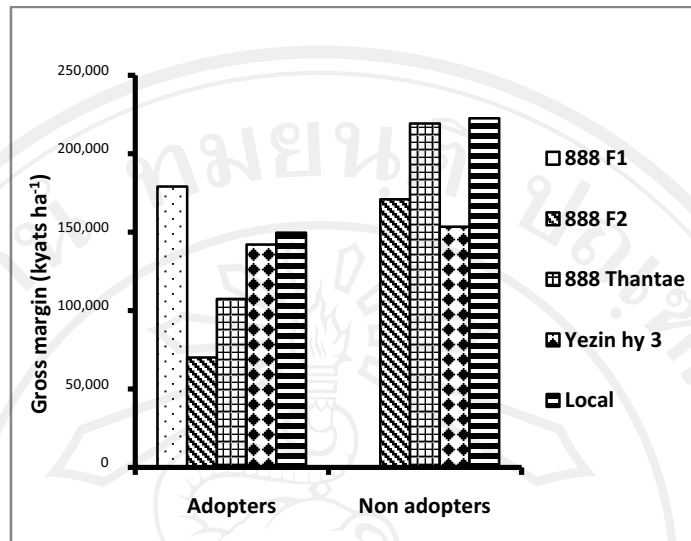


Figure 5.18 Gross margin (kyats ha⁻¹) by different varieties between adopters and non adopters.

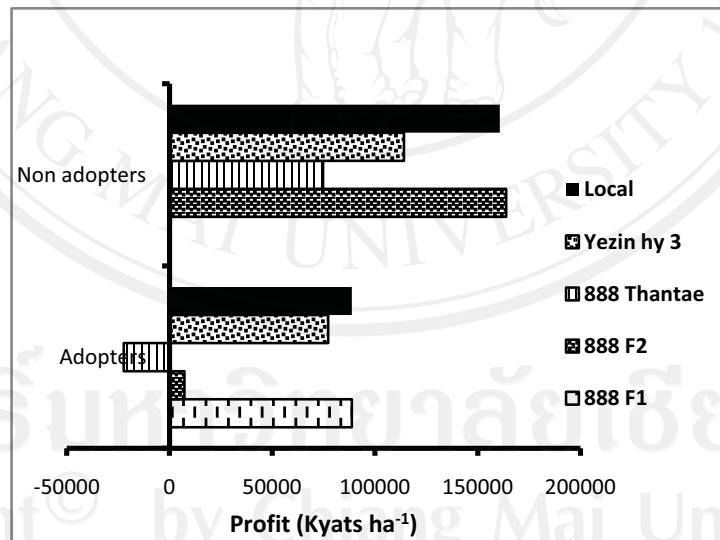


Figure 5.19 Profit (kyats ha⁻¹) by different varieties between adopters and non adopters.

Table 5.8 Gross margin between chemical fertilizer adopters and non adopters using different varieties.

	Adopters					Non adopters				
	888 F ₁	888 F ₂	888 Thantae	Yezin Hy 3	Local	888 F ₁	888 F ₂	888 Thantae	Yezin Hy 3	Local
Yield (kg ha ⁻¹)	2585.5	1437.3	1710.9	1530.8	1583.9	0	1260.7	2166.9	1561.6	1723.2
Price (ks kg ⁻¹)	161.2	159.8	174.4	182.2	164.8	0	186	148.4	178.2	168.0
Total revenue (ks ha ⁻¹)	416,782.6	229,680.5	298,380.9	278,911.8	261,026.7	0	234,490.2	321,567.9	278,277.1	289,497.6
Total cost (ks ha ⁻¹)	237,668.0	159,567.9	190,939.0	136,784.7	111,333.0	0	63,533.7	102,267.6	124,779.6	66,876.8
Gross margin (ks ha ⁻¹)	179,114.6	70,112.6	107,441.9	142,127.1	149,693.7	0	170,956.5	219,300.4	153,497.5	222,620.8
Family labor (opportunity cost) (ks ha ⁻¹)	43,500.3	45,294.0	49,859.7	52,783.8	59,354.1	0	576.8	52,766.6	38,821.4	52,557.6
Interest rate (ks ha ⁻¹)	43,772.3	17,590.2	74,395.1	11,694.3	1,642.6	0	6,519.9	91,811.0	553.4	9,366.2
Machinery (ks ha ⁻¹)	3,141.5	0	5,436.2	426.6	0	0	0	0	0	0
Total variable cost (ks ha ⁻¹)	328,082.1	222,452.1	320,630.0	201,689.4	172,329.7	0	70,630.4	246,845.2	164,154.4	128,800.6
Profit (ks ha ⁻¹)	88,700.5	7,228.4	-22,249.0	77,222.4	88,697.0	0	163,859.8	74,722.8	114,122.7	160,697.0
Total cost (ks kg ⁻¹)	127.4	154.8	187.4	131.8	110.7	0	56.0	113.9	105.1	74.7

Source: Survey data (2009)

Table 5.9 Gross margin between chemical fertilizer adopters and non adopters in two townships

Kyats ha ⁻¹	Yatsauk		Pindaya	
	Adopters	Non-adopters	Adopter	Non-adopters
Total revenue (kyats ha ⁻¹)	367,131	203,775	311,891	289,897
Total variable cost	215,171	76,611	165,042	126,785
Gross margin (kyats ha ⁻¹)	151,960	127,164	146,848	163,111
Gross margin by household who did not borrow money	189,313	127,164	156,919	217,867
Gross margin by household who borrowed money	119,286	-	130,623	114,798

Source: Survey Data (2009).

Even though the adopters in Yatsauk had higher total revenue (TR) than non adopters; they were not able to get high gross margin because of high cost of production for inputs and hired labor cost. In Yatsauk, every household adopter used borrowed money in maize production. Comparing to non adopters in Yatsauk townships, chemical fertilizer adopters obtained higher gross margin but they could get higher gross margin if they used their own money instead of borrowed money for maize production as shown in Table 5.9. If a household had to apply loans to purchase fertilizer and when the interest rate was high, fertilizer use may not be profitable.

5.4 Sensitivity analysis

In the year 2008, weather condition was abnormal especially in annual rainfall (Figure 4.1 and 4.8). In 2007, the weather was normal condition that affects the yield of maize to get higher profit. In Figure 5.20, yields were very different between two years and in 2007-08, every household got higher yield than the households in year 2008-09.

On average, every household in 2007-08 got 1 ton ha^{-1} more than the households who used same varieties in 2008-09. The households who use CPDK 888 F₁ gained their yield of 3,164.55 kg ha^{-1} in 2007-08 but survey year of 2008-09, households who use same variety got yield of 2,585.52 kg ha^{-1} in 2008-09.

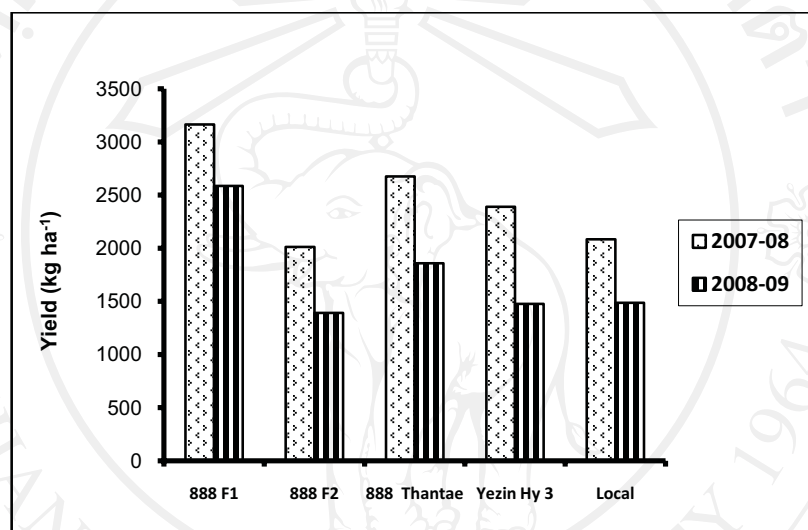
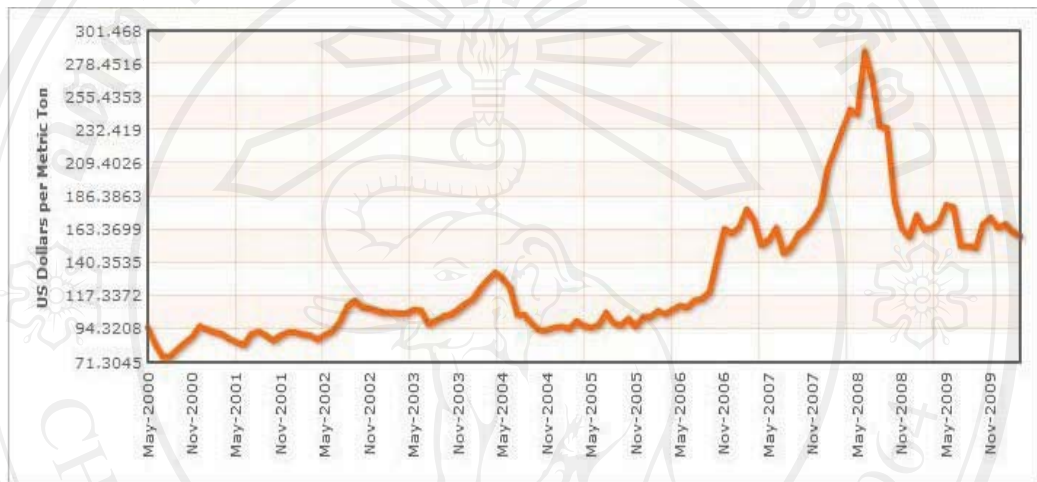


Figure 5.20 Average yields (kg ha^{-1}) by different varieties in 2007-08 and 2008-09.

In terms of average price, the households got the high price per kilogram of maize grain in 2007-08 (Figure 5.21) compared with the households in 2008-09 survey year. In Figure 5.21, it shows the world price of maize in 2000 to 2009. According to this figure, the price of maize was highest in November 2007 to May 2008 but it decreased in November 2008 to May 2009. This price fluctuation affected the price of maize in the study area. In 2007-08, households got higher price in maize due to the world price of

maize. In addition, the average price of maize in 2008-09 was lower than the price in 2007-08; and the range was between 161 to 180 kyats kilogram⁻¹ of maize and 205 to 225 kyats kilogram⁻¹ of maize in 2008-09 and 2007-08 respectively.



Source: <http://www.indexmundi.com/commodities/?commodity=corn&months=120>

Figure 5.21 World maize prices in 2000 to 2009.

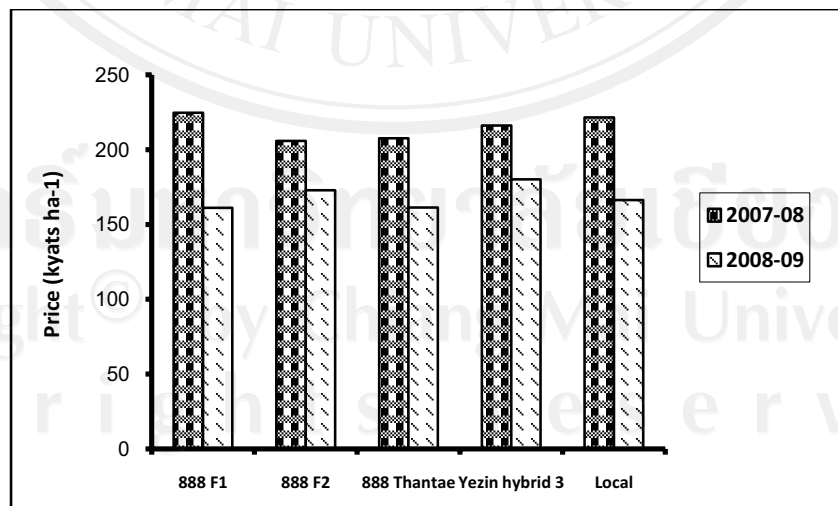


Figure 5.22 Average prices (kyats ha⁻¹) by different varieties in 2007-08 and 2008-09.

For CPDK 888 F₁ farmers, when total costs are constant and the yield (3,164.55 kg ha⁻¹) and the price (224.7 kyats ha⁻¹) change instead of yield (2,585.52 kg ha⁻¹) and the price (161.2 kyats ha⁻¹) in 2008-09 according to the figure 5.18 and 5.20; the profitability will be changed according to the Figure 5.23. The profitability (348,604 kyats ha⁻¹) in 2007-08 will increase four times higher than the profitability (87,523 kyats ha⁻¹) in 2008-09.

When total costs are constant and according to the change in yield and price in 2007-08 by the households who grow CPDK 888 F₂ variety (Figure 5.20 and 5.22); the profitability (227,165 kyats ha⁻¹) in 2007-08 will rise four times higher than the profitability (52,015 kyats ha⁻¹) in 2008-09.

At the same condition, by using CPDK 888 Thantae variety, households will profit more in 2007-08 than in 2008-09 if the yield and price are 2,676.14 kg ha⁻¹ and 207.6 kyats kg⁻¹ respectively. This profit (267,224 kyats ha⁻¹) also increases ten times higher than the profit (26,253 kyats ha⁻¹) in last year.

Similarly, the households who use Yezin hybrid 3 variety will get the higher profit if they catch the higher yield (2,389.53 kg ha⁻¹) and higher price (216.2 kyats kg⁻¹) according to the year 2007-08. Therefore, these households in 2007-08 will profit three times higher than the households in 2008-09.

For the households used local maize variety, if every cost of productions is constant and the price (221.6 kyats kg⁻¹) and yield (2,084.06 kg ha⁻¹) change by the year 2007-08 data, the profitability will be different and the households will gain three times higher than the households in 2008-09 survey year.

Therefore, if households get high yield and high price as the year 2007-08, they will profit by growing maize in the study area. Among them, the households who apply CPDK 888 F₁ variety gained more profit than the households who use other varieties as CPDK 888 F₂, CPDK 888 Thantae, Yezin hybrid 3 and local maize.

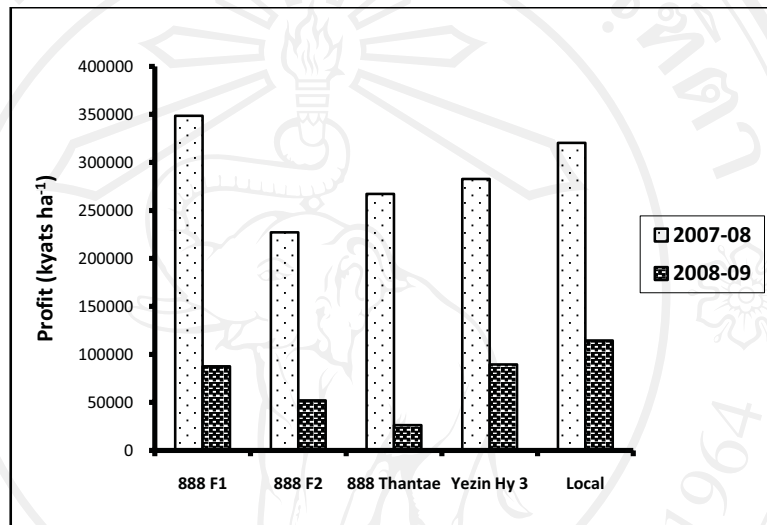


Figure 5.23 Profitability (kyats ha⁻¹) by different varieties in 2007-08 and 2008-09.

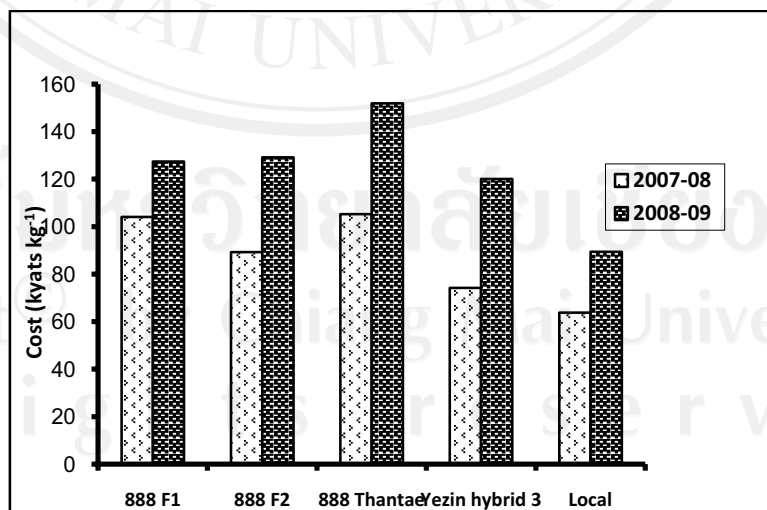


Figure 5.24 Average cost (kyats kg⁻¹) of maize in 2007-08 and 2008-09.

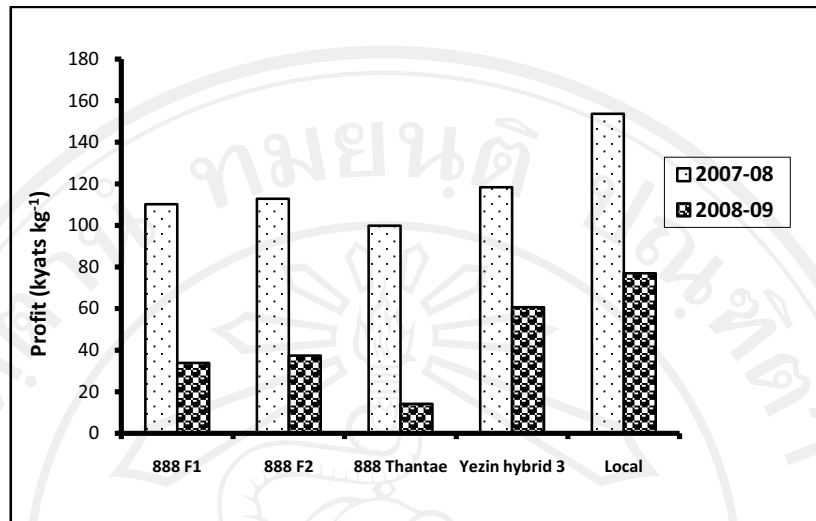


Figure 5.25 Profit (kyats kg⁻¹) of maize in 2007-08 and 2008-09.

Average cost of production per kilogram and profit per kilogram of maize grain by different varieties can be seen in Figure 5.24 and 5.25 respectively in 2007-08 and 2008-09. In 2008-09, every household had more cost of production than the households in 2007-08 within the range of 89.4 to 151.9 kyats kg⁻¹ and 63.8 to 105.3 kyats kg⁻¹ respectively. In addition, average profit per kilogram of maize was higher in every household who use different varieties in 2007-08 than the households in 2008-09 within the range of 99.6 to 153.7 kyats kg⁻¹ and 14.1 to 76.9 kyats kg⁻¹ respectively.

On the other hand, households will get more profit of 664,430 kyats ha⁻¹ if they use recommended fertilizer rate in the study area compared with the households who did not use recommended fertilizer rate (324,389 kyats ha⁻¹) as shown in Table 5.10. The households who used recommended chemical fertilizer rate achieved the profit of 2 times higher than the households who did not use recommended fertilizer rate in the study area in Figure 5.26. Therefore, if households apply enough chemical fertilizer as

recommended rate to their maize field, they will get the highest potential yield and gain more profit than the households who did not follow the adequate chemical fertilizer in maize field.

Table 5.10 Profitability between different chemical fertilizer rates in the study area

	Yield (kg ha ⁻¹)	Price (kyats kg ⁻¹)	Total revenue (kyats ha ⁻¹)	Total cost of production (kyats ha ⁻¹)	Profitability (kyats ha ⁻¹)
Recommended fertilizer rate	6,175.1	215.0	1,327,625.0	663,195.0	664,430.0
Farmers' rate	2,465.5	215.0	534,389.0	206,179.0	324,389.0

Source: Survey data (2009) and MAS annual report, Taunggyi, Southern Shan State (2009)

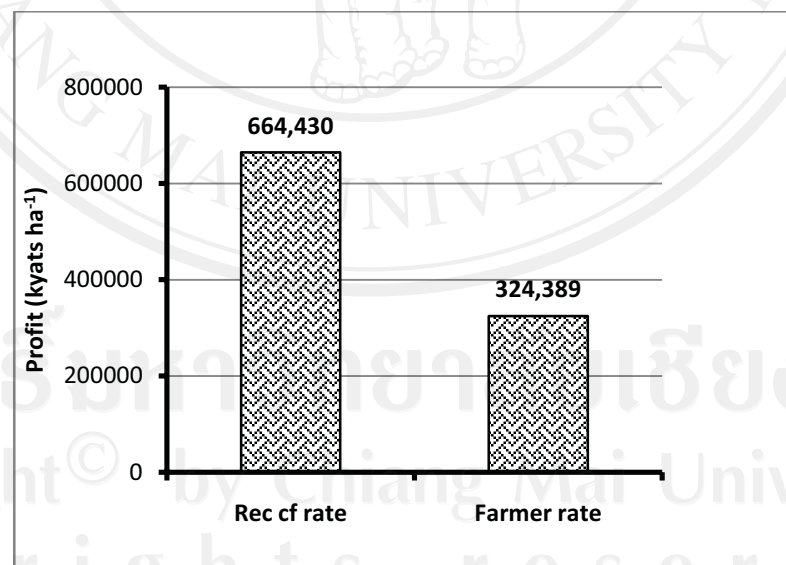


Figure 5.26 Profitability (kyats ha⁻¹) between different fertilizer rates used by households in the study area

5.5 Summary

Households used five kinds of maize variety in maize production but costs of seed were different in case of CPDK 888 because of farmers' choice of seed price. Average cost of production in maize varied according to the variety of 89.4, 120.1, 127.4, 129.2 and 151.9 kyats kg⁻¹ of maize grain in local, Yezin hybrid 3, CPDK 888 F₁, CPDK 888 F₂ and CPDK 888 Thantae variety respectively. If weather condition is normal and when households get high price because of world price, the households who use CPDK 888 F₁ will gain more profit than the households who use other varieties. At that time, if farmers apply enough chemical fertilizer as recommended fertilizer rate, they will get highest potential yield and gain profit 2 times higher than the farmers who did not use recommended fertilizer rate.

Average cost of production in maize varied from 119.72 kyats kg⁻¹ to 149.15 kyats kg⁻¹ of maize grain in study area regarding with households who did not borrow money and households who borrowed money respectively. There were different cost of production and also various gross margin between chemical fertilizer adopters and non adopters by using different maize varieties. Households had high interest rate for their loan. Cost of production included 33 percent of input and 53.5 percent of labor and other machinery cost but interest was 13.5 percent in study area. The most profitable region was created in Yatsauk that is 16 percent higher than Pindaya because of high yield and price. Comparing to non adopters in Yatsauk townships, chemical fertilizer adopters obtained higher gross margin but they could get higher gross margin if they used their own money instead of borrowed money for maize production.