CHAPTER III

PRODUCTION ENVIRONMENT IN THE STUDY AREA

The study area covered six districts of the Chiang Mai Province namely, Phrao, Doi Saket, San Sai, Mae Rim, San Kam Phaeng and San Pa Tong. The first four districts are located in the northern and northwestern part of the Chiang Mai city (Fig. 7). San Pa Tong and San Kam Phaeng is located in the southeastern and eastern part of the city respectively. A national highway network stretches across all these six districts and supporting feeder roads also facilitates the access to city market. Phrao is relatively dry area with upland land types and is located 100 km north from the city. The nearest district is the San Kam Phaeng, about 20 km from the city. The intent of the present chapter is to describe the physical production environment and socio-economic information of the sample farms as well as some selected information on the sample villages as a whole.

3.1 The Production Environment

Agricultural production environment is determined by physical, climatic and also to some extent by socio-economic factors. The study area comprises of a mix of irrigated agriculture as well as rainfed agriculture, with wet season rice as the main crop in the system. Surface water irrigation systems from Mae Khong, Mae Kai and Mae Taeng is the major water supply source for these areas. However, few

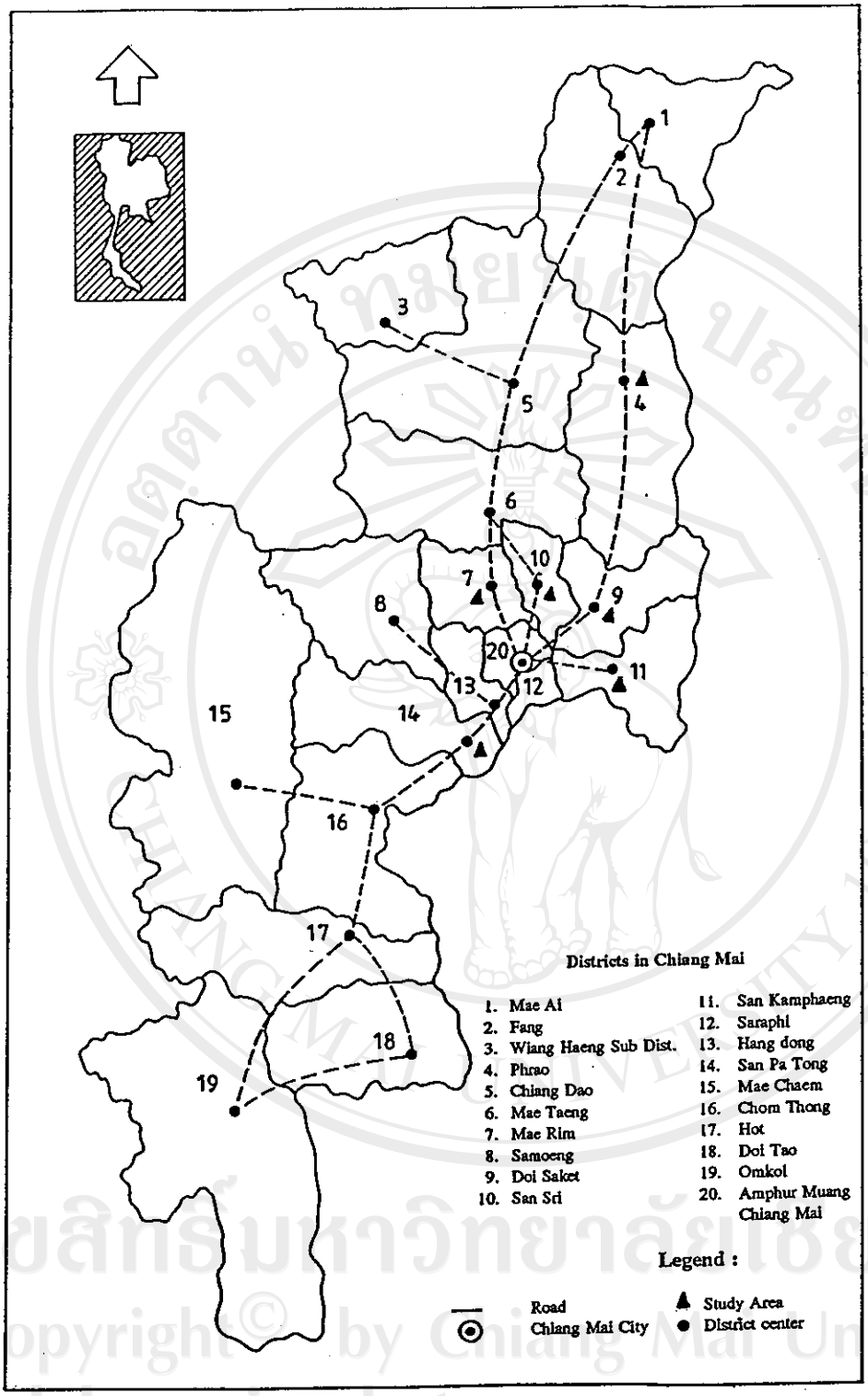

Figure 7. Map of Chiang Mai province showing the study area.

Source : Adapted from Abamo (1992)

shallow tubewell irrigation systems used mainly for irrigating potato and other vegetables in the dry season were observed in San Sai. Phrao district is basically considered as out of the lowland agro-ecosystem of the Chiang Mai valley characterized with relatively poor infrastructure network, irrigation system and partially elevated land types. This was also reflected in the lower productivity of rice in the sample. The other five districts have a complex mix of intensive agriculture based systems to semi-industrialized and urban economic systems.

3.1.1 Cropping Systems

Chiang Mai Valley which stretches over the provincial area is endowed with favorable production environment for most of the economic crops. The main notable crops are rice, soybean, onion, garlic, chilly, various vegetables, tobacco and seasonal fruits. Rice based cropping system is the mainstay of the farmers except in upland areas, with little or no irrigation, where soybean based cropping system is dominant (Abamo, 1992).

Rice-soybean, rice-tobacco, rice-peanut are the dominant cropping systems in Phrao. Rice-garlic, rice-chilly, rice-onion-soybean are practiced in San Pa Tong and San Kam Phaeng. In San Sai, rice-potato, rice-tomato, rice-vegetables systems are the major patterns. The farmers of other three areas also practice rice-soybean, rice-garlic and rice-vegetables. Seasonal fruits, such as, longan, lychee are also produced by some farm families having land in the upland areas. Table 3 presents the cropping system followed by the sample farms in general.

Table 3. Second crops grown in general after wet rice in the study area

Area	Second crop growers (%)	Non-growers (%)	Crop types (weighted by number of farms growing)					
			Soybean	Spices	Potato	Tobacco	Peanut	Others
San Kam Phaeng	18.18	81.82	25.00	50.00	-	-	-	75.00
Doi Saket	44.44	55.56	68.75	43.75	-	-	12.50	6.25
Phrao	85.71	14.29	94.44	5.56	-	8.33	2.78	8.34
San Sai	96.77	3.23	70.00	-	26.66	-	-	10.00
Mae Rim	90.91	9.09	100.00	-	-	10.00	-	-
San Pa Tong	100.00	-	92.59	18.52	-	-	-	3.70
Total	73.89	26.11	83.46	11.28	6.02	3.76	2.26	8.28

Source: Survey

3.2 Agro-economic Characteristics of the Sample Villages

In this study, respondents were represented from about 22 villages. As such, a brief on some selected agro-economic features of the villages as a whole seems desirable. Table 4 presents some selected features of the sample villages aggregated as one for each area. Overall family size of the study areas ranges from 3.19 persons in Doi Saket to 4.38 persons in San Pa Tong. Topographically, villages in Phrao are of upland land type having slopes of about 1 to 15 percent and in some cases up to 35 percent, and the rest are on flat lands. The major proportion of soils are clay with a mix of loamy and sandy soils. In the wet season, Khao Dawk Mali area constituted more than half of the total rice area in Doi Saket, Phrao and San Sai, while glutinous rice production was dominant in Mae Rim, San Pa Tong and San Kam Phaeng covering more than two-third of the total rice area. This

Table 4. Agro-economic profile of the study villages in aggregates in six districts

Attributes	San Kam Phaeng	Doi Saket	Phrao	San Pa Tong	San Sai	Mae Rim
Demographic						
Total village area (rai)	3809	1696	3164	1685	970	1030
No. of Households	829	376	254	528	309	343
Total population (persons)	3088	1200	954	2311	1280	1258
Family size	3.72	3.19	3.76	4.38	4.14	3.67
Topographic and climatic						
Rainfall (mm.)	905	866	910	785	843	928
Percent of precipitation during May-September	92.2	82.7	73.4	70.9	87.4	74.5
Agriculture						
Total cultivated area (rai)	2450	994	1138	1373	520	860
Total rice area (rai)	2296	805	1130	1228	520	860
KDML 105 (%)	39.9	71.9	53.5	33.0	67.7	17.1
RD 6 (%)	60.1	18.3	35.9	27.2	25.4	73.6
NSPT (%)	-	9.8	10.6	39.8	6.9	9.3
Other crops grown after wet rice[a]	C—,O,G	P,Ft,	S,T,	O,G,S, V,Dr	P,C,V, Dr,S	S,G,T
Tenurial structure						
Owner operated HHs (%)	62.4	78.6	57.4	68.3	26.0	44.4
Tenant operated HHs (%)	37.6	21.4	42.6	31.7	74.0	55.6
Wage structure						
Cash with food (baht/day)	100-120	80	60	60-70	100	70
Cash contract (baht/rai)	350	350	300-350	350	-	350
Kind in paddy (kg/day)	20-30	20	10	10-15	-	20
Tractor rental (baht/rai)	350	350	300-350	350	250-350	350

[a] C = Chilly, O = Onion, G = Garlic, P = Peanut, Ft = Fruit tree, S = Soybean, T = Tobacco, V = Vegetable, Dr = Dry rice.

Source : Survey

reflects that the sample of this study was represented from areas where either Khao Dawk Mali or the glutinous varieties were dominant.

Share-tenancy was found to be dominant in San Sai and Mae Rim. A wide variation in wage rate is observed, ranging from 60 baht in Phrao (farthest from Chiang Mai city) to 120 baht per day in San Kam Phaeng (nearest to the city).

3.3 General Socio-economic Information of the Sample Farms

3.3.1 Family Size

The size of families varied from 3.64 persons in Mae Rim to 4.42 in San Sai (Table 5). However, the figures are not significantly different from each other.

3.3.2 Land Ownership and Tenancy

Average size of land owned per farm is highest in Phrao (13.38 rai per farm), a dry upland area and lowest in San Pa Tong (5.35 rai per farm), a well irrigated area which is currently under pressure of expanding urbanization (Table 5). The operation size also varies largely across areas in a similar pattern, ranging from 19.06 rai per farm in Phrao to only 7.68 rai per farm in San Pa Tong.

Table 5. General socio-economic information of the sample farms

Attributes	San Kam Phaeng	Doi Saket	Phrao Rim	Mae Sai	San Tong	San Pa Area	All
Demographic							
Family size (persons)	4.05	3.94	4.05	3.64	4.42	4.00	4.03
Farm and household Assets (baht/farm)	122,570	147,645	114,120	66,737	171,509	118,771	118,770
Land ownership (rai/farm)							
Homestead area	0.71	1.08	0.95	0.84	0.94	0.62	0.88
Owned land	10.91	9.13	13.38	6.51	7.68	5.35	9.20
Size of rented-in land	2.41	4.53	6.62	3.23	4.85	2.94	4.42
Size of rented-out land	0.23	1.67	2.52	-	0.23	-	1.00
Operation size	12.66	12.83	19.06	8.72	11.68	7.68	12.79
Tenancy (percent)							
Owner operator	68.18	55.56	42.86	59.09	45.16	48.15	51.67
Pure tenant/landless	18.18	19.44	26.19	13.64	16.13	18.52	19.44
Part tenant	13.64	25.00	30.95	27.27	38.71	33.33	28.89
Prices							
Rice price (baht/kg)	3.78	3.86	3.63	3.93	3.92	3.50	3.78
Price of seed (baht/kg)	6.61	6.97	6.77	6.66	6.88	6.56	6.79
Wage rate (baht/day)	93.03	80.96	57.74	64.87	78.46	64.95	72.27
Tractor rate (baht/rai)	235.12	196.77	175.40	235.05	228.21	255.24	214.38
Farming experience (years)							
Overall farming	22.32	26.58	22.60	23.95	27.77	24.44	24.69
Growing Khao Dawk Mali	6.32	10.67	10.83	4.23	10.00	6.74	8.68
Growing glutinous rice	6.30	6.20	9.33	7.00	6.20	6.44	6.53

Source: Survey

Renting out land is not quite significant in any of the areas. On an average, about half of the farms are owner operated while about 20 percent farms are functionally landless and was farming under varied tenurial arrangements (Table 5). The rental arrangements vary from case to case, depending on whether a commercial or kinship relation dominates. The common practices include, (a) fifty-fifty crop output sharing with some input costs (such as fertilizer cost, half of the hired labor cost for harvesting and threshing) or no input costs sharing, (b) fixed rent in cash ranging from 400 to 1000 baht per rai per year, or (c) fixed rent in kind ranging

from 100 to 200 kg of paddy per rai per year. One important point is to note that, the rent is paid only once in rice while the tenant is allowed to use the land for the whole year and grow as many crop as he/she desires. Similar pattern of rental arrangements were also reported by Zhang (1991) for San Sai area.

3.3.3 Input and Output Prices

The mean level of farm specific rice price received (ignoring varietal differences) for the crop year 1992 was 3.78 baht per kg (Table 5). The mean labor wage was 72.27 baht per day and mean tractor hiring rate (4-wheel and 2-wheel) was 214.38 baht per rai.

3.3.4 Farming Experience

The mean level of overall farming experience of the sample farms was about 25 years (Table 5). Khao Dawk Mali seems to be newly extended (less than 7 years) in the three pre-dominantly glutinous rice growing areas, Mae Rim, San Pa Tong and San Kam Phaeng. This newly expanded cultivation of Khao Dawk Mali might have contributed to its observed increasing growth rate at the national scale (see Table 5).

3.3.5 Farms and Household Assets

San Sai farms had the highest value of farm and household assets (171,509 baht per farm). Farm machinery and equipment, which include tractors and accessories, sprayer, water pump constituted about 14 percent of total value and was owned by about half of the sample farms (see item number 1 through 4, Table 6). Means of transport, pick-up trucks and motorcycles constituted the major share of the assets value (40 percent) and more than 90 percent of the farms owned at least one motorcycle. About three quarter of the farms had liquid assets, such as, bank savings, cooperative funds or gold ornaments, which constituted about 27 percent of the assets value.

Table 6. Percentage distribution of farm and household assets of sample farms

Area	Tractor and accesorry	Generator and thresher	Sprayer	Water pump	Pick-up truck	Motorcycle and birds	Livestock	Farm house assets	Liquid assets	Household	Total
San Kam Phaeng	6.39 (54.55)	0.78 (9.09)	0.17 (54.55)	0.63 (59.09)	36.34 (22.73)	17.82 (100.0)	17.74 (72.73)	6.44 (68.18)	6.11 (63.64)	7.58 (100.0)*	100.00
Doi Saket	4.90 (47.22)	0.13 (5.56)	0.10 (41.67)	0.97 (58.33)	12.61 (11.11)	12.19 (88.89)	3.77 (52.78)	2.06 (38.89)	56.86 (69.44)	6.41 (100.0)	100.00
Phrao	16.66 (73.81)	9.39 (7.14)	0.38 (71.43)	1.55 (69.04)	25.04 (19.05)	18.67 (95.24)	7.25 (78.57)	3.08 (54.76)	10.31 (85.71)	7.67 (100.0)	100.00
Mae Rim	7.47 (40.91)	- -	1.60 (77.27)	2.18 (72.73)	36.10 (22.73)	18.71 (79.27)	3.56 (54.55)	6.88 (90.91)	12.95 (81.82)	10.55 (100.0)	100.00
San Sai	9.75 (35.48)	0.15 (6.45)	0.66 (77.42)	0.93 (70.97)	29.10 (32.26)	10.20 (83.57)	4.49 (64.52)	9.07 (83.87)	31.18 (74.19)	4.47 (100.0)	100.00
San Pa Tong	9.37 (51.85)	- -	0.81 (77.78)	2.11 (77.78)	22.36 (11.11)	22.46 (100.0)	3.63 (66.67)	11.83 (62.96)	14.30 (81.48)	13.13 (100.0)	100.00
All Area	9.48 (51.11)	2.27 (5.00)	0.47 (68.33)	1.23 (68.33)	24.92 (19.44)	15.16 (91.11)	6.46 (66.11)	5.74 (63.89)	27.06 (76.67)	7.21 (100.0)	100.00

* Figures in parenthesis are percentages of the farms that had those kind of farm and household assets as percent of total number of farms in each area.

Source : Survey

3.4 Economics of Rice Cultivation

This section analyzes the economics of cultivation of alternative rice varieties investigated. The objective is to highlight the implication of the adoption of high quality rice variety for costs of production, input requirements and profitability of cultivation. The larger the gains for farm households in the cultivation of Khao Dawk Mali rice relative to glutinous rice, the greater would be the possibility of diffusion of Khao Dawk Mali in northern region.

3.4.1 Yields

Land is a scarce resource in these Asian regions. As urbanization increases with consequent land value appreciation, agricultural production faces high competition and pressure to yield higher income which is feasible through intensification and increases in productivity of high valued crops.

At the sample means, significant yield differences (43 kg per rai) was observed between the two rice varieties ($P < 0.01$) (Table 7). Farm-level yield of Khao Dawk Mali was estimated at 643 kg per rai as compared to 600 kg per rai for glutinous varieties (80 percent of which is RD 6 alone, 15 percent Neaw San Pa Tong, and 5 percent RD 8 and RD 10). It should be noted that, no large variations was found among RD 6, RD 8, RD 10 and Neaw San Pa Tong with respect to yield levels, input uses and production practices. And as such, these varieties were grouped as one to represent as the glutinous variety.

Table 7. Average cost and profitability at farm specific prices of rice production, 1992

Variety/Area	Weight[a]	Yield (kg/rai)	Paddy price (baht/kg)	Gross value (baht/rai)	Variable cost (baht/rai)	Gross margin[b] (baht/rai)
San Kam Phaeng						
Khao Dawk Mali	0.671	676	4.28	2893.90	1143.75	1750.15
Glutinous rice	0.275	624	3.29	2056.30	1102.24	954.06
Doi Saket						
Khao Dawk Mali	0.811	650	4.16	2703.00	879.41	1823.59
Glutinous rice	0.189	647	3.29	2127.50	800.06	1327.44
Phrao						
Khao Dawk Mali	0.591	603	4.13	2488.60	732.29	1756.31
Glutinous rice	0.409	579	3.10	1814.70	799.08	1015.62
Mae Rim						
Khao Dawk Mali	0.339	751	4.18	3135.50	1040.22	2095.28
Glutinous rice	0.661	576	3.78	2179.10	866.07	1213.03
San Sai						
Khao Dawk Mali	0.744	643	4.07	2616.50	906.91	1709.59
Glutinous rice	0.256	690	3.64	2520.90	938.75	1582.15
San Pa Tong						
Khao Dawk Mali	0.373	594	3.88	2306.50	1042.65	1263.85
Glutinous rice	0.627	547	3.25	1775.80	1093.09	682.71
All Area						
Khao Dawk Mali	0.607	643	4.12	2652.50	917.27	1735.23
Glutinous rice	0.343	600	3.38	2029.00	917.74	1111.26
Mean difference		43	0.74	623.50	-	623.97
		(2.29)**	(16.90)***	(7.97)***	-	(7.31)***

Figures in parenthesis are approximate t-ratios

*** Significant at 1 percent level

** Significant at 5 percent level

[a] The proportion of total rice area

[b] Gross Margin = Gross value of production minus costs of seed, fertilizer, manure, irrigation, pesticides, hired labor, hired tractor price and imputed value of family and exchange labor and imputed value of tractor price.

Source: Survey

3.4.2 Material Inputs

The material inputs to be mentioned are seed, fertilizer, pesticides and irrigation.

3.4.2.1 Seeds

The amount of seed used per unit of land depends on whether the seed is broadcast, or a separate seed bed is prepared to grow seedlings which are then transplanted to the main field, the later being the common practice in these regions. Higher seed rate (7.82 kg per rai) was observed in glutinous rice production as compared to 6.90 kg per rai for Khao Dawk Mali (Table 8). The mean difference is about 0.92 kg of seeds per rai and is significant at 5 percent level.

3.4.2.2 Fertilizer and Pesticides

The fertilizer rate for Khao Dawk Mali and glutinous varieties were estimated at 17.12 kg and 16.32 kg of material per rai, respectively (Table 8). About 21 percent farms used manures in addition to low doses of chemical fertilizers.

In some areas of the northern region, widespread rice-blast disease were reported for the crop year 1992. Among the sample, few farms reported some damage in yield levels of both varieties. However, pesticides and herbicides were used by about 60 percent of the farmers as a precaution to imminent danger. It

Table 8. Material inputs in rice production

Variety/Area	Seed rate (kg/rai)	Fertilizer rate (kg/rai)	Pesticide rate (baht/rai)	Irrigation rate (baht/rai)
San Kam Phaeng				
Khao Dawk Mali	6.10	25.12	41.56	6.64
Glutinous rice	8.90	30.04	30.46	7.55
Doi Saket				
Khao Dawk Mali	6.47	18.20	8.52	-
Glutinous rice	7.18	16.08	5.61	-
Phrao				
Khao Dawk Mali	6.21	13.52	30.06	3.00
Glutinous rice	6.54	14.67	41.56	6.64
Mae Rim				
Khao Dawk Mali	7.15	13.31	42.15	12.38
Glutinous rice	7.77	14.13	29.55	22.00
San Sai				
Khao Dawk Mali	6.82	16.26	23.45	8.63
Glutinous rice	7.52	17.46	20.12	6.00
San Pa Tong				
Khao Dawk Mali	10.08	18.59	72.54	6.00
Glutinous rice	9.52	18.95	79.97	7.38
All Area				
Khao Dawk Mali	6.90	17.12	26.70	5.00
Glutinous rice	7.82	16.32	36.00	8.00
Mean difference	-0.92	0.80	-9.30	-3.00
	(-2.159)**	(0.677)	(-1.446)	(-1.127)

Figures in parenthesis are approximate t-ratios
** Significant at 5 percent level
Fertilizer rate is measured in kg of material per rai.
Source: Survey

should be noted that measurement of these inputs are complicated as farmers use various types of chemicals. A common measure of aggregation is to use the value of expenditure on pesticide and herbicide as a proxy. The mean expense incurred for such chemicals were 36.00 and 26.70 baht per rai for glutinous variety and Khao Dawk Mali, respectively (Table 8).

3.4.2.3 Irrigation

Surface water irrigation system is the dominant mode in the northern region. The Royal Irrigation Department (RID) constructs the weir and the main canal while the farmers receives water by paying a flat rate of 5.00 to 6.00 baht per rai for the growing season. Therefore, irrigation can be considered as a linear function of land size and frequency of irrigation and water control will vary from farm to farm depending on the stock of family labor. During the interview sessions, isolating the cost of irrigation came out to be very cumbersome. Only the flat water fee and in some cases fuel costs incurred to operate the water pumps were obtained and these values were aggregated to use as a proxy for irrigation expenses. The average expense per rai for irrigation was estimated at 5.00 baht and 8.00 baht for Khao Dawk Mali and glutinous varieties, respectively (Table 8).

3.4.3 Labor

Labor was classified into three groups; family labor, exchange labor and hired labor. Exchange labor means the host farmer calls in neighbors for farming

operations, mainly for transplanting, harvesting and threshing, and make up the labor used in return by working himself for equivalent man-days in the neighbors' farms. However, during work, the host provides one light meal and drinks, the cost of which was estimated at about 10 to 20 baht per person per day.

Significant ($P < 0.01, 0.05$) differences were observed in the use of family and exchange labor and hence the total labor per day and per ton of paddy between Khao Dawk Mali and glutinous varieties (Table 9). Higher amount of labor being used in growing glutinous varieties. However, the proportion of hired labor as percentage of total labor was found to be 15 percent lower in case of glutinous rice farms. The labor days per ton of paddy produced were estimated at 17.67 and 23.40 persons for Khao Dawk Mali and glutinous varieties, respectively.

Table 9. Labor inputs in rice production

Variety/Area	Family labor	Ex-change labor	Hired labor	Total labor	Hired labor as % of total	Labor days per ton of paddy
			.....(man-days/rai).....			
San Kam Phaeng						
Khao Dawk Mali	2.30	2.33	7.32	11.95	61.26	17.69
Glutinous rice	4.42	4.33	4.75	13.50	35.19	21.63
Doi Saket						
Khao Dawk Mali	4.49	3.43	5.70	11.72	48.63	19.45
Glutinous rice	5.73	5.99	3.98	15.70	25.35	24.28
Phrao						
Khao Dawk Mali	2.59	3.43	5.70	11.72	48.63	19.45
Glutinous rice	3.97	7.85	5.29	14.03	40.27	24.24
Mae Rim						
Khao Dawk Mali	3.73	4.77	8.69	17.19	50.55	22.88
Glutinous rice	3.99	7.85	5.29	17.13	30.88	29.74
San Sai						
Khao Dawk Mali	3.15	5.25	5.62	14.02	40.08	21.80
Glutinous rice	3.71	5.45	6.95	16.11	43.14	23.34
San Pa Tong						
Khao Dawk Mali	5.41	5.53	6.89	17.83	38.64	30.00
Glutinous rice	3.64	5.14	7.65	16.43	46.56	30.05
All Area						
Khao Dawk Mali	2.44	2.43	6.24	11.11	56.17	17.67
Glutinous rice	3.33	4.62	5.70	13.62	41.85	23.40
Mean difference	-0.89 (-2.31)**	-2.19 (-3.21)***	0.54 (0.93)	-2.51 (-3.27)***	-	5.73 (-3.99)***

Figures in parenthesis are approximate t-ratios
*** Significant at 1 percent level
** Significant at 5 percent level
Source: Survey

3.5 Average Cost and Profitability

The costs and gross returns have been estimated at actual prices paid and received by farmers. Land is an important fixed asset but the opportunity cost of the investment in land has not been included in the cost of production for owner operated farms. The justification is that land, unlike other fixed assets, land does not depreciate in value in land scarce countries (Hossain, 1991). Land rent for the tenant farmers were also not included in the calculation of farm operator's surplus because the rent for entire one year was paid in rice alone and as such inclusion of this item as a cost for only rice production will seriously overestimate the cost figures. Moreover, rent can also be treated as a fixed cost considering it as a linear function of the land size cultivated. Another cost element that has not been included is the rate of interest paid on working capital borrowed from outside, because of the short cycle of production and difficulty in apportioning the loan to various crops.

Family labor and exchange labor has been imputed at the entertainment cost incurred for exchange labor, as opportunity cost of family labor is unlikely to be same as the market wage rate. The opportunity cost of labor could vary across farms depending on the availability of family labor. Junankar (1989) criticized the use of same market wage rate for family and hired labor, (as well as male/female, child/adult labor) as a gross simplification, as it implies that labor market is perfect and the opportunity cost of family labor is the wage rate. Sevilla-Siero (1991) suggested an alternative view that farmers by segmenting the output and/or labor markets can turn a negative farm profit (computed at market prices) into a positive

one. In this view of production behavior, the farmer treats his family supply of labor and his family demand for output as *internal markets* which, under certain conditions, he may segment profitably from the '*external*', the market supply of labor to the farm, and the market demand for farm output. In his pursuit of profit in such cases, the farmer (i) sells part of farm output in the external market at the given market price, and the remainder in the internal (family) market at an endogenously determined price which is higher than the market price, and (ii) hires part of total labor requirements from the external labor market at the *given* wage rate, and the balance from the internal (family) market at an endogenous wage rate which is lower than the market wage. Thus profit maximization in the standard sense is a special case of a broader behavior rule involving profit maximization with market segmentation (Sevilla-Siero, 1991).

Owner operated tractors were imputed by the daily hiring rate of machines (different from the common hiring rate of 250 to 350 baht per rai), plus one day hired labor cost plus actual fuel costs spent for farm operation. This method was used mainly because, more than 50 percent of the sample farms own tractors reflecting that imputing this input by market rate will overestimate the cost figures, assuming that the farmers follows market segmentation strategies.

The items included in the estimation of different variables are as follows:

Material Input Costs = Seeds (own supplied and purchased), manure, fertilizer, pesticides, irrigation charges.

Purchased Input Costs = Material inputs plus hired labor and hired machine power services.

Total Cost	=	Purchased inputs plus imputed value of family labor and tractor power supplied from the household.
Profit	=	Gross value of production minus total cost.
Farm Family Income	=	Gross value of production minus purchased input costs.
Value Added	=	Gross value of production minus the material input costs.

The farm specific prices of paddy received for Khao Dawk Mali (4.12 baht per kg) is significantly ($P < 0.01$) higher than the price of glutinous rice (3.38 baht per kg) (Table 7). Coupled with higher yield and higher farm-specific prices of paddy, the gross value of production per rai of Khao Dawk Mali was also found to be significantly higher ($P < 0.01$).

However, no difference in variable cost per rai of rice production was observed between varieties at the sample means, though at a disaggregated level, the material costs were found to be higher for the glutinous varieties which was offset by lower total labor costs as a consequence of using less hired labor. As such the gross margin was estimated at 1,735 baht per rai for Khao Dawk Mali and 1,111 baht per rai for glutinous variety, resulting in a significant ($P < 0.01$) mean difference of 624 baht per rai.

The comparative positions of factor shares are analyzed in Table 10. Family supplied material inputs and labor were estimated to be significantly higher for glutinous rice production than for Khao Dawk Mali. The higher family supplied labor and input usage for glutinous rice production implicitly supports the assumption of market segmentation strategy explained above. Since, family supplied inputs do not involve cash expenses, these are used more in glutinous rice production

Table 10. Factor shares in rice production

Factors	Khao Dawk Mali		Glutinous variety		Mean difference	t-Ratio
	Baht per rai	% of Gross value of prod.	Baht per rai	% of Gross value	Baht per rai	
Material inputs	190.67	7.19	210.99	10.40	-20.32	-1.42[a]
Family supplied	20.72	0.79	36.11	1.78	-15.39	-2.36**
Purchased	169.95	6.40	174.88	8.62	-4.93	-0.43
Human labor	526.98	19.87	477.93	23.55	49.05	1.29[a]
Family	67.03	2.53	81.07	3.99	-14.04	-1.65*
Hired	459.95	17.34	396.86	19.56	63.09	1.54[a]
Tractor power	199.62	7.52	228.81	11.28	-29.19	-2.28**
Family supplied	54.64	2.06	49.73	2.45	4.92	0.68
Hired	144.98	5.46	179.08	8.83	-34.10	1.93*
Profit[b]	1735.20	65.42	1111.30	54.77	623.97	7.31***
Gross value of production[c]	2652.50	100.00	2029.00	100.00	623.50	7.97***
Farm family income	1856.90	70.01	1242.10	61.22	614.80	7.92***

*** Significant at 1 percent level
** Significant at 5 percent level
* Significant at 10 percent level
[a] Significant at 20 percent level
[b] Profit = Gross value of production minus total cost.
[c] Farm Family Income = Gross value of production minus purchased input costs.

Source: Survey

wherein consumption motive is a primary consideration and which yields significantly lower profits. On the other hand, lower labor input usage in Khao Dawk Mali production might be due to better and carefully managed allocation of proportionately higher hired labor and may not necessarily be the differences in labor intensiveness between varieties. The mean tractor power rate was found to be significantly higher in glutinous rice production because of higher hiring rate prevailing in San Pa Tong and Mae Rim districts.

The returns to family resources (farm family income) is about 9 percent higher for Khao Dawk Mali. The average labor productivity, estimated as value added per day of labor, was 222 baht and 133 baht for Khao Dawk Mali and glutinous rice varieties. The difference is about 60 percent.

3.6 Highlights

The production environment of the study area comprises of a mix of irrigated agriculture as well as rainfed agriculture with a rice based double cropping system. Khao Dawk Mali is more produced in Doi Saket, San Sai and Phrao, while glutinous varieties are dominant in San Pa Tong, San Kam Phaeng and Mae Rim. The average operation size was 12.79 rai and about half of the farms were owner operated while 20 percent were landless tenants.

Significantly higher yield was estimated for Khao Dawk Mali (643 kg per rai) as compared to glutinous varieties (600 kg per rai). Significant higher family and exchange labor use and hence the total labor use, and family supplied material inputs were also observed for the glutinous varieties as compared to Khao Dawk Mali.

Though on the whole no differences were observed in total variable costs, significantly higher profits were estimated for Khao Dawk Mali (1,735 baht) as compared to glutinous varieties (1,111 baht).