CHAPTER V
PROFITABILITY OF MAIZE PRODUCTION

This chapter aims to examine the profitability of local and hybrid maize varieties. So, it discusses the farmers' input use and cost, followed by profitability and sensitivity analysis for each data set and a summary of the empirical results. This study was divided in to two conditions: rainfed and irrigated conditions. For each condition, it was divided in to two types of maize output: selling maize as dry and fresh ears. The sample included 40 farmer households, who planted local maize varieties (35 of them planted y
ellow maize and the other 5 planted white maize) and the other 40 farmer households planted hybrid maize varieties (20 of them planted yellow maize in rainfed condition, 15 planted yellow maize in irrigated condition, and the other 5 planted write maize in irrigated condition).

5.1 Yield of local and hybrid maize varieties

Yield of maize production in the study area varied with the type of maize varieties and conditions (Rainfed or irrigated) under which it is grown. Maize growers under rainfed condition, did not apply any chemical fertilizer on local maize varieties and did it with the average of 25 kg/ha on hybrid maize varieties. Under irrigated condition, hybrid maize growers applied chemical fertilizers at the rate of 300 kg/ha. From looking at the Figure 5.1, it is recognized that the average yield for hybrid maize varieties under irrigated condition was the highest at 6,995 kg/ha. It was 1.7 times more than hybrid maize varieties under rainfed condition and 4.1 times more than local maize varieties.

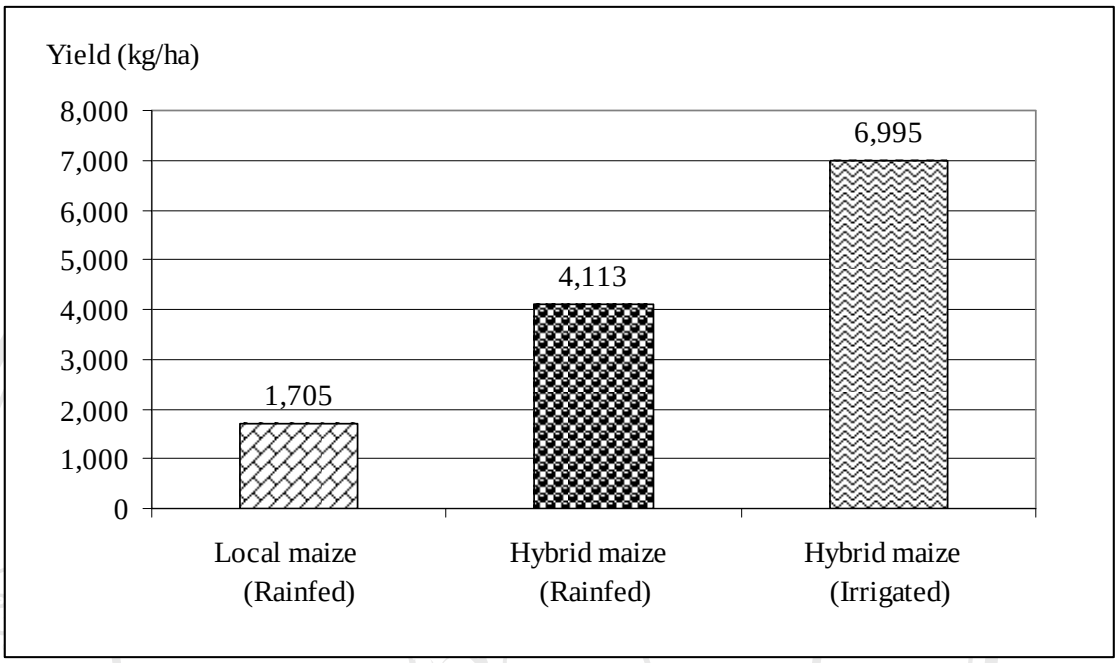

Figure 5.1 Yield of local and hybrid maize varieties in study area

Source: Survey, 2004

5.2 Input use and cost analysis

5.2.1 Input use

There are different production practices in local and hybrid maize production. Table 5.1 shows that costs of production of maize as regard to seed, fertilizer, pesticide, planting, fertilizer and pesticide applications, weeding, husking, transportation, drying, and other cost being significantly different at 1 per cent, and land preparation, harvesting, and shelling at 10 per cent between two maize types.

Seeds, chemical fertilizers, pesticides are the main inputs used in maize production. The amount of seed used per unit of land differs according to cultivation techniques and varieties. Local maize farmers use 30-35 kg/ha of seed. It is about 15,279 Riel/ha as shown in Table 5.1. While hybrid maize farmers use 20-25 kg/ha of seed (171,600 Riel/ha). The most popular fertilizers used in maize production were

Urea and 15:15:15 fertilizer. Local maize farmers apply neither fertilizer nor pesticide for their maize production. While hybrid maize farmers do apply fertilizers and pesticides, but application is restricted poorly growing areas. Table 5.1 shows the average cost of chemical fertilizer used in rainfed condition 31,525 Riel/ha (25kg/ha). Table 5.2 shows the average cost of chemical fertilizer used in irrigated condition 399,033 Riel/ha (250-300 kg/ha). Majority of the sample farmers in the study area employed insecticides and herbicides for the crop protection. Fungicide application is not so prevalent. Pesticide cost is 36,800 Riel/ha for hybrid maize in rainfed conditions (Table 5.1), which is less than 107,162 Riel/ha (Table 5.2) for irrigated conditions.

Land preparation referred here is the opportunity cost or the hired cost for using tractors or oxen for land tillage. Cost of land preparation for local maize is 187,143 Riel/ha (Table 5.1), it is higher than hybrid maize in rainfed condition (166,000 Riel/ha) in 10% level of significant. Land preparation for local maize is generally done 3 times: twice for ploughing and once for hilling up. Land for hybrid maize in rainfed condition is prepared twice without hilling up. For irrigated condition, land preparation of hybrid maize is done once or twice. That is why its cost is a little lower than that in rainfed conditions (Table 5.2).

There is significant difference between planting cost of local and hybrid maize as shown in Table 5.1. On the average, 10 mandays per ha (50,000 Riel/ha) are needed to plant hybrid maize in rainfed condition, while local maize need 2 to 3 maindays per ha, mostly 2 maindays per ha with the average cost 11,429 Riel/ha. Comparing cost of planting of hybrid maize in rainfed and irrigated condition (Table 5.2), there is significant difference between two types of maize production because of hired labor cost in the irrigated area (6,000 Riel/day) is higher than that in rainfed areas (5,000 Riel/day). On the average (Table 5.2), hybrid maize in irrigated condition need 12 mandays per ha (72,000 Riel/ha) to plant the maize crop.

Table 5.1. Cost of local and hybrid maize varieties in rainfed condition and sold as dry grain

Items	Local Maize (Riel/ha) (N=35)	Hybrid Maize (Riel/ha) (N=20)	Prob.
Seed	15,312	171,600	.000***
Fertilizer	0	31,525	.000***
pesticide	0	36,800	.000***
Land preparation	187,143	166,000	.059*
Planting	11,429	50,000	.000***
Apply fertilizer	0	5,000	.000***
Apply pesticide	0	26,800	.000***
Weeding	89,722	149,725	.000***
Harvesting	45,429	50,500	.071*
Transportation	27,285	42,850	.000***
Husking	41,917	102,650	.000***
Shelling	46,553	36,130	.099*
Drying	12,714	22,750	.000***
Other	114,373	35,358	.000***
Total	591,877	927,688	.000***

Note: * Significant at 10% level, *** Significant at 1% level

Other cost of local maize: Cost of thinning plants, hilling up, and interest of operating cost

Other cost of hybrid maize: Cost of replanting, hilling up, and interest of operating cost

1US$ = 4,075 Riel (March 2005)

Table 5.2 Cost of hybrid maize varieties in rainfed and irrigated condition and sold as dry grain

Items	Hybrid Rainfed condition (Riel/ha) (N=20)	Hybrid Irrigated condition (Riel/ha) (N=15)	Prob.
Seed	171,600	181,667	.419^{NS}
Fertilizer	31,525	399,033	.000***
pesticide	36,800	107,162	.000***
Land preparation	166,000	146,667	.204 ^{NS}
Planting	50,000	72,000	.000***
Irrigation	0	694,033	.000***
Apply fertilizer	5,000	64,000	.000***
Apply pesticide	26,800	52,400	.002***
Weeding	149,725	33,600	.000***
Harvesting	50,500	69,000	.000***
Transportation	42,850	78,533	.000***
Husking	102,650	205,240	.000***
Shelling	36,130	58,420	.000***
Drying	22,750	0	.000***
Other	35,358	61,265	.000***
Total	927,688	2,223,020	.000***

Note: ^{NS} Not significant level, *** Significant at 1% level

Other cost of hybrid maize in rainfed condition: Cost of replanting, hilling up, and interest of operating cost

Other cost of hybrid maize in irrigated conditon: Cost of replanting, and interest of operating cost

1US$ = 4,075 Riel (March 2005)

Cost of harvesting of hybrid maize in Table 5.1 is 50,500 Riel/ha, which is higher than that of local maize (45,429 Riel/ha) in 10% significant level. But it is lower in irrigated condition with 1% of significant level (Table 5.2). The cost variation depend on amount of its yields and higher number of labor is needed to load trucks with ears of maize if the yields are high.

On the average, local maize farmers incur a total cost of weeding of 89,722 Riel/ha, compared to 149,725 Riel/ha (Table 5.1) for hybrid maize in rainfed condition and 33,600 Riel/ha for hybrid maize in irrigated condition (Table 5.2). Hybrid maize farmers in rainfed condition tend to weed manually than applying herbicides, while hybrid maize farmers in irrigated condition tend to apply herbicides instead of weeding.

Husking is generally done manually. It takes 5 to 6 mandays per ton of maize grain a day to do it. Their cost variation depends on amount of the yield. On the average, cost of husking of local maize is 41,917 Riel/ha, compared to 102,650 Riel/ha for hybrid maize in rainfed condition (Table 5.1) and 205,240 Riel/ha for hybrid maize in irrigated condition (Table 5.2).

Shelling is done manually or by machine. Some of smallholders shell maize manually as they have small quantity and larger farmers shell by machine. On the average, one person can shell manually with knife 100 kg of maize grain per day. For local maize farmers, the cost of shelling averaged 46,553 Riel/ha, which is higher than 36,130 Riel/ha (Table 5.1) and lower than 58,420 Riel/ha (Table 5.2) for hybrid maize in rainfed and irrigated conditions, respectively.

Drying cost includes only the cost of storing maize ears from the ground floor to the first floor of their house. Because farmers generally keep it as whole ears after husking it if they do not want to sell it immediately after harvesting. Cost of drying for local maize is 12,714 Riel/ha compared to 22,750 Riel/ha for hybrid maize in rainfed condition (Table 5.1). Hybrid maize in irrigated condition do not have any cost of drying because those output are sold immediately after harvesting 4-6 days (Table 5.2). Other cost includes cost of thinning plants, hilling up, and interest of operating cost for local maize and cost of replanting, hilling up (For rainfed condition), and interest of operating cost for hybrid maize. For local maize, other cost averaged 114,373 Riel/ha compared to 35,358 Riel/ha for hybrid maize in rainfed conditions (Table 5.1) and 61,265 Riel/ha in irrigated conditions (Table 5.2).

5.2.2 Cost analysis of local and hybrid maize varieties in study area

There are five types of maize production under rainfed and irrigated conditions in the study. For rainfed condition, there are three types of maize production: local maize production sold as dry grain, local maize production sold as fresh ears, and hybrid maize production and sold as dry grain. For irrigated conditions, there are two types of maize production: hybrid maize sold as dry grain and hybrid maize sold as fresh ears. Figure 5.2 shows that the highest total cost of the maize production mentioned above is for hybrid maize sold as dry grain under irrigated condition (2,223,020 Riel/ha) with a difference of 1.2 times over hybrid maize sold as fresh ear under irrigated condition, 2.4 times over the hybrid maize sold as dry grain under rainfed condition, 3.8 times over local maize sold as dry grain, and 4.4 times over local maize sold as fresh ears. There are no significant difference between cost of hybrid maize production sold as dry grain and fresh ear under irrigated condition and between local maize sold as dry grain and fresh ears under rainfed condition.

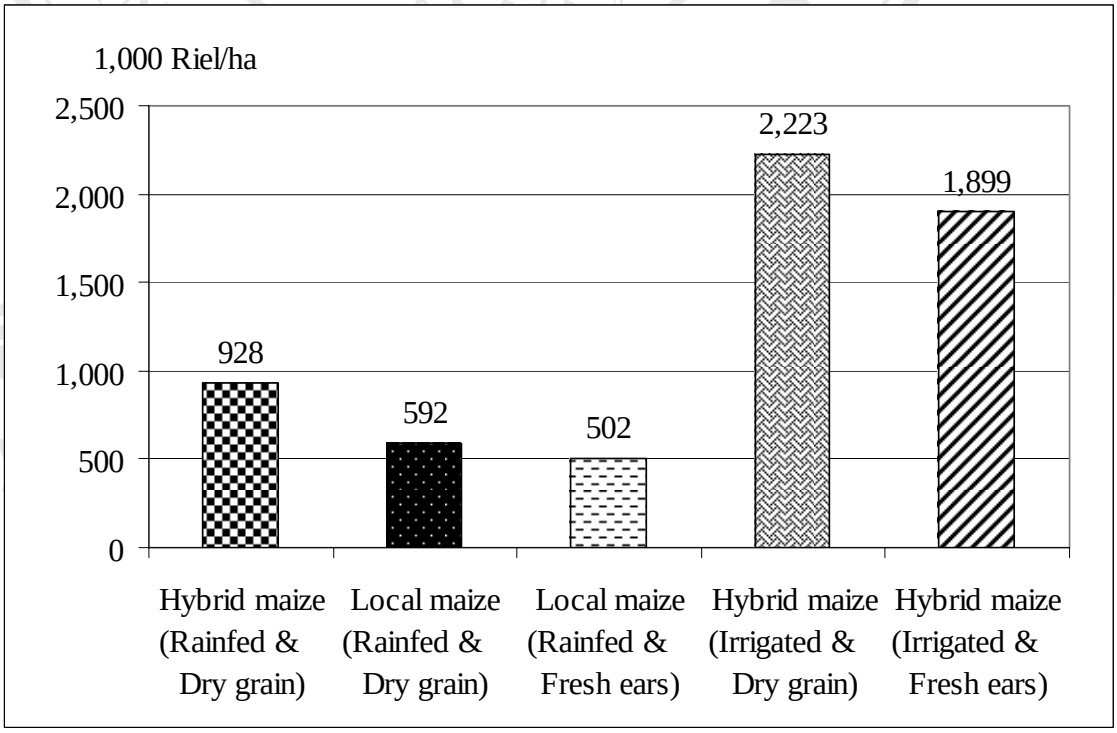

Figure 5.2 Total cost of local and hybrid maize varieties in study area

We can see in detail different costs associated with maize production in Figure 5.3. Total cost of maize production in the study consist three main costs of maize production: input cost, hired labor cost and family labor cost. Input cost includes cost of seeds, fertilizers, insecticide, fungicide and herbicide. Hired labor cost consists of land preparation, hired labor, irrigation, hilling up and transportation. Family cost is opportunity cost at the wage rate of 5,000-6,000 Riel/day.

Figure 5.3 indicates that the highest input cost is hybrid maize sold as dry grain under irrigated condition (687,862 Riel/ha) with a difference of 2.9 times over hybrid maize sold as dry grain under raifed condition, 45 times over local maize sold as dry grain, and 24 times over local maize sold as fresh ears. There is no significant difference between hybrid maize sold as dry grain and fresh ears under irrigated condition.

The highest hired labor cost is hybrid maize sold as dry grain under irrigated condition with a difference of 1.2 times over hybrid maize sold as fresh ears under the same condition, 3.5 times over hybrid maize sold as dry grain under rainfed condition, 3.8 times over local maize sold as dry grain, and 4.1 times over local maize sold as fresh ears.

The highest cost of family labor cost is hybrid maize sold as dry grain under irrigated condition with a difference of 1.6 times over hybrid maize sold as fresh ears under the same condition, 1.3 times over local maize sold as dry grain, and 1.9 times over local maize sold as fresh ears. There is no significant difference of family labor cost of hybrid maize sold as dry grain under irrigated condition and rainfed condition.

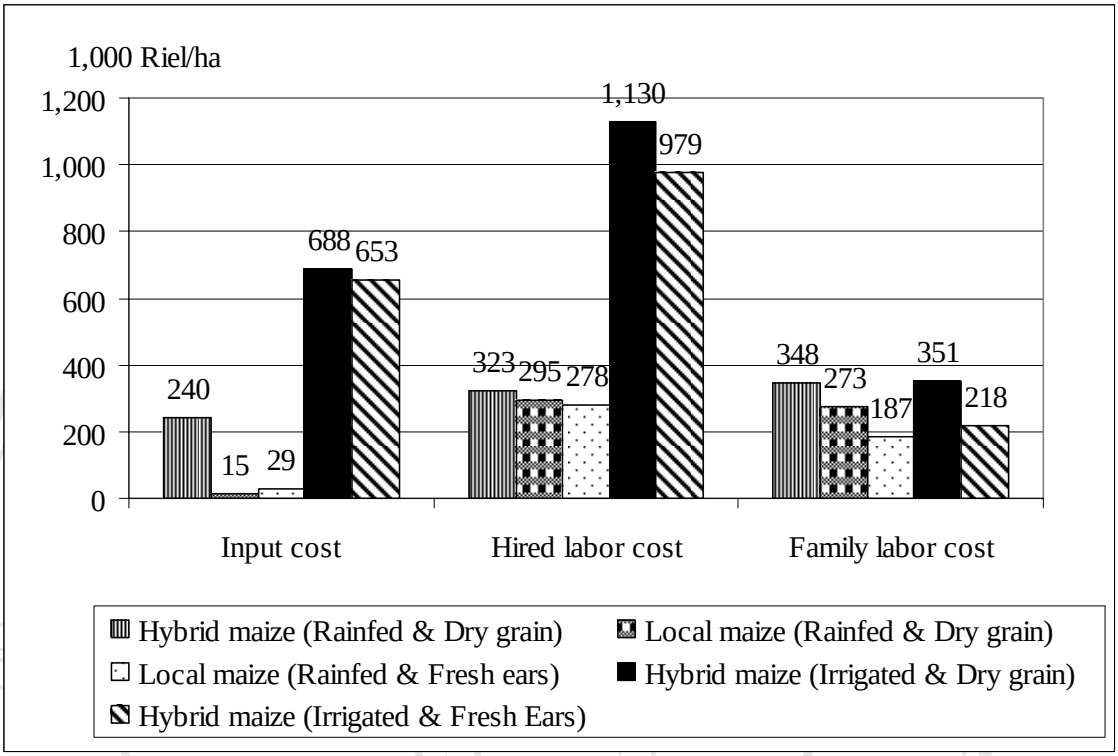

Figure 5.3 Input, hired labor, and family labor costs of local and hybrid maize varieties

Note:

- Input Cost: Cost of seeds, fertilizers, insecticides, fungicides and herbicides
- Hired Labor Cost: Land preparation, hired labor, irrigation, hilling up and transportation
- Family Labor Cost: Opportunity cost at the wage rate of 5,000 – 6,000 Riel/day

5.3 Profitability analysis

This section deals with the economics of production of local and hybrid maize varieties. The purpose is to investigate the profitability of both groups of maize growers based on types of outputs and varieties. It was divided in to two sections for this study: one is before including other income from corncob and thinned plants and the other one is after so doing.

5.3.1 Return to gross margins of local and hybrid maize varieties

Return to gross margin (GM) in the study is defined as a difference of gross income and total variable cost. Figure 5.4 shows that hybrid maize varieties sold as fresh ears under irrigated condition provided the highest gross margin (1,001,052 Riel/ha). Before including other income from corncob and thinned plants, it is 1.5 times over hybrid maize sold as dry grain under rainfed condition, 4.5 times over local maize sold as dry grain, and 3.6 times over local maize sold as fresh ears. It is no significant difference between gross margin of hybrid maize sold as fresh ears and sold as dry grain under the same condition. The gross margin of hybrid maize sold as fresh ears under irrigated condition did not have any addition income from corncob and thinned plats. Anyway, it is still the highest gross margin after including that of comparing to the other with a difference of 1.4 times over hybrid maize sold as dry grain under rainfed condition, 2.4 over local maize sold as dry grain, and 1.9 times over local maize sold as fresh ears.

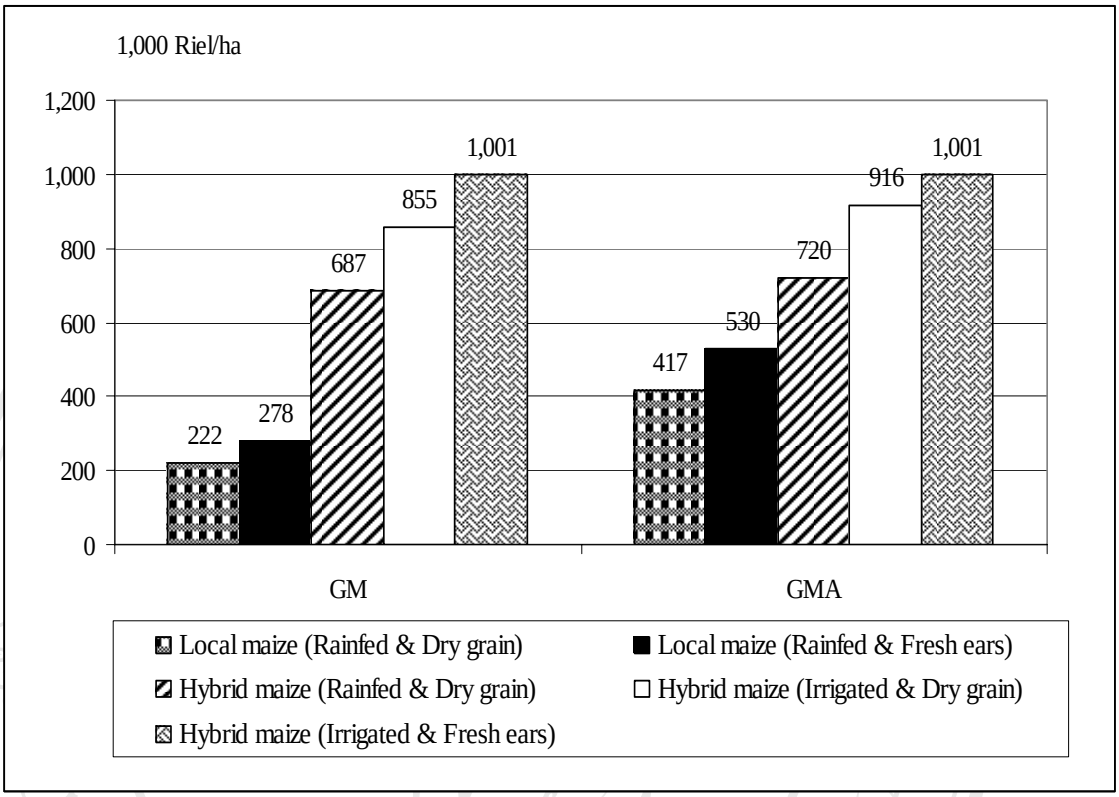

Figure 5.4 Return to gross margins of local and hybrid maize varieties

Note:

- GM: gross margin without addition of other income from corncob and thinned plants
- GMA: gross margin with addition of other income from corncob and thinned plants
- 1US$ = 4,075 Riel (March 2005)

5.3.2 Return to family land, labor, and management (RFLLM) of local and hybrid maize varieties

There are no significant differences between return to family land, labor, and management (RFLLM) of hybrid maize sold as fresh ears and dry grain under irrigated condition and between local maize sold as fresh ears and dry grain under rainfed condition in both sections (before and after including other income from corncob and thinned plants). Figure 5.5 shows that before including other income from that of, hybrid maize sold as fresh ears under irrigated condition provided the highest return to RFLLM with a difference of 1.2 times over hybrid maize sold as dry grain under rainfed condition, 2.5 times over local maize sold as dry grain, and 2.6 times over local maize sold as fresh ears. After including other income from corncob and thinned plants, the highest return to family land, labor, and management (RFLLMA) is hybrid maize sold as dry grain under irrigated condition with a difference of 1.2 times over hybrid maize sold as dry grain under irrigated condition, 2.4 times over local maize sold as dry grain, and 2.6 times over local maize sold as fresh ears.

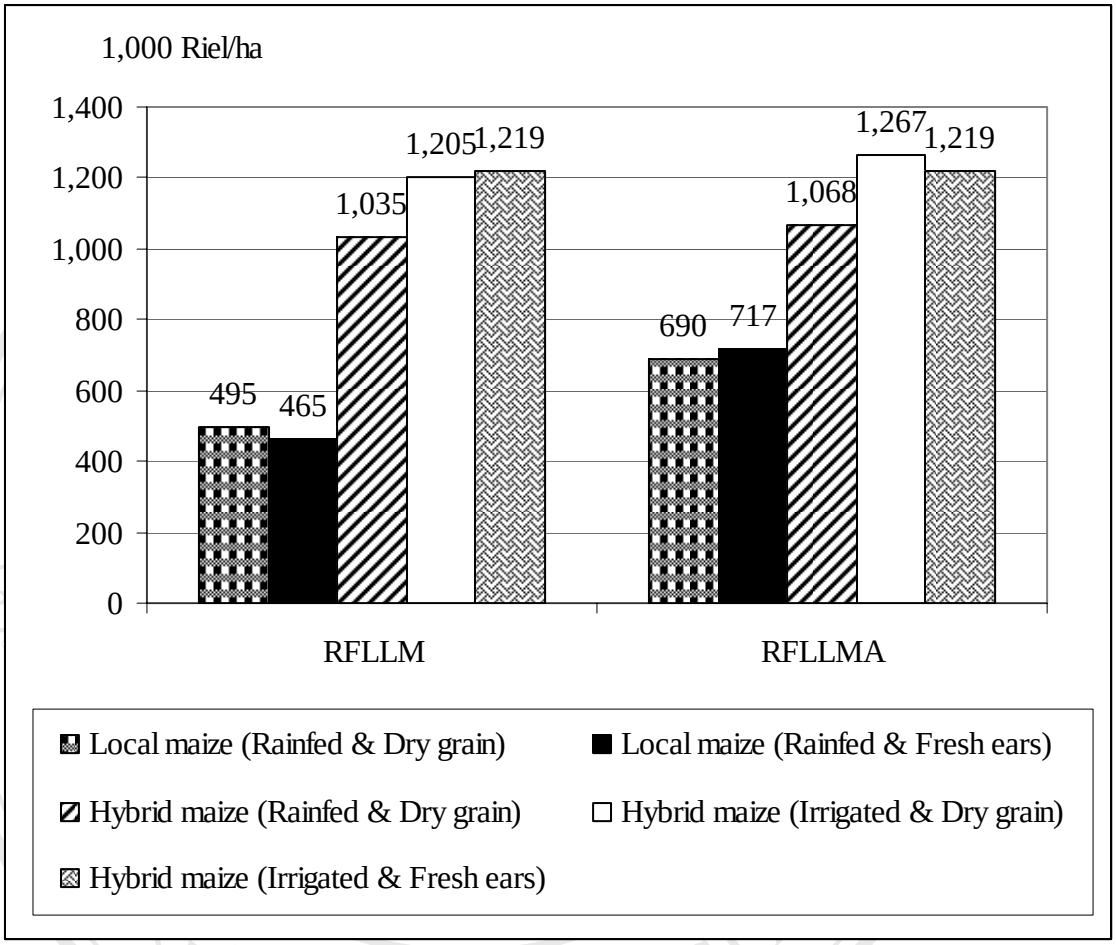

Figure 5.5 Return to family land, labor, and management of local and hybrid maize varieties

Note:

- RFLLM: Return to family land, labor, and management without addition of other income from corncob and thinned plants
- RFLLMA: Return to family land, labor, and management with addition of other income from corncob and thinned plants
- 1US$ = 4,075 Riel (March 2005)

5.3.3 Return to family land, labor, and management per day (RFLLMD) of local and hybrid maize varieties

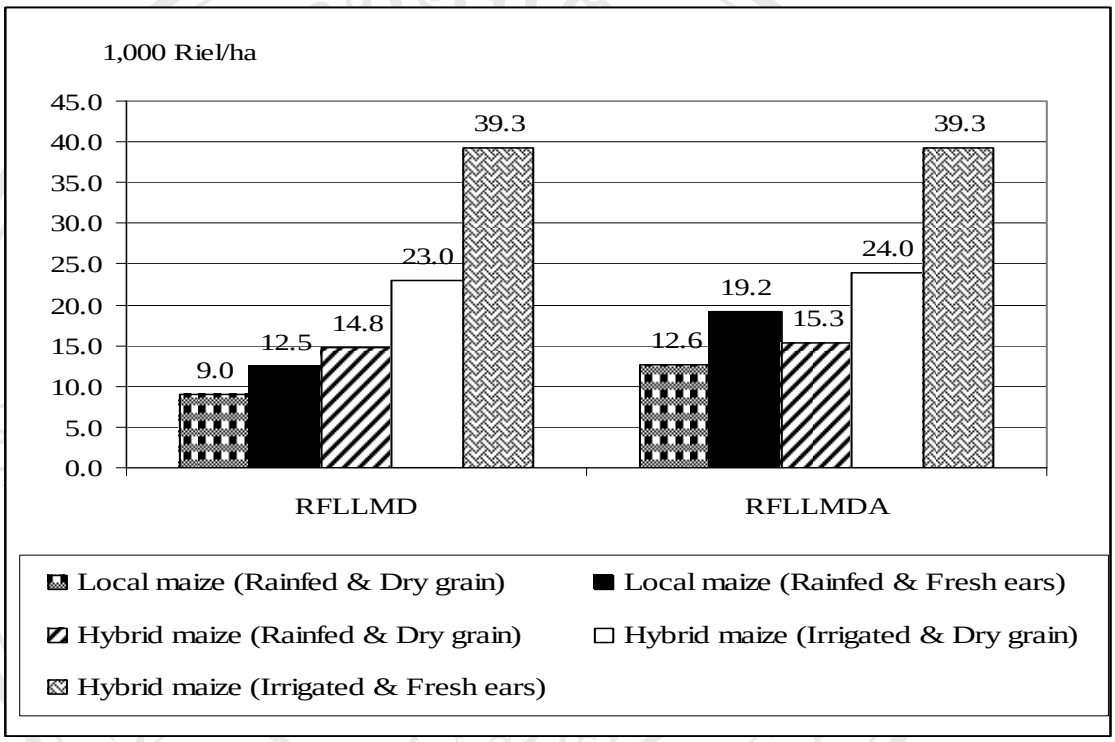

Figure 5.6 Return to family land, labor and management per day of local and hybrid maize varieties

Note:

- RFLLMD: Return to family land, labor, and management per day without addition of other income from corncob and thinned plants
- RFLLMDA: Return to family land, labor, and management per day with addition of other income from corncob and thinned plants
- 1US$ = 4,075 Riel (March 2005)

Figure 5.6 shows that hybrid maize sold as fresh ears under irrigated condition provided the highest return to family land, labor, and management per day in both sections (before and after including other income from corncob and thinned plants). Before including the other income, it is 1.7 times more than hybrid maize sold as dry grain under the same condition, 2.7 times more than hybrid maize sold as dry grain

under rainfed condition, 3.1 times more than local maize sold as fresh ears, and 4.4 times more than local maize sold as dry grain. After including the other income, it is still the highest one with a difference of 1.6 times over hybrid maize sold as dry grain under the same condition, 2.6 times over hybrid maize sold as dry grain under rainfed condition, 2 times over local maize sold as fresh ears, and 3.1 times over local maize sold as dry grain.

5.3.4 Comparison of local and hybrid maize varieties in rainfed condition and sold as dry grain

Various measures of costs and returns as shown in Table 5.3 are reported and presented below:

Revenue:

Yield, price and gross income: On average, local varieties obtained a yield of 1,704.7kg/ha (SD = 509.628) was lower than hybrid varieties, which obtained 4,113 kg/ha (SD = 809.815). Hybrid maize growers received an average price of 392.5 Riel/kg, while local maize growers received 477.1 Riel/kg. Local maize growers earned a gross income of 752,837 Riel/ha, which was lower than 1,614,353.0 Riel/ha by the hybrid maize growers. The gross income of local maize increased up to 1,008,760.8 Riel/ha after including other income from corncob and thinned plants, but it is still much lower than 1,647,257 Riel/ha by the hybrid maize after including other income from corncob.

Costs:

Total enterprise cost: For local maize growers, total enterprise cost averaged is equal to 591,877.5 Riel/ha, which consists of opportunity cost of input cost 2.6 per cent, hired labor cost 50 per cent, opportunity cost of equity capital 1.5 per cent and opportunity cost of family labor 46 per cent. While hybrid maize growers, total

enterprise cost averaged is equal to 927,688.7 Riel/ha, which consists of input cost 25.9 per cent, hired labor cost 35 per cent, opportunity cost of equity capital 1.8 per cent and opportunity cost of family labor 37.5 per cent.

Returns:

Average enterprise gross margin: For local maize growers is 221,528.4 Riel/ha (416,883.3 Riel/ha after including other income from corncob and thinned plants), it is lower than 686,663.7 Riel/ha by hybrid maize growers (719,567.8 Riel/ha after including other income from corncob).

Returns to family land, labor and management: For local maize growers averages at 494,528.4 Riel/ha compared to 1,034,663.8 Riel/ha for hybrid maize growers. After including the other income from corncob and thinned plants, return to family land, labor, and management of local maize increased up to 689,883 Riel/ha while hybrid maize increased up to 1,067,567.8 Riel/ha.

Return to family land, labor and management per day: For local maize grower averages at 9,057.4 Riel/day, while it is 14,865.9 Riel/day for hybrid maize growers. After including the other income from corncob and thinned plants, local maize farmer averages 12,635.2 Riel/day, while hybrid maize grower averages 15,338.6 Riel/day.

Table 5.3 Average yields, prices, costs and returns of local and hybrid maize in rainfed condition and sold as dry grain

Items	Local Maize (Dry grain) (N=35)	Hybrid Maize (Dry grain) (N=20)	Prob.
Revenue:			
Average yield (kg/ha)	1,704.7	4,113.0	.000***
Average price (Riel/kg)	477.1	392.5	.035**
(1) Gross income (Riel/ha)	752,837.1	1,614,353.0	.000***
Income from corncob (Riel/ha)	*13,637.9*	*32,904.0*	
Income from thinned plants (Riel/ha)	*242,285.7*	*0*	
(2) Total income (Real/ha)	*1,008,760.8*	*1,647,257.0*	*.000****
Costs:			
Input cost (Riel/ha)	15,278.6	239,925.0	.000***
Cost of equipment (Riel/ha)	0.0	0.0	
Hired labor cost (Riel/ha)	294,756.3	322,879.6	.101^{NS}
Opportunity cost of equity capital for 6 months (Riel/ha)	8,842.7	16,884.1	
Family labor			
(3) Number of family labor days/ha	54.6	69.6	
(4) Family labor cost (Riel/ha)	273,000.0	348,000.0	.003***
(5) Total enterprise cost (Riel/ha)	591,877.5	927,688.7	
Profitability measures			
(6) Enterprise gross margin (Riel/ha) [1-5]	221,528.4	686,663.7	.000***
(7) Return to family labor, land, and management (Riel/ha) [6+4]	494,528.4	1,034,663.8	.000***
(8) Return to family labor, land, and management per day (Riel/day) [7/3]	9,057.3	14,865.9	.000***
Profitability After including income from selling of corncob and thinned plants			
(9) Enterprise gross margin (Riel/ha) [2-5]	*416,883.3*	*719,567.8*	*.000****
(10) Return to family labor, land, and management (Riel/ha) [9+4]	*689,883.3*	*1,067,567.8*	*.000****
(11) Return to family labor, land, and management per day (Riel/day) [10/3]	*12,635.2*	*15,338.6*	*.054**

Note: NS: Not significant level, * Significant at 10% level

** Significant at 5% level, *** Significant at 1% level

- Opportunity cost of family labor was valued at the wage rate of 5,000 Riel/day

- Opportunity cost of equity capital was valuable at 6% of operating cost for 6 months

- 1US$ = 4,075 Riel (March 2005)

5.3.5 Comparison of local maize sold as fresh ears and hybrid maize sold as dry grain under rainfed condition

Various measures of costs and returns as shown in Table 5.4 are reported and presented below:

Revenue:

Gross income: On average, local maize growers earned a gross income of 780,000 Riel/ha, which was lower than 1,614,353.0 Riel/ha by the hybrid maize growers. The gross income of local maize increased up to 1,032,000 Riel/ha after including other income from thinned plants, but it is still much lower than 1,647,257 Riel/ha earned by the hybrid maize after including other income from corncob.

Costs:

Total enterprise cost: For local maize growers, total enterprise cost averaged is equal to 501,520 Riel/ha, which consists of 5.8 per cent being opportunity cost of input cost, 55.4 per cent being hired labor cost, 1.7 per cent being opportunity cost of equity capital and 37.2 per cent being opportunity cost of family labor. While hybrid maize growers, total enterprise cost averaged is equal to 927,688.7 Riel/ha, which consists of the opportunity cost of input cost 25.9 per cent, hired labor cost 35 per cent, opportunity cost of equity capital 1.8 per cent and opportunity cost of family labor 37.5 per cent.

Returns:

Average enterprise gross margin: For local maize growers is 278,480 Riel/ha (530,480 Riel/ha after including other income from thinned plants), it is lower than 686,663.7 Riel/ha earned by hybrid maize growers (719,567.8 riel/ha after including other income from corncob).

Return to family land, labor and management: For local maize growers averages at 464,980 Riel/ha compared to 1,034,663.8 Riel/ha for hybrid maize growers. After including the other income from thinned plants, return to family land, labor and management of the local maize increased up to 716,980 riel/ha while return to family land, labor and management of the hybrid maize increased up to 1,067,567.8 riel/ha.

Return to family land, labor and management per day: For local maize grower averages at 12,466 Riel/day, while it is 14,865.9 Riel/day for hybrid maize growers. After including the other income from corncob and thinned plants, local maize farmer averages 19,222 Riel/day, while hybrid maize grower averages 15,338.6 Riel/day.

Table 5.4 Average gross incomes, costs and returns of local maize sold as fresh ears and hybrid maize sold as dry grain in rainfed condition

Items	Local Maize (Fresh ears) (N=5)	Hybrid Maize (Dry grain) (N=20)	Prob.
Revenue:			
Average yield (kg/ha)	-	4,113.0	
Average price (Riel/kg)	-	392.5	
(1) Gross income (Riel/ha)	780,000.0	1,614,353.0	.000***
Income from corncob (Riel/ha)	*0.0*	*32,904.0*	
Income from thinned plants (Riel/ha)	*252,000.0*	*0*	
(2) Total income (Real/ha)	*1,032,000.0*	*1,647,257.0*	*.000***
Costs:			
Input cost (Riel/ha)	28,680.0	239,925.0	.000***
Cost of equipment (Riel/ha)	0.0	0.0	
Hired labor cost (Riel/ha)	278,000.0	322,879.6	.256^{NS}
Opportunity cost of equity capital for 6 months (Riel/ha)	8,340.0	16,884.1	
Family labor			
(3) Number of family labor days/ha	37.3	69.6	
(4) Family labor cost (Riel/ha)	186,500.0	348,000.0	.005***
(5) Total enterprise cost (Riel/ha)	501,520.0	927,688.7	
Profitability measures			
(6) Enterprise gross margin (Riel/ha) [1-5]	278,480.0	686,663.7	.003***
(7) Return to family labor, land, and management (Riel/ha) [6+4]	464,980	1,034,663.8	.001***
(8) Return to family labor, land, and management per day (Riel/day) [7/3]	12,466	14,865.9	.341^{NS}
Profitability After including income from selling of corncob and thinned plants			
(9) Enterprise gross margin (Riel/ha) [2-5]	*530,480.0*	*719,567.8*	*.145^{NS}*
(10) Return to family labor, land, and management (Riel/ha) [9+4]	*716,980.0*	*1,067,567.8*	*.023***
(11) Return to family labor, land, and management per day (Riel/day) [10/3]	*19,222.0*	*15,338.6*	*.109^{NS}*

Note: NS: Not significant level, ** Significant at 5% level, *** Significant at 1% level

- Opportunity cost of family labor was valued at the wage rate of 5,000 Riel/day
- Opportunity cost of equity capital was valuable at 6% of operating cost for 6 months
- 1US$ = 4,075 Riel (March 2005)

5.3.6 Comparison of local maize sold as dry grain and local maize sold as fresh ears under rainfed condition

Various measures of costs and returns as shown in Table 5.5 are reported and presented below:

Revenue:

Gross income: On average, local maize grower sold as fresh ears earned a gross income of 780,000 riel/ha (1,032,000 Rie/ha after including other income from thinned plants), which was higher than 752,837 Riel/ha (1,008,760.8 Riel/ha after including other income from corncob and thinned plants) by the local maize grower sold as dry grain.

Costs:

Total enterprise cost: Total cost of local maize farmers sold as fresh ears averages at 501,520 Riel/ha, while local maize farmer sold as dry grain averages at 591,877.5 Riel/ha.

Returns:

Average enterprise gross margin: For local maize farmers sold as fresh ears is 278,480 Riel/ha (530,480 Riel/ha after including other income from thinned plants), it is higher than 221,528.4 Riel/ha earned by hybrid maize farmers (416,883.3 riel/ha after including other income from corncob and thinned plants).

Return to family land, labor and management: For local maize farmer sold as fresh ears averages at 464,980 Riel/ha compared to 494,528.4 Riel/ha for local maize farmers sold as dry grain. After including other income from thinned plants, return to family land, labor and management of local maize increased up to 716,980 riel/ha

while return to family land, labor and management of local maize sold as dry grain increased up to 689,883 riel/ha.

Return to family land, labor and management per day: For local maize farmers sold as fresh ears averages at 12,466 Riel/day, while it is 9,057 Riel/day for loca maize farmers sold as dry grain. After including other income from thinned plants, local maize farmer sold as fresh ears averages 19,222 Riel/day, while local maize farmer sold as dry grain averages 12,635 Riel/day after including other income from thinned plants and corncob.

Table 5.5 Average gross incomes, costs and returns of local maize sold as dry grain and local maize sold as fresh ears in rainfed condition

Items	Local maize (Dry grain) (N=35)	Local maize (Fresh ears) (N=5)	Prob.
Revenue:			
Average yield (kg/ha)	1,704.7	-	
Average price (Riel/kg)	477.1	-	
(1) Gross income (Riel/ha)	752,837.1	780,000.0	.694^{NS}
Income from corncob (Riel/ha)	*13,637.9*	*0.0*	
Income from thinned plants (Riel/ha)	*242,285.7*	*252,000.0*	
(2) Total income (Real/ha)	*1,008,760.8*	*1,032,000.0*	
Costs:			
Input cost (Riel/ha)	15,278.6	28,680.0	.000***
Cost of equipment (Riel/ha)	0.0	0.0	
Hired labor cost (Riel/ha)	294,756.3	278,000.0	.366^{NS}
Opportunity cost of equity capital for 6 months (Riel/ha)	8,842.7	8,340.0	
Family labor			
(3) Number of family labor days/ha	54.6	37.3	
(4) Family labor cost (Riel/ha)	273,000.0	186,500.0	.009***
(5) Total enterprise cost (Riel/ha)	591,877.5	501,520.0	
Profitability measures			
(6) Enterprise gross margin (Riel/ha) [1-5]	221,528.4	278,480.0	.139^{NS}
(7) Return to family labor, land, and management (Riel/ha) [6+4]	494,528.4	464,980	.653^{NS}
(8) Return to family labor, land, and management per day (Riel/day) [7/3]	9,057.3	12,466	.013**
Profitability After including income from selling of corncob and thinned plants			
(9) Enterprise gross margin (Riel/ha) [2-5]	*416,883.3*	*530,480.0*	*.170^{NS}*
(10) Return to family labor, land, and management (Riel/ha) [9+4]	*689,883.3*	*716,980.0*	*.708^{NS}*
(11) Return to family labor, land, and management per day (Riel/day) [10/3]	*12,635.2*	*19,222.0*	*.005***

Note: NS: Not significant level, ** Significant at 5% level, *** Significant at 1% level

- Opportunity cost of family labor was valued at the wage rate of 5,000 Riel/day
- Opportunity cost of equity capital was valuable at 6% of operating cost for 6 months
- 1US$ = 4,075 Riel (March 2005)

5.3.7 Comparison of hybrid maize sold as dry grain and hybrid maize sold as fresh ears under irrigated condition

Various measures of costs and returns as shown in Table 5.6 are reported and presented below:

Revenue:

Gross income: On average, hybrid maize grower sold as dry grain earned a gross income of 3,077,653 Riel/ha, which was higher than 2,900,000 Riel/ha by the hybrid maize farmer sold as fresh ears. The gross income of hybrid maize sold as dry grain increased up to 3,139,206 Riel/ha after including other income from corncob, while hybrid maize sold as fresh ears do not have any other income.

Costs:

Total enterprise cost: For hybrid maize farmer sold as dry grain, total enterprise cost averaged is equal to 2,223,020 Riel/ha, which consists of input cost 31 per cent, hired labor cost 51 per cent, opportunity cost of equity capital 2.3 per cent and opportunity cost of family labor 15.7 per cent. While hybrid maize farmer sold as fresh ears, total enterprise cost averaged is equal to 1,898,948 Riel/ha, which consists of the input cost 34 per cent, hired labor cost 51.5 per cent, opportunity cost of equity capital 2.6 per cent and opportunity cost of family labor 11.5 per cent.

Returns:

Average enterprise gross margin: For hybrid maize farmer sold as dry grain is 854,633.4 Riel/ha (916,186.5 Riel/ha after including other income from corncob), it is lower than 1,001,052 Riel/ha by hybrid maize farmer sold as fresh ears.

Returns to family land, labor and management: For hybrid maize farmers sold as dry grain averages at 1,205,433 Riel/ha compared to 1,219,452 Riel/ha for hybrid maize farmers sold as fresh ears. After including other income from corncob, return to family land, labor, and management of hybrid maize sold as dry grain increased up to 1,266,986.5 Riel/ha while hybrid maize sold as fresh ears do not have any other income.

Return to family land, labor and management per day: For hybrid maize farmer averages at 23,004 Riel/day, while it is 39,274 Riel/day for hybrid maize farmer sold as fresh ears. After including other income from corncob hybrid maize farmer sold as dry grain averages 24,179 Riel/day.

Table 5.6 Average gross income, costs and returns of hybrid maize sold as dry grain and sold as fresh ears in irrigated condition

Items	Hybrid maize (Dry grain) (N=15)	Hybrid Maize (Fresh ears) (N=5)	Prob.
Revenue:			
Average yield (kg/ha)	6,994.7	-	
Average price (Riel/kg)	440.0	-	
(1) Gross income (Riel/ha)	3,077,653.3	2,900,000.0	.420^{NS}
Income from corncob (Riel/ha)	*61,553.0*	*0*	
Income from thinned plants (Riel/ha)	*0*	*0*	
(2) Total income (Real/ha)	*3,139,206.4*	*2,900,000.0*	
Costs:			
Input cost (Riel/ha)	687,862.2	653,000.0	.666^{NS}
Cost of equipment (Riel/ha)	0.0	0.0	
Hired labor cost (Riel/ha)	1,129,827.0	978,600.0	.047**
Opportunity cost of equity capital for 6 months (Riel/ha)	54,530.7	48,948.0	
Family labor			
(3) Number of family labor days/ha	58.5	36.4	
(4) Family labor cost (Riel/ha)	350,800.0	218,400.0	.045**
(5) Total enterprise cost (Riel/ha)	2,223,019.9	1,898,948.0	
Profitability measures			
(6) Enterprise gross margin (Riel/ha) [1-5]	854,633.4	1,001,052.0	.463^{NS}
(7) Return to family labor, land, and management (Riel/ha) [6+4]	1,205,433.4	1,219,452.0	.936^{NS}
(8) Return to family labor, land, and management per day (Riel/day) [7/3]	23,004.3	39,274.5	.029**
Profitability After including income from selling of corncob and thinned plants			
(9) Enterprise gross margin (Riel/ha) [2-5]	*916,186.5*	*1,001,052.0*	*.671^{NS}*
(10) Return to family labor, land, and management (Riel/ha) [9+4]	*1,266,986.5*	*1,219,452.0*	*.788^{NS}*
(11) Return to family labor, land, and management per day (Riel/day) [10/3]	*24,179.2*	*39,274.5*	*.044**

Note: NS: Not significant, ** Significant 5% level

- Opportunity cost of family labor was valued at the wage rate of 6,000 Riel/day
- Opportunity cost of equity capital was valuable at 6% of operating cost for 6 months
- 1US$ = 4,075 Riel (March 2005)

5.4 Sensitivity Analysis

To assess the degree of benefit and lost of both groups of farmers from growing local and hybrid maize, sensitivity analyses were done and reported as below, with respect to a ± 50 percent change in maize yield and maize price, holding the operating cost constant.

This sensitivity analysis for local maize farmers (appendix A), holding operating cost 591,877.5 Riel/ha and one of the either yield 1,704.7 kg/ha or price 477.1 Riel/kg constant, enterprise gross margin falls below zero with a 30 per cent decrease in price or yield. Holding operating cost constant, enterprise gross margin falls below zero with a 10 per cent decrease in price and 20 per cent decrease in yield and vice versa.

For hybrid maize farmers in rainfed condition (Appendix B), holding operating cost (927,688.7 Riel/ha) and one of either yield (4,113 kg/ha) or price (392.5 Riel) constant, enterprise gross margin falls below zero with a 50 per cent decrease in price or yield. On the other hand, holding operating cost constant, enterprise gross margin falls below zero with 20 per cent decrease in both price and 30 per cent in yield and vice versa.

For hybrid maize farmers in irrigated condition (Appendix C), holding operating cost 2,223,019.9 Riel/ha and one of either yield 6,994.7 kg/ha or price 440 Riel/kg constant, the enterprise gross margin falls below zero with a 30 per cent decrease in price or yield. On the other hand, holding only operating cost constant, enterprise gross margin falls below zero with 10 per cent decrease in price and 20 per cent decrease in yield and vice versa.

For local maize farmers (Appendix D), holding operating cost 591,877.5 Riel/ha and one of either yield 1,704.7 kg/ha or price 477.1 Riel/kg constant, enterprise gross margin remained positive with a 50 per cent decrease in price or

yield. Holding operating cost constant at 591,877.5 Riel/ha, enterprise gross margin would fall below zero with a 20 per cent decrease in yield and 50 per cent decrease in price and vice versa.

For hybrid maize farmers (Appendix E), holding operating cost (927,688.7 Riel/ha) and one of either yield (4,113 kg/ha) or price (392.5 Riel/ha) constant, enterprise gross margin falls below zero with a 50 per cent decrease in price or yield. On the other hand, holding operating cost constant, enterprise gross margin falls below zero with 20 per cent decrease in both price and 30 per cent in yield and vice versa.

For hybrid maize farmers in irrigated condition (Appendix F), holding total income 3,139,206.4 Riel/ha after including another income from corncob and thinned plants, operating cost 2,223,019.9 Riel/ha and one of either yield 6,994.7 kg/ha or price 440 Riel/kg constant, the enterprise gross margin falls below zero with a 30 per cent decrease in price or yield. On the other hand, holding only operating cost constant, enterprise gross margin falls below zero with 20 per cent decrease in price and 20 per cent decrease in yield.