CHAPTER VI

OPTIMAL FARM PLANS

This chapter will describe optimal farm plan and sensitivity analysis. The optimal solution obtained from analysing the MOTAD model will be presented and discussed. The optimal plan for rice production has been evaluated under risks and risk aversion. In the analysis, the maximum gross margin is indicated by the linear programming (L.P.). It will be derived the maximum revenue and minimum variance or minimum risk in linear programming. LINDO is employed as software for the analysis. Six models will be tested as shown in Figure 4.1.

In the analysis of model, resource constraints and coefficients of inputs were from primary data and secondary data. Land constraints, labour constraints and financial capital supply were obtained from secondary data. Wage rate and coefficients of labor use in each rice variety were obtained from the data in the survey. Coefficients of cash cost and gross margin were data in crop year 2000/2001 - 2005/2006 obtained from estimates of 2005/2006 data. The deviations of gross margin were obtained from using 2000/01 -2005/06 data.

Optimal crop plans was generated for different levels of the risk aversion coefficient, Φ. The risk aversion coefficient was parameterized to simulate the effect of risk aversion on cropping choices. A neutral aversion farmer is equal 0.90. Table 6.1 shows relationship between risk aversion level and probability of success. There is direct relation between risk aversion level and probabilities of success. If risk aversion levels increase, probabilities of success increase. Risk taking farmer has a risk aversion level of 0 with probability of success is only 50%. An extreme risk averse farmer has a risk aversion level of level 2.5 with probability of success is 99.9%. Farmers fall generally between 0 and 2.5 risk aversion level depending on their risk taking attitude.

Table 6.1 Relationship between risk aversion level (Φ) and probability of success

Risk aversion level	Probability of success
0.000[1]	0.500[2]
0.500	0.692
1.000	0.891
1.280	0.900
1.500	0.933
1.654	0.950
2.000	0.977
2.330	0.990
2.500	0.999

Source: McCarl and Tice, 1982

Note: [1] Z-score

[2] Under normal curve area

6.1 Optimal farm plan for rainfed area

To find the optimal farm plan for rainfed area, two models based on price types, namely, market price and government support price, were analysed. The farm plan was based on an average farm size for a household in the study area i.e. 12 *rai*. Model A is optimal farm plan for rainfed area under market price. Model B is optimal farm plan for rainfed area under government support price. Given risks associated with each rice variety and available resources, optimal cropping patterns and returns were the outputs of the model.

6.1.1 Optimal farm plan for Model A

After running model A, the optimal farm plan for rainfed areas using market price are shown in Table 6.2- 6.3. Different risk aversion levels were attempted. At each risk aversion level, the optimal cropping patterns were obtained.

Table 6.2 presents the solution of a farm plan with risk aversion average of farmer, 0.9. Under this optimal farm plan, land is allocated to RD15 and RD6, about 8.97 *rai* for RD15 and 3.03 *rai* for RD6. The expected gross margin is 1,404 baht/rai.

Risk variable $\sigma(c_{jt})$ is 310 baht/rai. The loan money is 20,923 baht. Total cost in this plan is 1,883 baht/rai including interest rate (8%). Household labor use is high in early November totaling 21.37 man-days.

As the level of risk aversion increases from 0 to 2.5, the expected gross margin is decreased from 1,385 baht/rai to 1,149 baht/rai, however mean absolute deviation $\sigma(\pi)$ whish measure risk is also decreased from 377 baht/rai to 94 baht/rai. The models for rainfed area by using market price (plan 1-7) show the highest of reduction in the area of RD15. It is decreased from 10.09 to 1.28 *rai* while KDML105 is increased from 0 to 5.93 *rai* and RD6 area is expanded to 4.78 *rai*. At low to moderate levels of risk aversion, RD15 is the predominant crop. However, at high levels of risk aversion (Φ=2.5) the area of RD15 is substantially reduced (i.e. from 10.09 to 1.28). Therefore under market price, RD15 is not suitable to farmer who has high risk aversion. KDML105 and RD6 are recommended in this case (Table 6.3).

Table 6.2 Optimal farm plan for rainfed area by using market (Model A) price at risk aversion 0.9

Items	Constraints	Used	Slack
1. Expected gross margin (baht/rai)	1,404		
2. Risk or gross margin deviation ($\sigma(c_{jt})$) (baht/rai)	310		
3. Total cost (baht/rai)	1,883		
4. Loan money (baht)	30,000	20,923	9,077
5. Land used (*rai*)	12		
RD15		8.97	
KDML105		0	
RD6		3.03	
6. Household labor used (man-days)			
Early July	38.85	9.78	29.07
Late July	41.45	20.75	20.70
Early August	38.86	14.03	24.83
Late August	41.45	2.01	39.44
Early September	38.86	3.38	35.48
Late September	38.86	2.63	36.23
Early October	38.86	3.58	35.28
Late October	41.45	1.66	39.79
Early November	38.86	21.37	17.49
Late November	38.86	10.40	28.46
Early December	38.86	12.11	26.75
Late December	41.45	4.57	36.88
7. Hired labor (man-days)	Unlimited	0	

Source: Calculation

Table 6.3 Optimal farm plan for rainfed area by using market price: Model A

Plan	Risk aversion	Max L (baht)	Expected gross margin (baht/rai)	Risk σ(c_{jt}) (baht/rai)	RD15 (*rai*)	KDML105 (*rai*)	RD6 (*rai*)	Land available(*rai*)	Total cost (baht/rai)
1	0.00	16,624	1,385	377	10.09	0	1.91	12	1,869
2	0.20	16,624	1,461	377	10.09	0	1.91	12	1,869
3	0.50	15,265	1,461	377	10.09	0	1.91	12	1,869
4	0.90	13,500	1,404	310	8.97	0	3.03	12	1,883
5	1.50	12,084	1,149	94	1.28	5.93	4.78	12	2,012
6	2.00	11,518	1,149	94	1.28	5.93	4.78	12	2,012
7	2.50	10,951	1,149	94	1.28	5.93	4.78	12	2,012

Source: Calculation

6.1.2 Optimal farm plan for Model B

The optimal farm plan for rainfed area by using government support price are presented in Table 6.4 – 6.5. At each risk aversion level, the cropping pattern and expected returns are obtained. RD15, KDML105 and RD6 are applied to government support price.

Plan 4 at the risk aversion level of 0.9, the expected gross margin is 1,450 baht/rai. Risk variable $\sigma(c_{jt})$ is 277 baht/rai. Land is allocated to RD15, KDML105 and RD6, namely 0.95 *rai* for RD15, 5.69 *rai* for KDML105 and 5.36 *rai* for RD6. Loan money is 22,384 baht. Total cost include interest rate (8%) is 2,015 baht/rai. This plan has no hired labor. Most of household labor use is in late July and late November at the level of 27.75 and 38.86 man-days subsequently (Table 6.4).

Table 6.6 shows that the optimal farm plans call for KDML105 area of 4.99 *rai* and RD6 of 7.01 *rai* for $\Phi = 0$ to 0.2. RD6 area is 7.01 *rai*. For $\Phi = 0.5$ to 1.5, KDML105 area should be increased to 5.69 *rai*, RD15 increased to 0.95 *rai*, RD6 area reduced 5.36 *rai*. For $\Phi = 2.0$ to 2.5 KDML105 area should be reduced to 4.35 *rai*, RD15 area increased to 1.88 *rai*, and RD6 area increased to 5.77 *rai*. As the levels of risk aversion increases from 0 to 2.5, the expected gross margin decrease from 1,462 baht/rai to 1,428 baht/rai, while risk or income deviation also decrease slightly from 312 baht/rai to 264 baht/rai. In general, the results show that expected income and income risk follow an inverse pattern as the levels of risk aversion increase. This indicates that risk-averse farmers should select more diverse cropping patterns that provide low income risks by trading off with higher expected profit. Therefore under government support price, KDML105 and RD6 are suitable to farmer who has low risk aversion (risk loving) (Table 6.5). This is different to the optimal farm plan under market price (Table 6.3) although under government support price, farmers would be better off to grow more RD6 and KDML105 than otherwise under market price.

Table 6.4 Optimal farm plan for rainfed area by using government support price (Model B) at risk aversion 0.9

Items	Constraints	Used	Slack
1. Expected gross margin (baht/rai)	1,450		
2. Risk or gross margin deviation ($\sigma(c_{jt})$) (baht/rai)	277		
3. Total cost (baht/rai)	2,015		
4. Loan money (baht)	30,000	22,384	7,616
5. Land used (*rai*)	12		
RD15		0.95	
KDML105		5.69	
RD6		5.36	
6. Household labor used (man-days)			
Early July	38.85	7.30	31.55
Late July	41.45	27.75	13.70
Early August	38.86	22.40	16.46
Late August	41.45	3.68	37.77
Early September	38.86	5.27	33.59
Late September	38.86	5.61	33.25
Early October	38.86	4.72	34.14
Late October	41.45	2.53	38.92
Early November	38.86	8.82	30.04
Late November	38.86	38.86	0
Early December	38.86	11.04	27.82
Late December	41.45	20.32	21.13
7. Hired labor (man-days)	Unlimited	0	

Source: Calculation

Table 6.5 Optimal farm plan for rainfed area by using government support price: Model B

Plan	Risk aversion	Max L (baht)	Expected gross margin (baht/rai)	Risk σ(c_{jt}) (baht/rai)	RD15 (*rai*)	KDML105 (*rai*)	RD6 (*rai*)	Land available(*rai*)	Total cost (baht/rai)
1	0.00	17,546.96	1,462	312	0	4.99	7.01	12	2,023
2	0.20	16,797.92	1,462	312	0	4.99	7.01	12	2,023
3	0.50	15,744.84	1,450	277	0.95	5.69	5.36	12	2,015
4	0.90	14,416.18	1,450	277	0.95	5.69	5.36	12	2,015
5	1.50	12,423.20	1,450	277	0.95	5.69	5.36	12	2,015
6	2.00	10,791.52	1,428	264	1.88	4.35	5.77	12	1,996
7	2.50	9,205.56	1,428	264	1.88	4.35	5.77	12	1,996

Source: Calculation

6.2 Optimal farm plan for irrigated area

To find optimal farms plan for irrigated area, two models (C and D) based on price type: market price and government support price are analysed. Model C is one using market price and Model D is one using government support price. In irrigated area, an average farm size is 6 *rai*. The solutions consisted of cropping patterns, gross margin and mean absolute deviation. The model solutions for each set of prices will be presented as follows.

6.2.1 Optimal farm plan for Model C

The optimal farm plan for irrigated area using market price are shown in Table 6.6 – 6.7. At each risk aversion level, optimal cropping patterns and their associated risk are obtained.

Table 6.6 shows the solution of optimal farm plans for irrigated area under market price. At the risk aversion of 0.9, expected gross margin is 1,363 baht/rai. 4.12 *rai* of RD15 and 1.88 *rai* of RD6 are recommended. Risk variable $\sigma(c_j)$ is 259 baht/rai. Loan money is 14,036 baht. So total cost includes interest rate (8%) is 2,526 baht/rai. With limited land, household labor use in planting period are just 17.35 man-days per farm and in harvesting period are just 14.45 man-days per farm.

The result of Model C shows that risk of those farm plans also increase while the gross margin increase. The optimal gross margins based on the land resource are 1,363 and 1,227 baht/rai. Risks or income deviation also decreases from 259 to 132 baht. The solution of optimal farm plan in irrigated area under market price shows that RD6 area is increased from 1.88 to 2.28 *rai*. RD15 planted area should be decreased from 4.12 to 1.15 *rai* per farm and KDML105 area increases from none to 2.57 *rai* as risk aversion increase. The risks in accordance with these models also decrease as KDML105 area is increased because KDML105 under market price had lowest gross margin risk.

The solution shows that plan 1 to 4 recommends just RD15 and RD6 for farmer who is not risk averse. At high risk aversion level ($\Phi \geq 1.5$) the area of RD15, KDML105 and RD6 should be 1.15, 2.57 and 2.28 *rai* subsequently (Table 6.7).

Table 6.6 Optimal farm plan for irrigated area by using market price (Model C) at risk aversion 0.9

Items	Constraints	Used	Slack
1. Expected gross margin (baht/rai)	1,363		
2. Risk or gross margin deviation ($\sigma(c_{jt})$) (baht/rai)	259		
3. Total cost (baht/rai)	2,526		
4. Loan money (baht)	30,000	14,036	15,964
5. Land used (*rai*)	6		
RD15		4.12	
KDML105		0	
RD6		1.88	
6. Household labor used (man-days)			
Early July	38.85	4.57	34.28
Late July	41.45	17.35	24.10
Early August	38.86	5.49	33.37
Late August	41.45	3.03	38.42
Early September	38.86	3.78	35.08
Late September	38.86	3.18	35.68
Early October	38.86	3.75	35.11
Late October	41.45	2.63	38.82
Early November	38.86	9.26	29.60
Late November	38.86	6.67	32.19
Early December	38.86	14.45	24.41
Late December	41.45	4.72	36.73
7. Hired labor (man-days)	Unlimited	0	

Source: Calculation

Table 6.7 Optimal farm plan for irrigated area by using market price: Model C

Plan	Risk aversion	Max L (baht)	Expected gross margin (baht/rai)	Risk $\sigma(c_{jt})$ (baht/rai)	RD15 (*rai*)	KDML105 (*rai*)	RD6 (*rai*)	Land available(*rai*)	Total cost (baht/rai)
1	0.00	8,177	1,363	259	4.12	0	1.88	6	2,526
2	0.20	7,867	1,363	259	4.12	0	1.88	6	2,526
3	0.50	7,401	1,363	259	4.12	0	1.88	6	2,526
4	0.90	6,780	1,363	259	4.12	0	1.88	6	2,526
5	1.50	6,173	1,227	132	1.15	2.57	2.28	6	2,651
6	2.00	5,777	1,227	132	1.15	2.57	2.28	6	2,651
7	2.50	5,382	1,227	132	1.15	2.57	2.28	6	2,651

Source: Calculation

6.2.2 Optimal farm plan for Model D

The farm plan solutions for irrigated area by using government support price are presented in Table 6.8 – 6.9. At each risk aversion level, the cropping pattern and their associated risk are obtained. RD15, KDML105 and RD6 are applied to government support price.

Table 6.8 displays result of Plan 4 with the risk aversion level of 0.9. The expected gross margin is 1,501 baht/rai. Risk variable $\sigma(c_{jt})$ is 363 baht/rai. 1.52, 2.61 and 1.88 *rai* is allocated to RD15, KDML105 and RD6 respectively. Loan money is at 14,695 baht. Hence total cost is 2,645 baht/rai (including interest rate 8%). With limited land area, household labor use in planting period is just 17.82 man-days per farm and in harvesting period just 16.08 man-days per farm.

As the risk aversion level increases from 0 to 2.5, the expected gross margin decrease from 1,501 baht/rai to 1,485 baht/rai, while risk or income deviation also decreases from 363 baht/rai to 248 baht/rai. In the risk model solution for irrigated area by using government support price, the area in KDML105 is declined from 4.12 *rai* to 1.04 *rai* for the farm plan of the higher risk-averse farmer (Φ=0 -2.5).

The optimal plans show a decline in the area of KDML105. As the area of KDML105 is reduced, the cultivated area in RD15 is increased from 0 to 3.08 *rai*. KDML105 area should be reduced but RD15 should be expanded but RD6 area stays the same at 1.88 *rai* per household, when risk aversion increase. Therefore, in this model KDML105 is not suitable to farmer who has high risk aversion. RD15 is recommended instead.

Table 6.8 Optimal farm plan for irrigated area by using government support price (Model D) at risk aversion 0.9

Items	Constraints	Used	Slack
1. Expected gross margin (baht/rai)	1,493		
2. Risk or gross margin deviation ($\sigma(c_{jt})$) (baht/rai)	253		
3. Total cost (baht/rai)	2,645		
4. Loan money (baht)	30,000	14,695	15,305
5. Land used (*rai*)	6		
RD15		1.52	
KDML105		2.61	
RD6		1.88	
6. Household labor used (man-days)			
Early July	38.85	4.08	34.77
Late July	41.45	17.82	23.63
Early August	38.86	5.91	32.95
Late August	41.45	2.38	39.07
Early September	38.86	2.84	36.02
Late September	38.86	2.37	36.49
Early October	38.86	2.44	36.42
Late October	41.45	1.85	39.60
Early November	38.86	4.16	34.70
Late November	38.86	16.08	22.78
Early December	38.86	8.15	30.71
Late December	41.45	10.61	30.84
7. Hired labor (man-days)	Unlimited	0	

Source: Calculation

Table 6.9 Optimal farm plan for irrigated area by using government support price: Model D

Plan	Risk aversion	Max L (baht)	Expected gross margin (baht/rai)	Risk $\sigma(c_{jt})$ (baht/rai)	RD15 (*rai*)	KDML105 (*rai*)	RD6 (*rai*)	Land available(*rai*)	Total cost (baht/rai)
1	0.00	9,009	1,501	363	0	4.12	1.88	6	2,714
2	0.20	8,658	1,494	256	1.35	2.78	1.88	6	2,653
3	0.50	8,200	1,493	253	1.52	2.61	1.88	6	2,645
4	0.90	7,592	1,493	253	1.52	2.61	1.88	6	2,645
5	1.50	6,681	1,493	253	1.52	2.61	1.88	6	2,645
6	2.00	5,931	1,485	248	3.08	1.04	1.88	6	2,574
7	2.50	5,187	1,485	248	3.08	1.04	1.88	6	2,574

Source: Calculation

6.3 Optimal farm plan for a combination of market and government support price

As government support price average of KDML105 is the highest and KDML105 yield risk is low. A combination of market and government support price will be a good option for farmers. These models recognize that farmers have options to sell rice in different markets. As they prefer the highest price, when market price goes down they will sell rice in government support price and vice versa. According to the highest government support price average of KDMl105, combination models are provided market price for RD15 and RD6, and government support price for KDML105. To find optimal farm plan under a combination of market price and government support price. The two models on different land types. Model E is for rainfed area under market price of RD15 and RD6, and under government support price of KDML105. Model F is for irrigated area under market price of RD15 and RD6, and under government support price of KDML105. These solutions consisted of optimal cropping pattern, gross margin and the risk associated with each rice variety. From these set of solutions, the risk and return will be analyzed. The farm plan solution of each model will be displayed as follows:

6.3.1 Optimal farm plan for Model E

The optimal farm plan for rainfed area using market price and government support price (Model E) are presented in Table 6.10 – 6.11. At each risk aversion level, the cropping pattern and their associated risk are obtained. RD15 and RD6 are subject to market price and for KDML105 is subject to government support price.

In Plan 4 (Table 6.10) with risk aversion level of 0.9, optimal farm plan calls for about 2.97, 7.12 and 1.91 *rai* to RD15, KDML105 and RD6 respectively. The expected gross margin is 1,426 baht/rai. Risk variable $\sigma(c_{jt})$ is 215 baht/rai. Loan money is 22,182 baht. Total cost is 1,996 baht/rai (including interest rate 8%). Most household labor use is in late July (planting period) and in late November (harvesting period) with no hired labor.

As the levels of risk aversion increases from 0 to 2.5, the expected gross margin slightly decreases from 1,461 baht/rai to 1,411 baht/rai, while risk or income deviation

also decreases from 376 to 207 baht/rai. At risk aversion from 0 onwards, RD15 should be reduced from 10.09 to 2.93 *rai* while KDML105 should be increased from 0 to 6.82 *rai* and RD6 area increased to 2.25 *rai*. This shows that farmers want to reduce risk, they should decrease RD15 area if RD15 is not under government support price. At the same time, with KDML105 under government support price, farmers will be better off produce KDML105. As for RD6, they would grow it for household consumption.

This risk model in rainfed area with a combination of using market price and government support price shows that at low to moderate levels of risk aversion (risk taking), RD15 is the predominant crop. However, at high levels of risk aversion (Φ=0 or more) the area of RD15 is substantially reduced.

Table 6.10 Optimal farm plan for rainfed area by using market price and government support price (Model E) at risk aversion 0.9

Items	Constraints	Used	Slack
1. Expected gross margin (baht/rai)	1,426		
2. Risk or gross margin deviation ($\sigma(c_{jt})$) (baht/rai)	215		
3. Total cost (baht/rai)	1,996		
4. Loan money (baht)	30,000	22,182	7,818
5. Land used (*rai*)	12		
RD15		2.97	
KDML105		7.12	
RD6		1.91	
6. Household labor used (man-days)			
Early July	38.85	11.07	27.78
Late July	41.45	32.26	9.19
Early August	38.86	9.03	29.83
Late August	41.45	4.46	36.99
Early September	38.86	3.65	35.21
Late September	38.86	4.15	34.71
Early October	38.86	2.94	35.92
Late October	41.45	1.83	39.62
Early November	38.86	13.01	25.85
Late November	38.86	38.70	0.16
Early December	38.86	11.74	27.12
Late December	41.45	18.19	23.26
7. Hired labor (man-days)	Unlimited	0	

Source: Calculation

Table 6.11 Optimal farm plan for rainfed area by using market price and government support price: Model E

Plan	Risk aversion	Max L (baht)	Expected gross margin (baht/rai)	Risk $\sigma(c_{jt})$ (baht/rai)	RD15 (*rai*)	KDML105 (*rai*)	RD6 (*rai*)	Land available(*rai*)	Total cost (baht/rai)
1	0.00	17,530	1,461	376	10.09	0	1.91	12	1,869
2	0.20	16,671	1,457	339	9.32	0.76	1.91	12	1,883
3	0.50	15,830	1,426	215	2.97	7.12	1.91	12	1,996
4	0.90	14,800	1,426	215	2.97	7.12	1.91	12	1,996
5	1.50	13,256	1,426	215	2.97	7.12	1.91	12	1,996
6	2.00	11,972	1,411	207	2.93	6.82	2.25	12	1,995
7	2.50	10,732	1,411	207	2.93	6.82	2.25	12	1,995

Source: Calculation

6.3.2 Optimal farm plan for Model F

In irrigated areas under a combination of market price and government support price, results of Model F are presented in Table 6.12 – 6.13. At each risk aversion level, optimal cropping patterns and their associated risk are obtained. Market price are applied to RD15 and RD6 and for KDML105, government support price is used.

At the risk aversion average of 0.9, land is optimally allocated to RD15 (1.77 *rai*), KDML105 (1.77 rai) and RD6 (1.88 *rai*). The expected gross margin is 1,367 baht/rai. Risk variable $\sigma(c_{jt})$ is 212 baht/rai. Loan money is at 14,630 baht. Total cost is 2,633 baht/rai (including interest rate 8%). Household labors are used in planting period at 17.77 man-days and in harvesting period 15.14 man-days.

The result of Model F shows that risks in accordance with these models also decrease while the gross margins decrease. When risk aversion increases from 0 to 2.5, the expected gross margins based on the land resource are decreased slightly from 1,370 to 1,367 baht/rai, while risks of income deviation are decreased 377 to 212 baht/rai. The solution of optimal farm plan in irrigated area under market price and government support price shows that RD6 area stays at 1.88 *rai*. If farmer are risk aversion, KDML105 planted area should be decreased from 4.12 to 2.35 rai and RD15 area increased from none to 1.77 rai (Table 6.13). This in contrast with the solution in rainfed area because in irrigated area, gross margin risk of KDML105 by using government support price is higher than gross margin of RD15 by using market price while in rainfed area, gross margin risk of KDML105 by using government support price is lower than gross margin of RD15 by using market price.

Table 6.12 Optimal farm plan for irrigated area by using market price and government support price (Model F) at risk aversion 0.9

Items	Constraints	Used	Slack
1. Expected gross margin (baht/rai)	1,367		
2. Risk or gross margin deviation ($\sigma(c_{jt})$) (baht/rai)	212		
3. Total cost (baht/rai)	2,633		
4. Loan money (baht)	30,000	14,630	15,370
5. Land used (*rai*)	6		0
RD15		1.77	
KDML105		2.35	
RD6		1.88	
6. Household labor used (man-days)			
Early July	38.85	4.13	34.72
Late July	41.45	17.77	23.68
Early August	38.86	5.87	32.99
Late August	41.45	2.45	39.00
Early September	38.86	2.93	35.93
Late September	38.86	2.45	36.41
Early October	38.86	2.57	36.29
Late October	41.45	1.93	39.52
Early November	38.86	4.66	34.20
Late November	38.86	15.14	23.72
Early December	38.86	8.77	30.09
Late December	41.45	10.02	34.72
7. Hired labor (man-days)	Unlimited	0	

Source: Calculation

Table 6.13 Optimal farm plan for irrigated area by using market price and government support price: Model F

Plan	Risk aversion	Max L (baht)	Expected gross margin (baht/rai)	Risk $\sigma(c_{jt})$ (baht/rai)	RD15 (*rai*)	KDML105 (*rai*)	RD6 (*rai*)	Land available(*rai*)	Total cost (baht/rai)
1	0.00	8,222	1,370	377	0	4.12	1.88	6	2,714
2	0.20	7,948	1,367	212	1.77	2.35	1.88	6	2,633
3	0.50	7,567	1,367	212	1.77	2.35	1.88	6	2,633
4	0.90	7,058	1,367	212	1.77	2.35	1.88	6	2,633
5	1.50	6,295	1,367	212	1.77	2.35	1.88	6	2,633
6	2.00	5,659	1,367	212	1.77	2.35	1.88	6	2,633
7	2.50	5,023	1,367	212	1.77	2.35	1.88	6	2,633

Source: Calculation

In term of expected gross margin, this is shown in Figure 6.1. In the models under government support price, expected gross margin is greater than those under market price. Under government support price, expected gross margin is 1,450 baht/*rai* in rainfed area and in irrigated area 1,493 baht/*rai*. Under market price, expected gross margin is 1,363 baht/*rai* in rainfed area and in irrigated area 1,404 baht/*rai*. For the combination of market price and government support price, expected gross margin is 1,426 baht/*rai* in rainfed area and in irrigated area 1,367 baht/*rai* (Figure 6.1).

Total cost in optimal farm plans are shown in Figure 6.2. Under government support, total cost is 2,015 baht/*rai* in rainfed area and in irrigated area 2,645 baht/*rai*. Under market price, gross margin deviation is 1,883 baht/*rai* in rainfed area and in irrigated area 2,526 baht/*rai*. For the combination of market price and government support price, total cost is 1,996 baht/*rai* in rainfed area and in irrigated area 2,633 baht/*rai*.

Figure 6.3 shows risk in optimal farm plans. The models under government support risks are lower than under market price. Under government support price, gross margin deviation is 253 baht/*rai* in rainfed area and in irrigated area 277 baht/*rai*. Under market price, gross margin deviation is 259 baht/*rai* in rainfed area and in irrigated area 310 baht/*rai*. For the combination of market price and government support price, gross margin deviation is 215 baht/*rai* in rainfed area and in irrigated area 212 baht/*rai*.

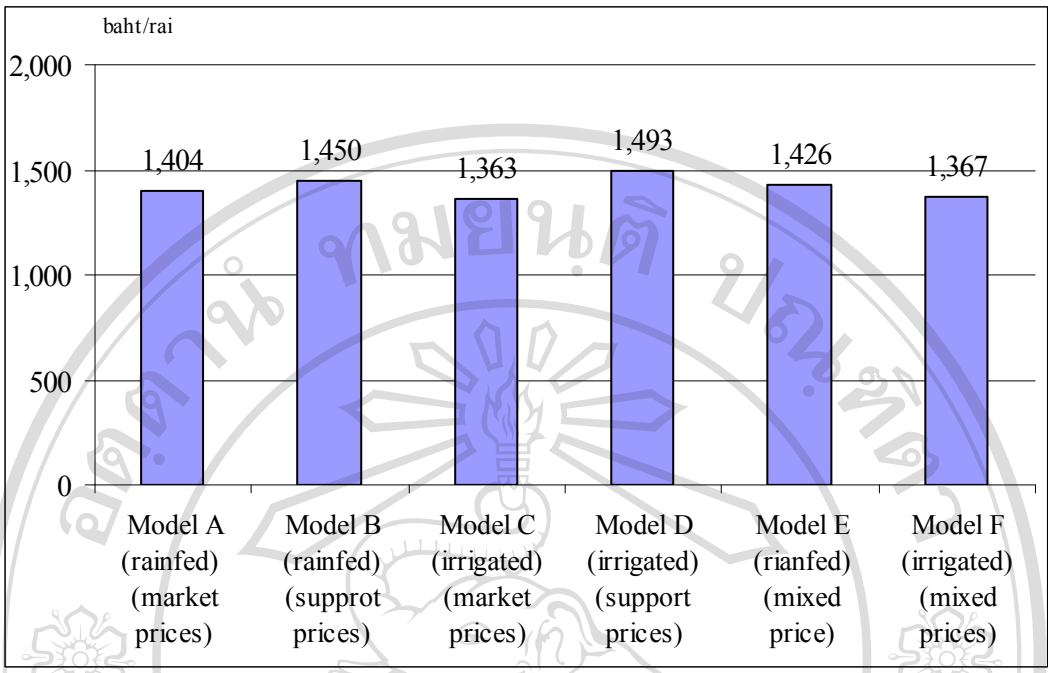

Figure 6.1 Expected gross margin in optimal farm plans

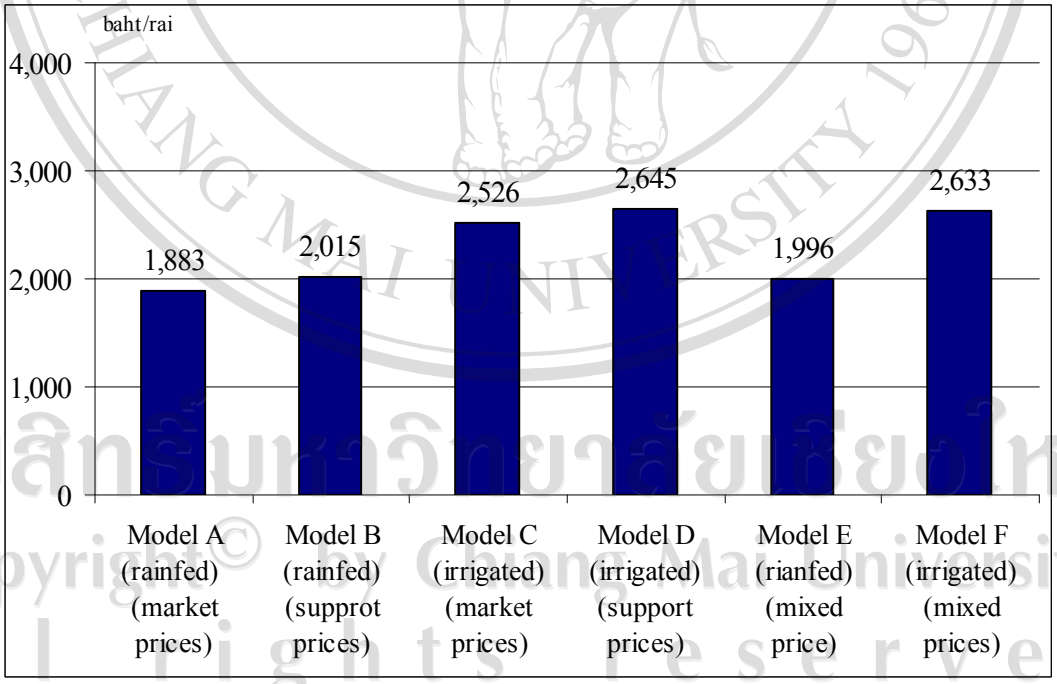

Figure 6.2 Total cost in optimal farm plans

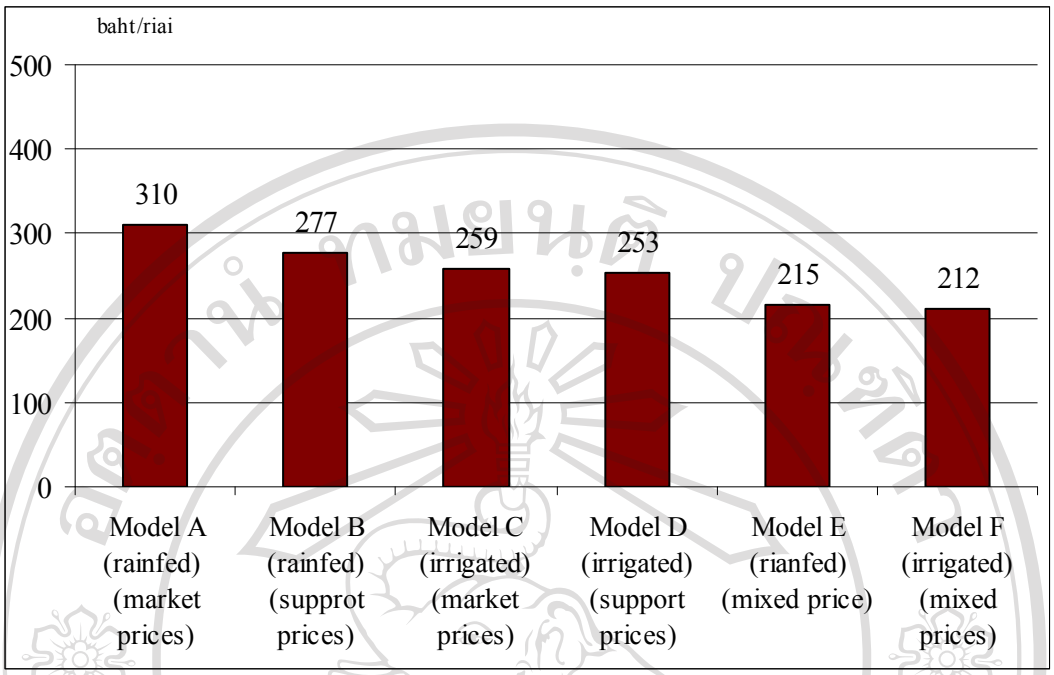

Figure 6.3 Risk in optimal farm plans

Figure 6.4 shows comparison in land allocation among Model A, Model B and Model E that are representative of optimal farm plan for rainfed area. In Model A is one for optimal farm plan under market price, RD15 area is decreased when risk aversion level increases because RD15 gross margin risk under market price was high. Under government support price, KDML105 and RD6 area are slightly decreased when risk aversion level increases because KDML105 price and gross margin was high while RD15 gross margin under government support price was low. A combination of market price and government support price is in Model E. It shows that RD15 area is also decreased when risk aversion level increases while KDML105 is increased. Because KDML105 gross margin risk under government price was lower than RD15 gross margin risk under market price. Therefore, under market price RD15 is suitable for farmers who are risk taking but under government support price, KDML105 is suitable for farmers who are risk taking. For a combination price, RD15 is suitable for farmers who are risk taking because RD15 gross margin under market price was higher than KDML105 gross margin under government support price. However under market price and government support price KDML105 is a better choice for farmers who are

risk aversion. Because more KDML105 is recommended in every model at risk aversion level of 2.5.

Figure 6.5 shows comparison in land allocation among Model C, Model D and Model F that are representative of optimal farm plan for irrigated area. In Model C is one for optimal farm plan under market price, RD15 area is decreased like Model A when risk aversion level increases. Because RD15 has high gross margin risk under market price as well as gross margin. Under government support price, KDML105 area is decreased like Model B. A combination of market price and government support price is in Model F. It shows that KDML105 area is decreased when risk aversion level increases while RD15 is increased that is different from Model E. Because in irrigated area, KDML105 gross margin risk under government price was higher than RD15 gross margin risk under market price. Therefore, in irrigated area under market price RD15 is suitable for farmers who are risk taking but under government support price, KDML105 is suitable for farmers who are risk taking. For a combination price, KDML105 is suitable for farmers who are risk taking because in irrigated area, KDML105 gross margin under market price was higher than RD15 gross margin under government support price.

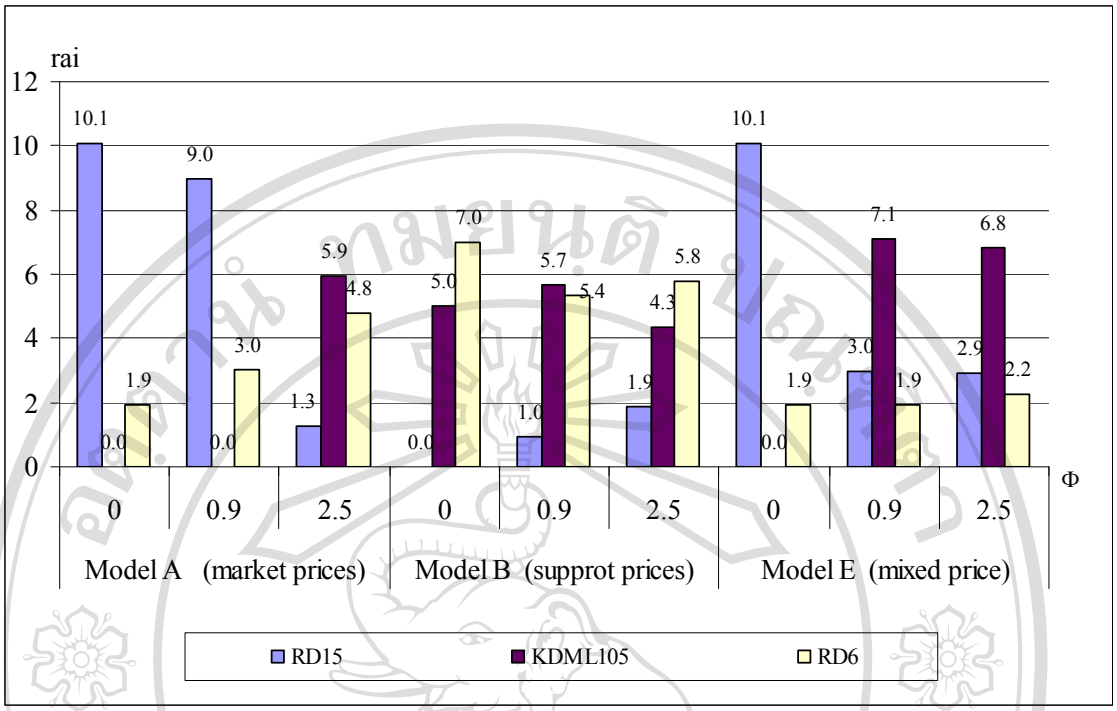

Figure 6.4 Land allocation among Model A, Model B and Model E

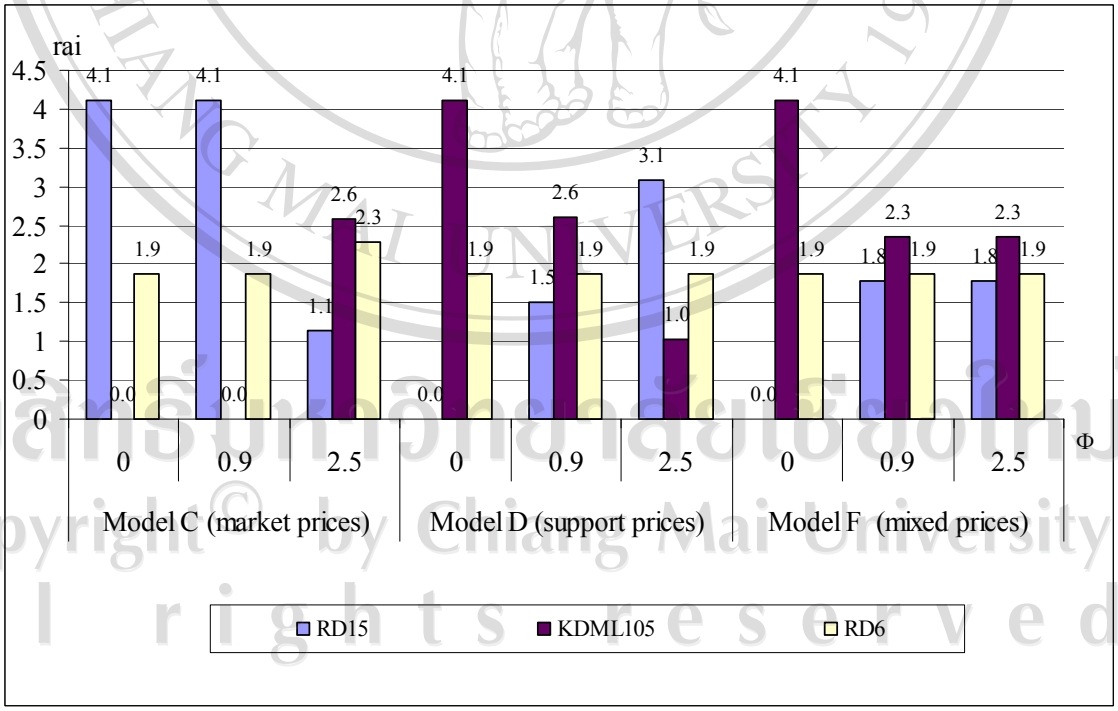

Figure 6.5 Land allocation among Model C, Model D and Model F

6.4 Sensitivity Analysis

6.4.1 Optimal farm plan (Model A, B, C, D, E and F) at risk aversion of 0.9

Table 6.14 shows reduced costs and ranges of coefficient in objective function over which the basis (activities in optimal plan) are unchanged. At the risk aversion of 0.9, optimal farm plan under market price in rainfed area (Model A) recommends RD15 and RD6 rice in the solution. The range in which the basis is unchanged for RD15 gross margin is 1,609 to 1,736 baht/*rai* of gross margin and RD6 1,052 to 1,261 baht/*rai* of gross margin. The range in which the basis is unchanged for KDML105 is 0 to 1,473 baht/*rai* of gross margin. The objective function for KDML105 must be increased by 97.46 baht/*rai* before KDML105 will enter the optimal solution in Model A.

Optimal farm plan under government support price in rainfed area (Model B) recommends RD15, KDML105 and RD6 rice in the solution. The range of 1,123.01 to 1,521.19 baht/*rai* of RD15 gross margin will not change the basis. The range in which the basis is unchanged for RD6 is 1,442.76 to 1,727.92 baht/*rai* of gross margin and KDML105 is 1,552.19 to 1,983.06 baht/*rai* of gross margin.

Model C, optimal farm plan under market price in irrigated area suggests RD15 and RD6 rice in the solution. Increasing KDML105 gross margin by 31.93 baht/*rai* is necessary to have KDML105 in the base solution. The range in which the basis is unchanged for RD15 gross margin is 1,684.07 to infinity and for RD6 0 to 1,311.36 baht/*rai* of gross margin. The range in which the basis is unchanged for KDML105 is 0 to 1,533.93 baht/*rai* of gross margin.

For Model D, optimal farm plan under government support price in irrigated area shows RD15, KDML105 and RD6 rice in the. The range of 1,641.09 to 1,709.27 baht/*rai* of RD15 gross margin will not change the base solution for RD15. The range in which the basis is unchanged for RD6 is 0 to 1,713.01 baht/*rai* of gross margin and KDML105 is 1,731.73 to 1,799.91 baht/*rai* of gross margin.

Optimal farm plan for a combination of market price and government support price in rainfed area (Model E) recommends RD15, KDML105 and RD6 rice in the

solution. The range of 1,491.44 to 1,848.99 baht/*rai* of RD15 gross margin will not change the basis for RD15. The range in which the basis is unchanged for RD6 is 0 to 1,398.31 baht/*rai* of gross margin and KDML105 is 1,499.01 to 1,856.56 baht/*rai* of gross margin.

For Model F, optimal farm plan for a combination of market price and government support price in irrigated area shows RD15, KDML105 and RD6 rice in the solution. The range of 1,377.44 to 1,795.51 baht/*rai* of RD15 gross margin will not change the basis for RD15. The range in which the base solution is unchanged for RD6 is 1,667.49 to 2,085.56 baht/*rai* of gross margin and KDML105 is 0 to 1,660.59 baht/*rai* of gross margin.

Table 6.15 shows reduced costs and ranges of coefficient of hired labor cost in the basis are unchanged. Coefficient of hired labor cost is 150 baht/man-day. In Model A, C, D and E, the base solutions are the same. Increasing hired labor in early July, August and November 1 man-day will increase hired labor cost 150 baht. In The other period, increasing hired labor will increase hired labor cost 162 baht. The range of hired labor in early July, August and November in which the basis are unchanged is 0 to infinity baht/man-day. For the other period, the range in which the basis is unchanged is 12 to infinity. In Model B, increasing 1 man-day hired labor in late November will increase cost by 134.74 baht. Increasing 1 man-day hired labor in early July, August and November will increase cost by 150 baht. For the rest of the periods, increasing 1 unit of hired labor will increase cost by 162 baht. The range in which the base solution is unchanged for hired labor in late November is 134.74 to infinity baht/man-day. The range of hired labor in early July, August and November in which the basis is unchanged is 150 to infinity. For the rest of period, the range in which the basis is unchanged is 162 to infinity. In Model F, increasing hired labor in every period, 1 man-day will increase hired labor cost 150 baht. The range in which the basis is unchanged is 150 to infinity.

Table 6.14 Reduced costs and ranges of coefficient in the objective function which the basis is unchanged

Model			Value	Reduced cost	Current coefficient	Allowance increase	Allowance decrease
A	RD15 area	X1	8.97	0.00	1,695.00	41.47	85.70
	KDML105 area	X2	0.00	97.46	1,376.00	97.46	Infinity
	RD6 area	X3	3.03	0.00	1,094.00	167.43	41.47
B	RD15 area	X1	0.95	0.00	1,375.00	146.19	251.99
	KDML105 area	X2	5.69	0.00	1,653.00	330.06	100.81
	RD6 area	X3	5.36	0.00	1,583.00	144.92	140.24
C	RD15 area	X1	4.12	0.00	1,716.00	Infinity	31.93
	KDML105 area	X2	0.00	31.93	1,502.00	31.93	Infinity
	RD6 area	X3	1.88	0.00	1,186.00	125.36	Infinity
D	RD15 area	X1	1.52	0.00	1,694.00	15.27	52.91
	KDML105 area	X2	2.61	0.00	1,747.00	52.91	15.27
	RD6 area	X3	1.88	0.00	1,605.00	108.01	Infinity
E	RD15 area	X1	2.97	0.00	1,695.00	153.99	203.56
	KDML105 area	X2	7.12	0.00	1,653.00	203.56	153.99
	RD6 area	X3	1.91	0.00	1,094.00	304.31	Infinity
F	RD15 area	X1	1.77	0.00	1,716.00	79.51	338.56
	KDML105 area	X2	2.35	0.00	1,747.00	338.56	79.51
	RD6 area	X3	1.88	0.00	1,186.00	474.59	Infinity

Source: Calculation

Table 6.15 Reduced costs and ranges of coefficient of hired labor cost in the basis is unchanged

Variable		Value	Current coefficient	Model A, C, D and E			Model B			Model F		
				Reduced cost	Allowance increase	Allowance decrease	Reduced cost	Allowance increase	Allowance decrease	Reduced cost	Allowance increase	Allowance decrease
Hired labor in early July	X5	0.00	150.00	150.00	150.00	Infinity	150.00	150.00	Infinity	150.00	150.00	Infinity
Hired labor in late July	X6	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity
Hired labor in early Aug.	X7	0.00	150.00	150.00	150.00	Infinity	150.00	150.00	Infinity	150.00	150.00	Infinity
Hired labor in late Aug.	X8	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity
Hired labor in early Sept.	X9	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity
Hired labor in late Sept.	X10	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity
Hired labor in early Oct.	X11	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity
Hired labor in late Oct.	X12	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity
Hired labor in early Nov.	X13	0.00	150.00	150.00	150.00	Infinity	150.00	150.00	Infinity	150.00	150.00	Infinity
Hired labor in late Nov.	X14	0.00	150.00	162.00	162.00	Infinity	134.74	134.74	Infinity	150.00	150.00	Infinity
Hired labor in early Dec.	X15	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity
Hired labor in late Dec.	X16	0.00	150.00	162.00	162.00	Infinity	162.00	162.00	Infinity	150.00	150.00	Infinity

Source: Calculation

Table 6.16 shows dual price, slack and ranges in which the base solutions are unchanged. In every model, total rice area is exhausted and for total own capital, dual price is equal to interest rate (8%). In Model A increasing rice area 1 *rai* will increase income 1,125 baht. The range in which the basis is unchanged is 7.57 to 17.21 *rai* of total rice area. For total own capital, the basis is not changed if total own capital is 0 to 20,923.11 baht. Total loan money is 20,923.11 baht and surplus 9,076.89 baht. The range in which the basis is unchanged is 20,923.11 baht to infinity of total loan money, and household consumption allowance increase is up to 1,584.26 kg of RD6.

In Model B, increasing rice area of 1 *rai* will increase income 1,113 baht. The range in which the basis is unchanged is 11.36 to 13.76 *rai* of total rice area. For total own capital, the base solution is not changed if total own capital is 0 to 22,383.85 baht. Total loan money is 22,384 baht and surplus 7,616 baht. The range in which the basis is unchanged is 22,383.85 baht to infinity of total loan money, and household consumption allowance increase is up to 1,801.75 kg of RD6.

For Model C, increasing rice area of 1 *rai* will increase income 1,169 baht. The range in which the basis is unchanged is 5.23 to 7.46 *rai* of total rice area. For total own capital, the basis is not changed if total own capital is 0 to 14,035.88 baht. Total loan money is 14,036 baht and surplus 15,964 baht. The range in which the base solution is unchanged is 14,035.88 baht to infinity of total loan money, and household consumption is 804.16 to 1,168.53 kg of RD6.

For Model D, increasing rice area 1 *rai* will increase income 1,299 baht. And range in which the basis unchanged is 7.60 to 8.78 *rai* of total rice area. For total own capital, the basis is not changed if total own capital is 0 to 14,695.20 baht. Total loan money is 15,305 baht and surplus 14,695 baht. The range in which the base solution is unchanged is 15,304.80 baht to infinity of total loan money, and household consumption is 683.30 to 1,364.37 kg of RD6.

For Model E, increasing rice area 1 *rai* will increase income 1,282 baht. The range in which the basis is unchanged is 9.22 to 12.05 *rai* of total rice area. For total own capital, the basis is not changed if total own capital is 0 to 22,181.89 baht. Total loan money is 7,818 baht and surplus 22,182 baht. The range in which the basis is

unchanged is 7,818.31 baht to infinity of total loan money, and household consumption is 965.66 to 1,175.55 kg of RD6.

And Model F, increasing rice area 1 *rai* will increase income 1,325 baht. And range in which the base solution is unchanged is 5.46 to 7.07 *rai* of total rice area. For total own capital, the base solution is not changed if total own capital is 0 to 14,629.89 baht. Total loan money is 14,630 baht and surplus 15,370.11 baht. The range in which the base solution is unchanged is 14,629.89 baht to infinity of total loan money, and household consumption is 848.63 to 1,099.71 kg of RD6.

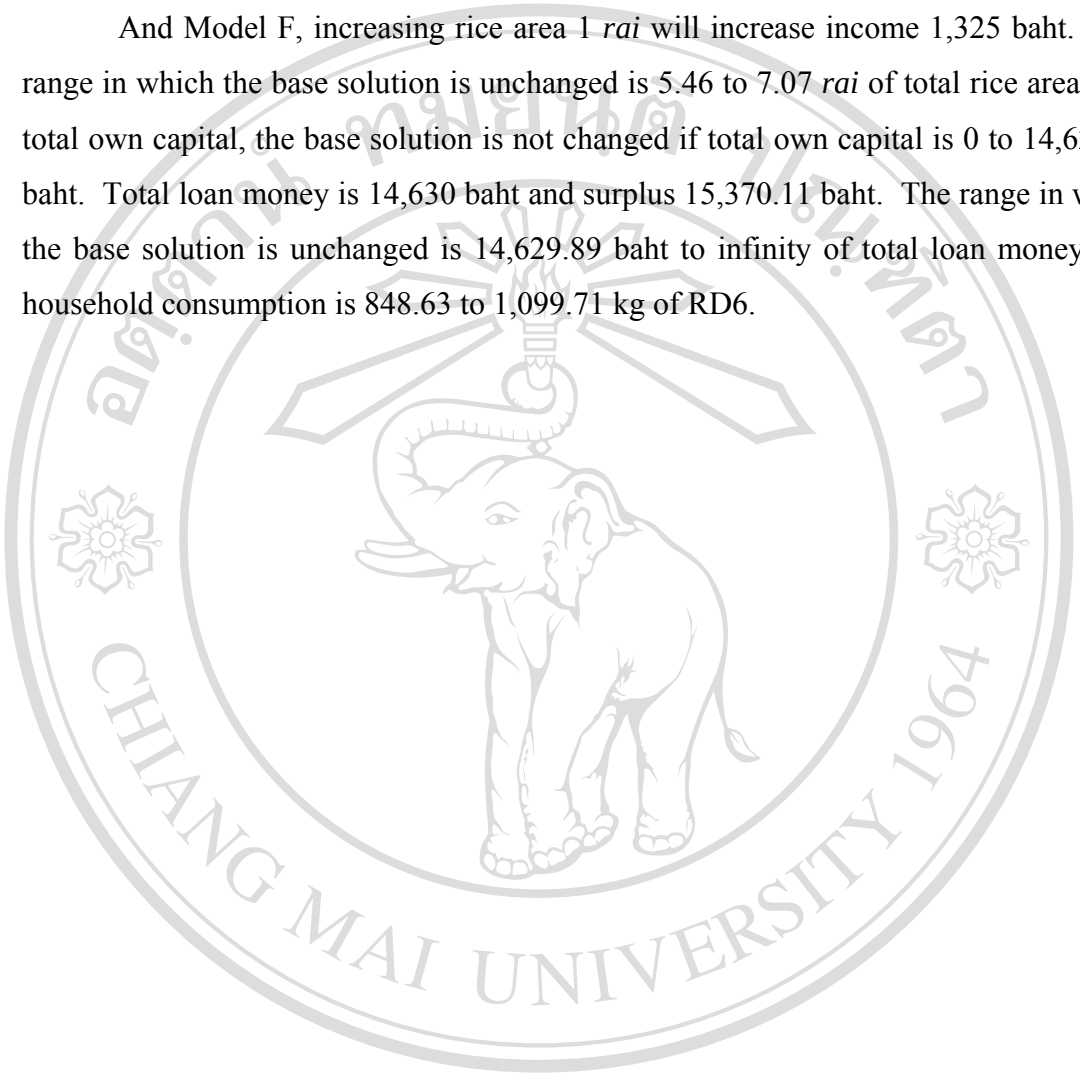

Table 6.16 Dual price, slack and ranges in which the basis is unchanged

Model	Variable	Total area	Total own capital	Total loan money	Household consumption
	RHS current	12.00	0.00	30,000	1,000
	Slack or surplus	0.00	0.00	9,076.89	584.26
A	Dual price	1,125.00	0.08	0.00	0.00
	Allowance increase	5.21	20,923.11	Infinity	584.26
	Allowance decrease	4.43	0.00	9,076.89	Infinity
	RHS current	12.00	0.00	30,000	1,000
	Slack or surplus	0.00	0.00	7,616	1,801.75
B	Dual price	1,113.07	0.08	0.00	0.00
	Allowance increase	1.76	22,383.85	Infinity	1,801.75
	Allowance decrease	0.64	0.00	7,616.15	Infinity
	RHS current	6.00	0.00	30,000	1,000
	Slack or surplus	0.00	0.00	15,964.12	0.00
C	Dual price	1,169.20	0.08	0.00	-0.24
	Allowance increase	1.46	14,035.88	Infinity	168.53
	Allowance decrease	0.87	0.00	15,964.12	195.84
	RHS current	6.00	0.00	30,000	1,000
	Slack or surplus	0.00	0.00	15,304.80	0.00
D	Dual price	1,299.19	0.08	0.00	-0.20
	Allowance increase	2.78	14,695.20	Infinity	364.37
	Allowance decrease	1.60	0.00	15,304.80	316.70
	RHS current	12.00	0.00	30,000	1,000
	Slack or surplus	0.00	0.00	7,818.31	0.00
E	Dual price	1,281.86	0.08	0.00	-0.58
	Allowance increase	0.05	22,181.69	Infinity	174.55
	Allowance decrease	1.78	0.00	7,818.31	34.34

Table 6.16 Dual price, slack and ranges in which the basis is unchanged (cont'd.)

Model	Variable	Total area	Total own capital	Total loan money	Household consumption
	RHS current	6.00	0.00	30,000	1,000
	Slack	0.00	0.00	15,370.11	0.00
F	Dual price	1,324.95	0.08	0.00	-0.89
	Allowance increase	1.07	14,629.89	Infinity	99.71
	Allowance decrease	0.54	0.00	15,370.11	151.37

Source: Calculation

Table 6.17 shows dual price, slack and ranges of family labor over which the basis is unchanged. As total family labor dose not exhauste, dual price is 0 baht/man-day. In Model B and Model E, family labor used is exhausted only in late November.

From these sensitivity results, policy implication can be drawn to recommend to farmers in the study area. Financial institutions or BAAC bank should limit loan at 20,000 baht/household for the farmers who have rice area not more than 12 *rai* and about 10,000 baht/household for the farmers who have rice area not more than 6 *rai*. From Model A, if the government wants to promote extension of KDML105 area, the government should increase the price of KDML105 by 0.2 baht/kg (7.6 up to 7.8 baht/kg). Other way round, if the government wants to promote extension of RD15 area, the government should increase 0.1 baht/kg of RD15 (7.5 up to 7.6 baht/kg) and RD6 price increases 0.3 baht/kg (5.8 up to 6.1 baht/kg) as well.

Table 6.17 Dual price, slack and ranges of family labor over which the basis is unchanged

Model	Variable	Family labor											
		Early July	Late July	Early Aug.	Late Aug.	Early Sept.	Late Sept.	Early Oct	Late Oct.	Early Nov.	Late Nov.	Early Dec.	Late Dec.
A	RHS	38.85	41.45	38.86	41.45	38.86	38.86	38.86	41.45	38.86	38.86	38.86	41.45
	Slack or surplus	29.07	20.70	24.83	39.44	35.48	36.23	35.28	39.79	17.49	28.46	26.75	36.88
	Dual price	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Allowance increase	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
	Allowance decrease	29.07	20.70	24.83	39.44	35.48	36.23	35.28	39.79	17.49	28.46	26.75	36.88
B	Slack or surplus	31.55	13.69	16.46	37.77	33.59	33.25	34.14	38.92	30.04	0.00	27.82	21.13
	Dual price	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.26	0.00	0.00
	Allowance increase	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
	Allowance decrease	31.55	13.69	16.46	37.77	33.59	33.25	34.14	38.92	30.04	4.97	27.82	21.13
C	Slack or surplus	34.28	24.10	33.37	38.42	35.08	35.68	35.11	38.82	29.60	32.19	24.41	36.73
	Dual price	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Allowance increase	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
	Allowance decrease	34.28	24.10	33.37	38.42	35.08	35.68	35.11	38.82	29.60	32.19	24.41	36.73

Table 6.17 Dual price, slack and ranges of family labor over which the basis is unchanged (cont'd)

Model	Variable	Family labor											
		Early July	Late July	Early Aug.	Late Aug.	Early Sept.	Late Sept.	Early Oct	Late Oct.	Early Nov.	Late Nov.	Early Dec.	Late Dec.
D	Slack or surplus	34.77	23.63	32.95	39.07	36.02	36.49	36.42	39.60	34.70	22.78	30.71	30.84
	Dual price	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Allowance increase	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
	Allowance decrease	34.77	23.63	32.95	39.07	36.02	36.49	36.42	39.60	34.70	22.78	30.71	30.84
E	Slack or surplus	27.78	9.19	29.83	36.99	35.21	34.71	35.92	39.62	25.85	0.16	27.12	23.26
	Dual price	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Allowance increase	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
	Allowance decrease	27.78	9.19	29.83	36.99	35.21	34.71	35.92	39.62	25.85	0.16	27.12	23.26
F	Slack or surplus	34.72	23.68	32.99	39.00	35.93	36.41	36.29	39.52	34.20	23.72	30.09	31.43
	Dual price	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Allowance increase	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity	Infinity
	Allowance decrease	34.72	23.68	32.99	39.00	35.93	36.41	36.29	39.52	34.20	23.72	30.09	31.43

6.4.2 Sensitivity analysis in prices

In this section, sensitivity analysis is considered to validate the stability of the model and to obtain the impact on the objective function by changing the price variable. To validate the stability of the model, coefficient of crop price will change to be price in year 2010 from simple regression result.

Table 6.18 shows market price and government support price in year 2010. From regression result in Chapter V, market price of each rice variety is increased. RD15 market price is 9.31 baht, KDML105 9.80 baht and RD6 6.63 baht. Under government support price, KDML105 is the highest (11.69 baht). RD15 is 7.98 baht and RD6 is 8.79 baht.

Table 6.18 Market price and government support price of each rice variety in year 2005 and 2010

Rice variety	Market price		Government support price	
	2005	2010	2005	2010
RD15	8.65	9.31	6.70	7.98
KDML105	8.71	9.80	9.90	11.69
RD6	6.76	6.63	7.40	8.79

Source: Calculation

Gross margin used as the coefficients of the objective function. Table 6.19 shows gross margin by using price in year 2010. Using market prices, gross margin of RD15 was the highest, in rainfed area being 2,460 baht/*rai*, and in irrigated area being 2,397 baht/*rai*. Also, using market price, KDML105 gross margin in irrigated area will be the highest at 2,491 baht/*rai* and in rainfed area will be 2,266 baht/*rai*. Similarly, RD6 gross margin will be 1,060 baht/*rai* in rainfed area and for irrigated area at 1,192 baht/*rai* using market price. Under market price, gross margin KDML105 and RD15 will be increased while RD6 will be decreased.

Under government support price system, gross margin of KDML105 will be the highest, in rainfed area being 3,155 baht/*rai*, and in irrigated area being 3,423 baht/*rai*. RD6 gross margin in rainfed area will be 1,583 baht/*rai* and in irrigated area

will be 1,605 baht/*rai*. For RD15 gross margin will be the lowest at 1,776 baht/*rai* in rainfed area and for irrigated area at 1,718 baht/*rai*. Under government support price system, gross margin KDML105, RD15 and RD6 will be increased.

Table 6.19 Gross margin of each rice variety in year 2010

Rice variety	Market price		Government support price	
	Rainfed area	Irrigated area	Rainfed area	Irrigated area
	----baht/*rai*----			
RD15	2,460	2,397	1,776	1,718
KDML105	2,266	2,491	3,155	3,423
RD6	1,060	1,192	2,189	2,342

Source: Calculation

The sensitivity in price aims to see the impact of prediction price in the future. To consider the effect of price in farm plan solution, model A1, B1, C1, D1, E1 and F1 are adopted. Summary of sensitivity models description is shown in Table 6.20.

Table 6.20 Summary of sensitivity models description

Sensitivity model	Descriptions
A1	Changing in price of each rice variety in model A
B1	Changing in price of each rice variety in model B
C1	Changing in price of each rice variety in model C
D1	Changing in price of each rice variety in model D
E1	Changing in price of each rice variety in model E
F1	Changing in price of each rice variety in model F

At the risk aversion average of 0.9, the sensitivity models are presented in Table 6.21.

Model A1 is one for optimal farm plan in rainfed area under market price. The feasible gross margin is 2,121 baht/*rai*. Income deviation is 223 baht/*rai*. Land is allocated for 2.93 *rai* of RD15, 7.15 *rai* of KDML105 and 1.91 *rai* of RD6. By

including interest rate 8%, total cost is 1,997 baht/*rai*. Considering under government support price Model B1 is one for optimal farm plan for rainfed area. The feasible gross margins are 2,845 baht/*rai*. Income deviation is 390 baht/rai. 10.09 *rai* is allocated to KDML105 and 1.91 *rai* to RD6. Total cost is 2,218 baht/*rai* with interest rate 8%.

As for model C1 is one optimal farm plan in irrigated area under market price. The feasible gross margin is 1,420 baht/*rai*. Income deviation is 92 baht/*rai*. 0.59 *rai* of RD15, 3.45 *rai* of KDML105 and 1.96 *rai* of RD6 are planted. Total cost is 2,529 baht/*rai*. Model D1 is optimal farm plan for irrigated area under government support price. The feasible gross margin is 2,733 baht/*rai*. Income deviation is 1,210 baht/*rai*. 0.82 *rai* of RD15, 2.64 *rai* of KDML105 and 2.54 *rai* of RD6 are grown. By including interest rate 8%, total cost is 2,659 baht/*rai*.

In Model E1 is one for optimal farm plan in rainfed area under combination of market and government support price. The feasible gross margin is 2,652 baht/*rai*. Income deviation is 215 baht/*rai*. 2.93 *rai* is allocated to RD15, 7.15 *rai* to KDML105 and 1.91 *rai* to RD6. By including interest rate 8%, total cost is 1,997 baht/*rai*. As for Model F1 is one for optimal farm plan in irrigated area. The feasible gross margin is 2,724 baht/*rai*. Income deviation is 377 baht/*rai*. In Model F1, 4.12 *rai* is allocated to grow KDML105 and 1.88 *rai* to RD6. Total cost is 2,714 baht/*rai* with interest rate 8%.

Table 6.21 Optimal farm plan solution of price sensitivity models

Model	Max L (baht)	Expected gross margin (baht)	Risk (baht)	RD15 (*rai*)	KDML105 (*rai*)	RD6 (*rai*)	Land available (*rai*)	Total cost (baht)
A	13,500	1,404	310	8.97	0	3.03	12	1,883
A1	23,050	2,121	223	2.93	7.15	1.91	12	1,997
B	14,416	1,450	277	0.95	5.69	5.36	12	2,015
B1	29,936	2,845	390	0	10.09	1.91	12	2,218
C	6,780	1,363	259	4.12	0	1.88	6	2,526
C1	8,022	1,420	92	0.59	3.45	1.96	6	2,529
D	7,592	1,493	253	1.52	2.61	1.88	6	2,645
D1	9,865	2,733	1,210	0.82	2.64	2.54	6	2,659
E	14,800	1,426	215	2.97	7.12	1.91	12	1,996
E1	29,496	2,652	215	2.93	7.15	1.91	12	1,997
F	7,058	1,367	212	1.77	2.35	1.88	6	2,633
F1	14,313	2,724	377	0	4.12	1.88	6	2,714

Source: Calculation

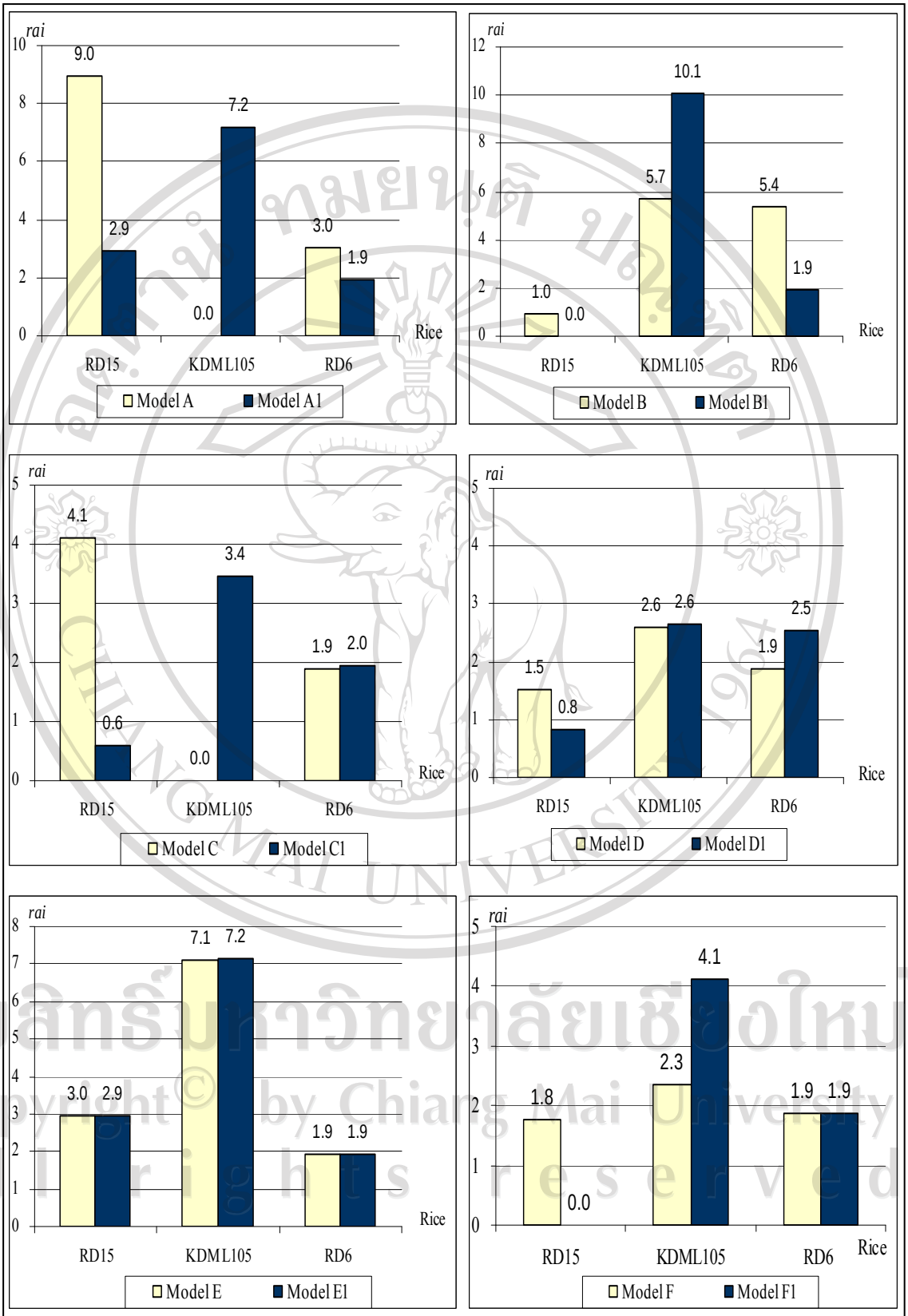

Figure 6.7 Land allocation in optimal farm plans

Figure 6.7 shows land allocation in these optimal farm plans. Comparison between Model A and Model A1 shows that under market price, KDML105 area is increased from 0 *rai* to 7.2 *rai* while RD15 area is decreased from 9.0 *rai* to 2.9 *rai*. RD6 area is decreased from 3.0 rai to 1.9 *rai*. Under government support price (Model B and Model B1), KDML105 area is increased from 5.7 *rai* to 10.1 *rai* while RD15 area is decreased from 1 *rai* to 0 *rai* and RD6 area is decreased from 5.4 *rai* to 1.9 *rai*. Land allocation in optimal farm plan for irrigated areas (Model C and Model C1) are similar to rainfed area. Under market price (Model D and Model D1), KDML105 area is increased from 0 *rai* to 3.4 *rai* while RD15 area is decreased from 4.1 *rai* to 0.6 *rai*. Under government support price, KDML105 area is increased from 2.5 *rai* to 2.6 *rai* while RD15 area is decreased from 1.5 *rai* to 0.6 *rai*. RD6 is increased from 1.9 rai to 2.5 *rai*. Similarly, optimal farm plan for a combination of market price and government support price in rainfed area, KDML105 area is increased from 7.1 *rai* to 7.2 *rai* and RD15 area is also decreased from 3.0 *rai* to 2.9 *rai*. As for RD6 is stay at 1.9 *rai*. In irrigated area, KDML105 area is increased from 2.3 *rai* to 4.1 *rai* while RD15 area is decreased from 1.8 *rai* to 0 *rai*.

Under market price, KDML105 gross margin risk is the lowest. Therefore more land is allocated to KDML105 and less to RD15, and the risk level also decreases. Feasible gross margin is increased, as the risk level increases.

In term of government support price program, feasible gross margin increases, more land is also allocated to KDML105 and less to RD15, but the risk level will increase. This also reflects the tradeoff risk and return because KDML105 gross margin risk is high.

Considering farm plan solutions under a combination of market price and government support price, feasible gross margin increases, more land is also allocated to KDML105 and less to RD15.

When considering the gross margin in price increase model and the base model, the price increase model has the higher feasible gross margin than in the base model. In those models, gross margin varies directly with price. In other words, the higher prices yield more the gross margin.