CHAPTER VI

EFFICIENCY OF RESOURCE UTILIZATION

A farmer in any LRA is normally provided with a small plot of land (about 5-10 rai/household). Farm land is usually of low-fertility or it has a lack of water or it is not very suitable for growing most kinds of crops. The farmers in the Chom Thong LRA also faced with these problems and, therefore, some of them left part of their land unused, eventhough they were allotted only small plots.

Land was the most critical and scarcest resource of the poor farmers in the LRA. However, labor and capital were also found to be factors limiting their farm production. Some of these farmers had opportunities to work off-farm and some had better land outside the LRA. To answer a policy question : If the LRA allotted an appropriate size of land for a farm family, one needs to find out how the farmers utilized their main resources (land, labor and capital) especially in crop production in the LRA. Thus, this chapter intends to investigate 2 issues. First, why farmers fully or partially used their land and second, if they used other key input factors efficiently (or at the optimal levels).

6.1 Land Utilization.

One of the key questions addressed in the first chapter was if farmers in the LRA efficiently utilized their land. In other words, whether farmers fully used their land, and if not, why not? To answer this question, the analysis based on 177 farm observations was carried out. As indicated in Chapter IV and

restated in Table 6.1, about 41% of these farmers partially cultivated their LR farm land.

Table 6.1 Percentage of Farmers Partially Cultivated LR Land

Cropping system	Total (HH)	Fully use (HH)	%	Partially use (HH)	%
1. Soybean	53	42	79.25	11	20.75
2. Soybean-tobacco	12	9	75.00	3	25.00
3. Soybean-mango	15	14	93.3	1	6.67
4. Tobacc	59	19	32.22	40	67.78
5. Tobacco-mango	25	14	56.0	11	44.0
6. Tobacco-tomato -mango	13	6	46.15	7	53.84
Total (HH)	177	104		73	
%	100	58.76		41.24	

Note : Soybean based systems without tobacco (i.e. 1 and 3), percentage of no. partially use to total household = 17.64% that of tobacco based (4-6) = 59.80%.

Among six cropping systems, tobacco based systems (excluding soybean-tobacco) exhibited a much higher percentage of partial land use than soybean-based system i.e. 59.80% compared to 17.64%.

The farmers gave several reasons why they left some land idle. The first main reason was having insufficient capital to invest (Table 6.2). Insufficient farm labor and physical limitations in terms of gravel land, flooded areas, and water shortage were also problems. Besides, some farmers needed to put aside some land for tobacco rotation.

Table 6.2 Reasons for Partial Land Utilization of Chom Thong LR Farmers

Farmer groups	Insuffic. budget	Insuffic. labor	Physical constraint	Water lackage	Tobacco rotation	Total (HH)
Soybean						
G12	2	1	2	-	-	5
G22	2	1	3	-	-	6
Soybean-tobacco						
G12	1	-	-	-	-	1
G22	-	-	2	-	-	2
Soybean-mango						
G12	-	-	-	-	-	0
G22	-	1	-	-	-	1
Tobacco						
G12	20	7	3	3	2	35
G22	1	-	4	-	-	5
Tobacco-mango						
G12	4	4	1	-	1	10
G22	-	1	-	-	-	1
Tobacco-tomato-mango						
G12	-	-	-	-	3	3
G22	2	2	-	-	-	4
Total (HH)	32	17	15	3	6	73
%	43.84	23.29	20.55	4.11	8.22	100.00

Table 6.3 Determinants of land use intensity in LRA and both inside and outside LRA.

Variables	LRA		LRA and outside	
	Coefficient	t-value	Coefficient	t-value
Constant	1.9686	6.670***	2.4176	8.137***
LNTLAND	-0.1945	-3.936***	-0.3707	-7.178***
LNFLAB	0.0049	0.094	0.0385	0.818
LNOINC	-0.1098	-3.097***	-0.1340	-3.831***
CSYS	0.2849	7.864***	0.2535	7.784***
R^2	0.26		0.33	
F	15.2911***		21.8679***	

*** significant at 99%

Where Y_1 = land use intensity in LRA (%)
= total cultivated land in LRA divided by total land in LRA

Y_2 = total cultivated land (in and outside LRA) divided by total land (in and outside LRA)

LN = natural logarithm

TLAND = total land in and outside LRA (rai)

OINC = off-farm income (baht/household/year)

FLAB = farm labor (person)

CSYS = 1 if cropping system includes soybean
= 0 otherwise

The farmers decision regarding the size of cultivation is multifacet and probably involves more factors than mentioned above. To statistically confirm why farmers fully or partially use their land, two models of land intensity were regressed against several determinants. Unfortunately, the data on the foregoing attitudes were gathered only from the partial cultivators. Therefore, they are not included in the models. The explanatory factors and the estimated results are shown in Table 6.3.

The first model is land use intensity of the LRA land (Y_1) and the second is the intensity of land use including land in and outside LRA land (Y_2).

The rather low R^2s imply that the model should have included more variables. The second model (Y_2) performs better than the first since the decision of the farmers who had land outside the LRA (G_{21} and G_{22}) on land use in the LRA was not independent from outside land. Despite the low R^2s, the Estimated Generalized Least Squares (EGLS) shows that the model is significant and all explanatory variables are highly significant except farm labor (Details of the variables are found in Appendix 13). The negative signs of the total land and off-farm income indicate that land use intensity declines as farm size gets larger and when farmers allocate more time for off-farm work. However, the result confirms that farmers can cultivate more land, and thus raise land intensity when they include soybean in their cropping system as compare to growing tobacco or tomato which is a labor and capital intensive crop.

6.2 Efficiency of Resource Utilization.

To evaluate efficiency of resource use, the analysis carried out is based on the assumption that farmers are profit maximizers. This is a reasonable assumption since all crops grown in this study are for market. The underlining principle is to use each input up to the amount that the last unit provides additional return (marginal value product or MVP) equal to the additional cost of using it (i.e. marginal factor cost or price of the input).

The evaluation was performed for two major crops in the study,i.e. soybean and tobacco in 2 steps. First, the production functions were estimated. Second, marginal products and marginal value products of 3 main inputs (labor, capital and fertilizer) were calculated and compared to their respective prices.

The production functions of soybean and tobacco were in Cobb-Douglas form. Multicollinearity was not serious. The heteroscedasticity problem was corrected[1]. The estimated results are shown in Table 6.4. The yield per rai of tobacco is significantly related to fertilizer (LNFERT); cash expended on pesticides, herbicides and machines purchased for land preparation (LNCASH) and labor (LNLAB). The dummy variables of farm groups show that only G_{22} (those who had outside farm and partially cultivated LR farm land) is statistically significant.

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1 method suggested by White (1978).

Table 6.4 Estimated production functions of tobacco and soybean.

Variables	Soybean		Tobacco	
	Coefficient	t-value	Coefficient	t-value
Constant	3.4587	6.492*	4.8020	10.379*
LNLAB	0.0645	.741	0.0994	1.781***
LNFERT	0.1393	6.818*	0.2415	5.494*
LNCASH	0.1948	2.299**	0.1982	2.295*
G_{12}	-0.1940	-2.283**	-0.0241	-.723
G_{21}	-0.0308	-.545	-0.0116	-.233
G_{22}	-0.0017	-.022	0.1952	4.070*
M_1	-0.1611	-3.008*	-0.0501	-1.109 M_2-
0.2963	-4.667*	0.3440	.835	
M_3	-	-	0.0015	.029

Note * significant at 99%
** significant at 95%
*** significant at 90%

LNLAB = natural log of labor (manday/rai)
LNFERT = natural log of fertilizer (kg/rai)
LNCASH = natural log of cash expenses (baht/rai)
G_{12}...G_{22} = dummy variable of farmer groups previously defined
M_1 = soybean - mango for soybean model
M_2 = soybean -tobacco for soybean and tobacco - mango for tobacco model
M_3 = soybean - tobacco for tobacco model

The additional yield due to this farm group, however, is negligible (0.1952 kg/rai). The dummy variables of cropping systems are insignificant. This reveals that tobacco production practices of the farmers in the LRA were the same as for other farmer groups regardless of how farmers mixed it with soybean or tomato or intercropped with mango.

As for soybean, fertilizer (LNFERT) and cash input (LNCASH) significantly determine the yield but not labor (LNLAB).Since most farmers used about the same amount of labor (the coefficient of variation of labor is only 11 percent), labor can not really explain the variations in the yield (eventhough it is an important input). The average yield of the G_{12} and other soybean cropping systems M_1 and M_2 (soybean-mango and soybean-tobacco) are lower than the G_{11}, G_{21}, G_{22} and soybean monocropping pattern but the differences are very minimal (details of the variables are found in Appendix 14 and 15).

6.3 Output Elasticities and Returns to Scale

One advantage of using the Cobb-Douglas production functional form is that one can derive output elasticity of each input directly. A coefficient of an input indicates the percent of change of the output as that input changes by 1 percent (Henderson and Quandt, 1980 : 69)

$$\text{i.e.} \quad \frac{\partial \ln y}{\partial \ln x} = \frac{\partial y}{\partial x} \cdot \frac{x}{y}$$

$$\text{or} \quad = \frac{\text{Marginal product}}{\text{Average product}}$$

where y is output and x is input factor. The elasticity of labor, fertilizer and cash for tobacco are 0.099, 0.241 and 0.198 and those for soybean are .0, 0.139 and 0.195 respectively.

The low elasticities explain the fact that the farmers used such a large quantity of labor in both crops that the marginal product of labor is almost zero in tobacco and not different from zero in soybean productions. This is confirmed by the values of marginal product of labor (MVP) in Table 6.5 which are far below the market wage rates.

Table 6.5 Comparison of MVPs to input prices.

Item	Soybean	Tobacco
Output price (baht/kg)	9.07	2.60
MP of fertilizer (kg/kg)	1.176	7.012
MVP of fertilizer (baht/kg)	10.67	18.23
Price of fertilizer (baht/kg)	8.00	7.00
MP of labor (kg/md)	0	4.614
MVP of labor (baht/md)	0	11.997
Wage rate (baht/md)	26-80	40-80
MP of cash (kg/baht)	0.0836	0.705
MVP of cash (baht/baht)	0.757	1.833
Cash cost of 1 baht[a] (baht/baht)	1.046	1.046

a) interest rate = 14% per annum

As for fertilizer, on the average, farmers were using less than the optimal rate since one can raise profit by adding more fertilizer until the MVP gets closer to 8.00 baht (for soybean) and much more for tobacco (approaching 7.00 baht). Soybean farmers over utilized other cash input (LNCASH) while tobacco farmers should have invested more.

Returns to scale of a homogeneous function is the sum of input elasticities. Here, both tobacco and soybean productions in the LRA exhibit decreasing return to scale since they are .539 and .33 which are below 1. This result implied that, in aggregate, the farmers used inputs at a rather high level for the given technology. (Henderson and Quandt, 1980 : 105), and thus unit cost of production is in the increasing range for both tobacco and soybean. The latter demonstrates lower return to scale because the marginal productivity of labor is not statistically different from zero whereas that of the farmer is slightly above zero.

One may conclude that for the present technology, tobacco farmers over-employed labor, and properly applied fertilizer and other cash inputs, but soybean farmers over used all inputs except fertilizer.

To improve efficiency of labor and other cash inputs, soybean farmers should adopt better production technology to make the use of these inputs more valuable and thus the return on the unit area would consequently increase. However, one could argue that adopting better technology possibly requires higher cash input as well as fertilizer. Thus, the present level of the input use might become less than optimal. This is quite possible and, therefore, calls for credit facilities to improve production efficiency.

Concerning partial use of the LRA land, the results from Table 6.2 and 6.3 reveal that insufficiency of labor and capital partly constrain tobacco farmers from fully utilizing their land. Since they have limited capital to achieve the optimal level of input applied to all their land they decided to employ only part of

their land to the optimal. This is evidently true from the result that at the average of land intensity of tobacco system (0.73), the farmers tried to maximize profit by using capital (LNCASH) approaches to its cost (MVP = 1.833 as opposed to MFC = 1.046). If the available capital were spread over all their available land the MVP would be much higher than 1.833 (which suggests that they were using too little capital).