CHAPTER 4

RESULTS AND DISCUSTION

This chapter described existing cropping systems, row-seeding and rice production practice, social-economic characteristic of farm households, the result of costs and returns of row-seeding and conventional broadcasting practice, and the explanation of the result in estimating Cobb-Douglas production function model.

4.1 Existing Cropping Systems

Participatory Rural Appraisal (PRA) and direct or face-to-face interview were simultaneously conducted to identify shortcomings and opportunities of row-seeding practice, to obtain information of inputs and outputs in both row-seeding and broadcasting practice of the existing rice production systems.

4.1.1 Transect Map

A typical transect (Figure 4.1) of Tan Phu Thanh village were carried out in participatory rural appraisal (PRA). Using the transect map, one can graphically described the factors such as soil, water, crops, livestock, problems, affecting crop production. In general, homesteads are mostly located along the main river and rural road in front of the house. Behind the house are fruit tree garden, and rice fields are the last.

Soil textures in fruit tree garden are alluvium soils with loam and clay and paddy fields are mostly silty and clay soils. Abundant fresh water is supplied all year round by main river. Crops consist of fruit tree and rice. Fruit tree includes citrus, bananas, caimito, guava, longan, mango, hog-plum, jambosa, and durian, in which orange and mandarin citrus were planted over many past years because it brought high income. Paddy field was grown two crops and three crops per year with modern rice varieties. Among these, two rice crops were rotated with upland crops such as

tomato, lettuce, cucumber, and asparagus bean. Livestock including fishery and poultry also plays an important role in increasing farmers' income. Fishes were raised for both sale and home consumption, especially hybrid catfish for sale only. Poultry including pigs, duck, and chicken, in which pigs and chicken were raised for sale.

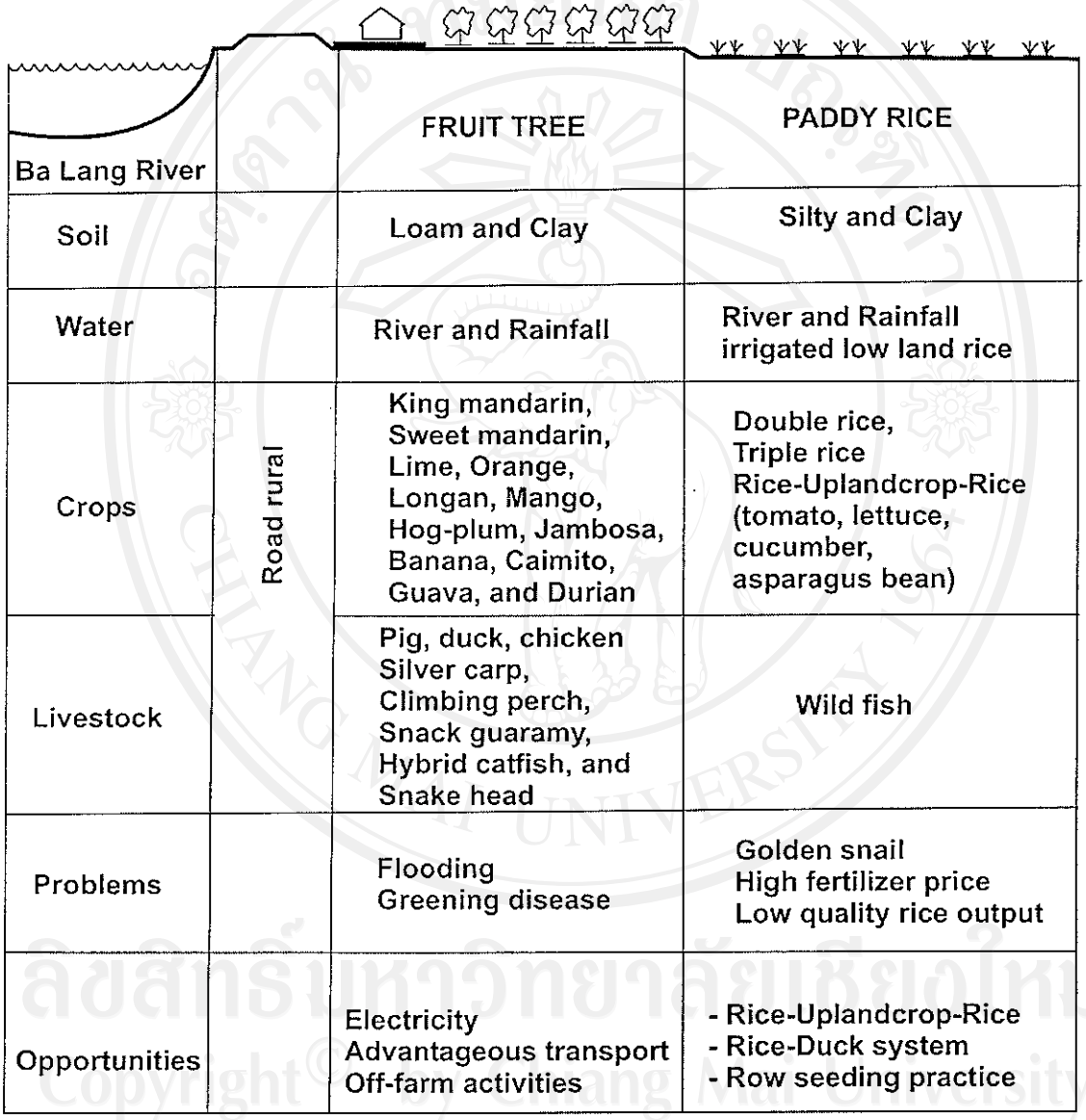

Figure 4. 1 Transect map of Tan Phu Thanh village.

Source: PRA March, 2003

Flooding and greening disease were two main shortcomings in fruit garden, and problems in paddy fields were golden snail, high fertilizer price, and low quality rice out put.

Farmers also concerned about opportunities to overcome the shortcomings. According to farmers, practicing major cropping pattern such as rice-duck and rice-upland crops systems help stabilize their income, and row-seeding technique was also viewed a good crop establishment. Moreover, off-farm activities were also identified as way to increased their living standard.

4.1.2 Seasonal Calendar

Rice cultivation is major source income in Tan Phu Thanh village where there are three cropping systems: triple rice (rice-rice-rice) (340ha), double rice (rice-rice), (467.5 ha) and double rice upland crop (rice-upland crop-rice) (42 ha).

The first crop (dry season) of triple rice (Figure 4.2) starts in mid or late November when the flood just receded and is harvested in mid and late February. Direct seeded rice with wet seeding technique is the most popular one for crop establishment. After harvesting the first crop, the second crop (early wet season) is followed immediately with no-tillage (zero-tillage) practice, and is harvested at the end of May. The third crop (late wet season) with wet seeding begins after harvesting the second crop, and is harvested at the onset of flooding in early September.

In double rice cropping system the first crop (dry season) starts in the same period the first crop of triple rice. After harvesting the first crop, land is fallowed during mid February to early May. The second crop (wet season) begin in early May and is harvest in early August.

For double rice- upland crop cropping system, the first crop (dry season) and the third crop (late season) are the same period triple rice and double rice. The second crop is grown vegetables instead of rice.

Annual flooding often appears in mid August and last until the end of November. During flooding period, the paddy fields are waterlogged and fallowed.

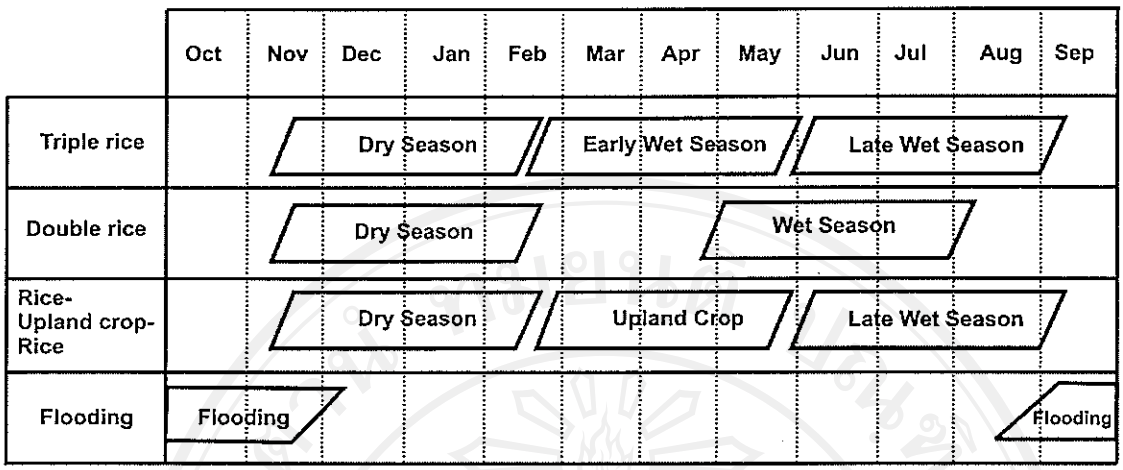

Figure 4. 2 Seasonal calendar of Tan Phu Thanh village.

Source: *PRA March, 2003*

The rice growers who are rich and fair practices triple rice and double rice, but whereas the poor practices triple rice and double rice-upland crop. This was because the poor wanted to get more income in their small-scale. In triple rice cropping system modern rice varieties with short duration are usually used, especially in triple rice in order to harvest the last season before the annual flood appears.

4.1.3 The Trends of Rice Cropping System

The timeline and trendline of rice production development in Tan Phu Thanh village conducting in PRA were presented in Table 4.1. Rice production was shifted from transplanted traditional varieties with single crop per year (pre 1975) to direct-seeded modern varieties with double crop per year (1977-1980) and then with triple crop per year (1997). Row-seeding was introduced firstly in 2000, and it was practiced in dry season and wet season.

There was a sharp decrease in cultivated rice area of triple rice cropping pattern from 80 percent in 1999 to 40 percent in 2003. The reason was that early wet season has high production cost resulting from water shortage, weed infestation, pest and disease damage, and low yields.

Golden snail eating young rice appeared in 1999, and now it is being big problem in diffusing row-seeding practice.

Table 4. 1 Timeline development of direct seeding and related practices in Tan Phu Thanh village's rice cultivation.

Year	Development of rice production
Pre 1975	- Single rice crop per year, transplanted manually.
	- Traditional varieties were popular with long growth duration and strong photo-sensitiveness.
1976	- Modern rice varieties were introduced.
1977-1980	- Double rice crop was practiced (modern rice variety with short duration and traditional rice crop)
1981-1986	- Double rice crop with both crops using modern rice varieties (IR42, TR25, MTL36, 37).
	- Direct seeding initiated to save time and labor.
	- Rice-upland crop (sweet potato) was practiced.
1987	- One hundred percent of cultivated rice area is under double rice, the average yield was 3.2 ton/ha in dry season and 2.4 ton/ha in wet season.
1997	- Triple rice crop was firstly practiced.
1998-1999	- Majority of cultivated rice area (80%) was practiced triple rice crop per year, the rest is double rice crop.
	- Rice-upland crop was declined.
	- Golden snail infested.
	- Rat damage was considerable.
2000	- Row seeding was introduced with only three households in early wet season.
	- Production efficiency began to drop, especially in early wet season.
	- Golden snail damage rice field was widespread.
2002	- Row seeding adopted (in dry season and late wet season).
	- The cultivated rice areas under triple rice dropped to 70%, double rice occupies 30%.
	- The cultivated rice areas under row seeding were 50 ha.
2003	- The cultivated rice areas under triple rice have dropped to 40%, and double rice occupied 55%.
	- Rice-upland crop cropping pattern (5%) resumed.

Source: *PRA March, 2003*

4.2 Socio-Economic Characteristic of Farm Households

4.2.1 Wealth Ranking

Table 4.2 presents the result of wealth ranking that was conducted with all farmers in Thanh My hamlet (374 households). The result revealed that the distribution of the poor, fair, and rich household was 11, 82, and 7 percent, respectively. The proportion of the poor household in Thanh My hamlet (11%) was slightly higher than Can Tho province's average proportion of the poor household (10%).

Table 4. 2 Distribution of wealth in Thanh My hamlet.

Wealth	Frequency	Percentage
Poor	42	11
Fair	305	82
Rich	27	7
Total	374	100

4.2.2 The Surveyed Samples

Seventy farmer-respondents were interviewed in April 2003, of which 31 farmer-respondents practicing conventional broadcasting and 39 farmer-respondents applying row-seeding (Table 4.3). Farmer-respondents in both row-seeding and broadcasting were divided into three groups: poor, fair, and rich. The farmer-respondents of broadcasting included 13 (41.9%), 10 (32.3%), and 8 (25.8%) in the poor, fair, and rich group, respectively. The farmer-respondents of row-seeding had the distribution of samples was 8 (20.5%), 16 (41.0%), and 15 (38.5%) in the poor, fair, and rich group, respectively.

Table 4. 3 Distribution of samples by seeding method and wealth.

Method	Poor	Fair	Rich	Total
Broadcasting	13	10	8	31
	(41.9)	(32.3)	(25.8)	(100)
Row-seeding	8	16	15	39
	(20.5)	(41)	(38.5)	(100)
Total	21	26	23	70
	(30)	(37.1)	(32.9)	(100)

Numbers in parentheses are percentage (%) of farmers group

4.2.3 Farm Size

In General, average area (Table 4.4) was 0.75 ha/household, in which rice area was 0.53 ha/household or 70.7% of total land holding; the remainder area was 0.22 ha (29.3%) devoted fruit tree. The poor farmers in both broadcasting and row-seeding group had the smallest total area, ranging from 0.29 to 0.54 ha/household. The rich farmers had the largest total area, ranging from 0.91 to 1.12 ha/household. Following the rich farmers, total area of the fair farmers ranged from 0.75 to 0.88 ha/household.

Table 4. 4 Average area (ha/ household) and land use by seeding method and wealth.

	Broadcasting			Row seeding			Total
	Poor	Fair	Rich	Poor	Fair	Rich	
Total	0.54	0.75	0.91	0.29	0.88	1.12	0.75
Rice	0.45	0.56	0.48	0.25	0.64	0.78	0.53
Fruit tree	0.09	0.19	0.43	0.04	0.24	0.34	0.22

4.2.4 Household Size

Household or family size was considered as an important variable because of its role in food demand in the household and labor supply in the farm. In 2003, family size ranged from 3-9 members or on average of 5 members for both broadcasting and row-seeding (Table 4.5).

Table 4. 5 Distribution of family size toward row-seeding and broadcasting.

Member/HHs	Broadcasting	Row-seeding	Total
<= 4 members	11	14	25
	(35)	(36)	(35.5)
5-6	16	20	36
	(52)	(51)	(51.5)
>7	4	5	9
	(13)	(13)	(13)
Mean	5.06	5.07	5.07
SD	1.2	1.53	1.39
Range	3-7	3-9	3-9

Numbers in parentheses are percentage (%) of household member (household size)

In general, the 5-6 members group make up half (51.5%), following less than or equal 4 members group (35.5%) and greater than 7 members group (13%). There were no differences in percentage among number of household member groups in both sowing methods.

4.2.5 Education Attainment

Education is considered as one of the essential factor to development. Education enhances the people's capacity to better deal with issues and problems that may come their way. Table 4.6 revealed that for the total data, Three percent of household members are illiterate. About 37.7 percent (132 members), 38 percent, 14.6 percent, and 0.9 percent of household members had received primary, secondary, high school, and college education, respectively. In addition, the pre-school, the baby who has not enough age to go to school was distinguished separated from persons who are illiterate, and made up 6 percent.

In general, there are no difference in education between row-seeding household members and broadcasting household members. In addition, the percentage of illiterateness under broadcasting practice (3.2%) was higher than that under row-seeding practice (2.6%), and the percentage of college education was 3 percent in row-seeding. Nobody in broadcasting obtained college certificate.

Table 4. 6 Distribution of education of members of farmer-respondents according to education obtainment in Tan Phu Thanh village.

Educational obtainment	Broadcasting		Row-seeding		Total	
	Freq.	%	Freq.	%	Freq.	%
Illiteracy	5	3.2	5	2.6	10	3
Primary school	64	41	68	35.1	132	37.7
Secondary school	60	38.5	73	37.6	133	38.0
High school	19	12.2	32	16.5	51	14.6
College	0	0	3	1.5	3	0.9
Pre-school	8	5.1	13	6.7	21	6
Total	156	100.0	194	100.0	350	100.0

4.2.6 Rice Production Experience

The average number of years of experience in rice production (Table 4.7) was the same as for both group of farmer, broadcasting (22 years) and row-seeding (20.1 years) with standard deviations of 11.5 and 11.6, respectively. These were indicated that the rice growers who practiced both broadcasting and row-seeding have had long years of experience.

Table 4. 7 Distribution of respondents according to years of experience of rice production.

Rice production experience	Broadcasting		Row seeding	
	Frequency (n=31)	%	Frequency (n=39)	%
Less than or equal 10 years	6	19.3	10	25.6
11 – 20 years	9	29	13	33.3
21 – 30 years	9	29	10	25.6
More than 30 years	7	22.5	6	15.3
Total	31	100	39	100
	Mean = 22		Mean = 20.1	
	SD = 11.5		SD = 11.6	
	Range = 1-47		Range = 1 – 50	

4.2.7 Row-Seeding Experience

The mean number of seasons that the farmer-respondents practice row-seeding was 3.6 seasons with standard deviation of 3.97 (Table 4.8). Slightly more than a half (51%) has been engaged equal or less than 2 seasons of experience. This shows that row-seeding respondents have had short seasons of experience.

Table 4. 8 Distribution of respondents according to number of season (times) of experience of row-seeding practice.

RS experience	Frequency (n = 39)	Percentage
<= 2 times	20	51.2
3 – 4 times	13	33.3
> 4 times	6	15.3
Total	39	100
Mean = 3.6	SD = 3.97	Range = 1 - 18

4.2.8 Gender Analysis

Gender analysis was conducted to gain understanding of the differences between men and women in various activities of rice production in three different farmer groups. The activities in rice production consist of sowing, replanting, weeding, fertilizing, water management, spraying, harvesting, threshing, drying, storing, selling, and keeping money (Table 4.9). Sowing was done by men only in all groups of farmers. Replanting was done by both women and men, but it was mainly women's work (75%) in both the poor and fair group. Weeding is mainly women's work in the Mekong River Delta; however in this situation, this activity was mostly done by men (100 and 75 in the fair and rich group respectively), but in the poor group this activity was equally shared (50 % in both women and men).

Fertilizing, water management, and spraying was major men' works, especially in the fair group these works were mostly done by men (100%). Gender roles in harvesting, threshing, and storing do not differ very much from one group to the other, but storing work in the rich group was done by women (75%).

In Tan Phu Thanh village essentially women kept all money. Selling rice output was a shared activity between women and men, but women were more responsible than men in the rich group. In the poor group, selling was men's work (75%).

It can be concluded that major rice production activities were done by men; while women kept money from selling rice output.

Table 4. 9 Percentage distribution of men and women engaging in rice production activities in three farmer groups.

Activities	Poor group		Fair group		Rich group	
	Men (%)	Women (%)	Men (%)	Women (%)	Men (%)	Women (%)
Sowing	100	0	100	0	100	0
Replanting	25	75	25	75	50	50
Weeding	50	50	100	0	75	25
Fertilizing	100	0	100	0	75	25
Water management	75	25	100	0	100	0
Spraying	100	0	100	0	75	25
Harvesting	50	50	50	50	50	50
Threshing	50	50	50	50	50	50
Drying	50	50	50	50	50	50
Storing	50	50	50	50	25	75
Selling	75	25	50	50	25	75
Keeping money	25	75	25	75	0	100

Gender analysis also was deeply discussed the differences in decision-making and responsibility in activities of rice production as well as livestock and fishery between women and men, as shown in Table 4.10. "decision-making" that implies who has power in this activities and "responsibility" that mentions who has done it. The farmers who have power and make decision in any work were not sure to carry out this work. This part discusses more deeply rice production activities.

The finding shown that men has almost power both in making decision and doing all activities of rice production such as sowing method, seeds selection for next

season, soaking and sowing timing, type of chemical, type of fertilizer, hiring labor, borrowing, livestock, and fishing. However, women make a decision and carry out only two activities that are diary expenditure and buying furniture. Especially, the men have power in deciding which the kind of livestock raised (75%), but livestock raising activities is equally shared between women and men.

The same figure is shown in the fair group and rich group, the men control all activities on rice production, in both two group hiring labor was work of both men and women for deciding and doing it.

In brief, main activities on rice production were men's work because they had both control power and responsibility for it.

Table 4. 10 Gender analysis on decision-making and responsibility.

Activities	Decision-making		Responsibility	
	Men (%)	Women (%)	Men (%)	Women (%)
Poor group				
Sowing method	100	0	100	0
Variety selecting for next season	100	0	100	0
Soaking and sowing timing	100	0	100	0
Type of chemical	75	25	100	0
Type of fertilizers	75	25	100	0
Hiring labors	75	25	50	50
Borrowing	75	25	100	0
Daily expenditure	0	100	0	100
Buying furniture	50	50	50	50
Livestock	75	25	50	50
Fishing	100	0	75	25
Fair group				
Sowing method	75	25	75	25
Variety selecting for next season	100	0	100	0
Soaking and sowing timing	100	0	75	25
Type of chemical	100	0	100	0
Type of fertilizers	100	0	100	0
Hiring labors	50	50	50	50
Borrowing	100	0	100	0
Daily expenditure	0	100	0	100
Buying furniture	0	100	0	100
Livestock	25	75	25	75
Fishing	75	25	50	50
Rich group				
Sowing method	100	0	100	0
Variety selecting for next season	75	25	75	25
Soaking and sowing timing	100	0	100	0
Type of chemical	100	0	100	0
Type of fertilizers	100	0	100	0
Hiring labors	50	50	50	50
Borrowing	0	0	0	0
Daily expenditure	25	75	25	75
Buying furniture	50	50	50	50
Livestock	50	50	25	75
Fishing	50	50	50	50

4.2.9 Credit

There are two main formal sources of credit that are Commercial Bank and Agricultural Bank. The farmer-respondents borrowed at an average of 6 months, or 12 months, or 24 months, and they used land certificate for collateral. Interest rates for formal loans were 1 percent per month. In addition, farmer-respondent can borrow money from other sources such as Poverty Alleviation Fund and Farmers Association, lending with low interest rate (less than one percent per month) and without collateral.

One hundred percent farmers-respondents used the loan to invest in agricultural production. Beyond rice production the farmer-respondents also invested in livestock and fruit tree. Moreover, some farmer-respondents used the loan for both agricultural production and home expenditure.

The characteristics of farmer-respondents using credit are shown in Table 4.11. Majority of the farmer-respondents of research site did not borrow (71%) from credit formal sources, the remainders (29%) borrowed capital.

Result of the study suggested that about 77% of the farmers-respondents, practicing row-seeding, did not borrowed money from the bank. The rest (23%) were divided in two farmers groups (fair and rich group). Therefore, the poor farmers had no access credit.

Majority (65%) of farmer-respondents in broadcasting practice had no access credit service from formal sources. In poor group, there were 85% did not access credit service, while there were 50% did not access one in fair and rich group.

Table 4.11 presents the amount of money borrowed. There were 60% farmers-respondents in both row-seeding and broadcasting borrowed less than or equal 5 million dong, following 25% from 5.1 to 9.9 million dong and 25% greater than 10 million dong. The poor group borrowed capital less than or equal 5 million dong with 85% in broadcasting and with 100% in row-seeding.

Table 4. 11 Distribution of credit availability from formal sources.

Activities	Broadcasting				Row-seeding				Grand total
	Poor	Fair	Rich	Total	Poor	Fair	Rich	Total	
Did not borrow	11 (85)	5 (50)	4 (50)	20 (65)	8 (100)	11 (69)	11 (73)	30 (77)	50 (71)
Borrowed	2 (15)	5 (50)	4 (50)	11 (35)	0 (0)	5 (31)	4 (27)	9 (23)	20 (29)
Total	13 (100)	10 (100)	8 (100)	31 (100)	8 (100)	16 (100)	15 (100)	39 (100)	70 (100)
Amount borrowed (million dong)									
Less than or equal 5	2 (100)	3 (60)	2 (50)	7 (64)	0	4 (80)	1 (25)	5 (56)	12 (60)
From 5.1 to 9.9	0	1 (20)	2 (50)	3 (27)	0	0	2 (50)	2 (22)	5 (25)
Greater than 10	0	1 (20)	0	1 (9)	0	1 (20)	1 (25)	2 (22)	3 (15)
Total	2 (100)	5 (100)	4 (100)	11 (100)	0	5 (100)	4 (100)	9 (100)	20 (100)

Numbers in parenthesis are percentage.

In summary, the majority of farmers-respondents in both broadcasting and row-seeding did not access formal credit services, especially the poor group accessed formal credit service less than the fair and rich groups.

4.2.10 Training Courses

Training courses focusing on rice production included integrated pest management (IPM) and technique of rice seed production. Organizers were extension station at district level in co-operation with programs and institutes such as Danida project of Danish, Can Tho University, and O Mon Rice Research Institute.

About 58.6 percent of respondents had attended training courses on rice production (Table 4.12). The remainder (41.4%) did not participate training at all. About 64.5 percent of broadcasting's farmer-respondents attended training courses, compared to 58.6 percent of row-seeding's farmer-respondents. Especially, in row-seeding all poor group (100%) did not participated any training course, compared to more than haft of the poor group (61.5) attended training courses.

Table 4. 12 Distribution of respondents according to the training courses attended in rice production.

	Broadcasting				Row-seeding				Grand total
	Poor	Fair	Rich	Total	Poor	Fair	Rich	Total	
Training courses	8	7	5	20	0	12	9	21	41
	(61.5)	(70)	(62.5)	(64.5)	(0)	(75)	(60)	(53.8)	(58.6)
Not attended	5	3	3	11	8	4	6	18	29
	(38.5)	(30)	(36.5)	(35.5)	(100)	(25)	(40)	(46.2)	(41.4)
Total	13	10	8	31	8	16	15	39	70
									(100)

Numbers in parenthesis are percentage.

4.2.11 Perceptions of Row-seeding's Farmer

Ten questions were asked to study perception of 39 row-seeding's farmer about the row-seeding practice. Descriptive statistics on these questions is presented in Table 4. 13. The weighted average to each question was also obtained.

In question 1, a weighted average of 4.56 compared to the maximum value of 5 was obtained. Therefore, row-seeding's farmer-respondents generally accept row-seeding as a useful method in rice cultivation. The findings are important since question 2, a weighted score of 4.85 was indicated that the respondents has adopted this method with high score. The respondents were also identified the advantages of row-seeding by looking at question 3, 4, 5, 6 and 8. Notice that in question 3, a weighted score of 4.77 shown that the respondents believe strongly that the seed rate decrease under row-seeding practice. Moreover, in question 4, a weighted score of 3.69 indicated that the rice yield has a slight increase. In fact, in this study the average rice yield of row-seeding was higher than that of broadcasting by 0.3 tons/ha. In question 5, 6 and 8, a weighted score of 4.41, 4.23, and 3.44 respectively indicated that row-seeding can decrease pests and diseases, fertilizer and chemical use, and herbicides use. Row-seeding required good land preparation with leveled land, but in question 7 with weighted score of 2.74 indicated that land preparation cost does not increase. Like land preparation, labor cost does not increase with weighted score of

3.47 in question 9. The latter result in more easier crop management is in question 10 where a score of 4.44 is obtained.

Table 4. 13 Descriptive statistics of row-seeding's farmer-respondents

	Average	Percentage				
		1	2	3	4	5
Q.1	4.56	0.00	0.00	2.56	38.46	58.97
Q.2	4.85	0.00	0.00	2.56	10.26	87.18
Q.3	4.77	0.00	0.00	5.13	12.82	82.05
Q.4	3.69	0.00	12.82	30.77	30.77	25.64
Q.5	4.41	0.00	0.00	2.56	53.85	43.59
Q.6	4.23	0.00	2.56	7.69	53.85	35.90
Q.7	2.74	17.95	28.21	20.51	28.21	5.13
Q.8	3.44	12.82	10.26	23.08	28.21	25.64
Q.9	3.74	2.56	7.69	30.77	30.77	28.21
Q.10	4.44	0.00	0.00	7.69	41.03	51.28

Note: Scale: 1 = strongly disagree, 2 = moderately disagree, 3 = agree, 4 = moderately agree, and 5 = strongly agree.

Q.1 = Row-seeding is a useful method for rice grower.

Q.2 = I will practice row-seeding for the next growing season.

Q.3 = Row-seeding can decrease seed rate.

Q.4 = Row-seeding can increase rice yield.

Q.5 = Row-seeding can decrease insects and diseases problems.

Q.6 = Row-seeding helps decreasing chemical and fertilizer application.

Q.7 = Increases in land preparation under row-seeding practice.

Q.8 = Increase in amount of herbicide under row-seeding practice.

Q.9 = Row-seeding helps saving labor in weed control.

Q.10 = Row-seeding allows ease of taking care and managing rice field.

4.3 Rice Production and Row-Seeding Practice

4.3.1 Land Preparation

Broadcasting practice in dry season in Tan Phu Thanh village applied wet seeding method that the seeds were broadcasted directly into the wet rice field by hand. Row-seeding practice, in fact, is also wet seeding method that the seeds were sown by row seeder instead of by hand. The major differences between row-seeding and broadcasting practice is in land preparation phase. Row-seeding used amount of seeds is lower than broadcasting; consequently, crop establishment of it is lower rice plant density and rice plant in a straight row.

Row-seeding requires a good land preparation and leveled land; therefore, land preparation for row-seeding have to do well. Majority of farmers (87%) in dry season at Tan Phu Thanh village took land preparation by tractors, the remainder practiced no-tillage. For tillage practice, there are two ways of land preparation: harrowing followed by puddling and only puddling with one or twice. Before seeding the water was drained. Seeds were soaked for 24 hours, and incubated from 24 to 36 hours. After that pregerminated seed are sown onto soil surface. For row-seeding seeds after soaking and incubating are sown when the coleoptile just emerge. Rice field was irrigated the first time after sowing 5 or 7 days. Water level in rice field was kept around from 5 to 10 centimeters high. Water was drained from flowering to the end of crop.

4.3.2 Rice Varieties

Almost farmers (100%) grew modern rice varieties with high yield and short growth duration (from 90 to 110 days). The seeds that were prepared for the next crop derive from three sources: preparing seed stock themselves, exchanging seeds with neighbors, and buying certified seeds from institutions and university. The farmers in Tan Phu Thanh often buy seed from O Mon Rice Research Institution and Farming System Development and Research Institution where supply mainly the seed for the whole Mekong River Delta zone.

Table 4. 14 Distribution of varieties in two seeding methods.

Varieties	Broadcasting		Row-seeding		Total	
	Frequency	%	Frequency	%	Frequency	%
OM576	11	36	5	12.8	16	23
OMCS2000	1	3	11	28	12	17
IR64	6	18	7	18	13	19
MTL250	6	18	5	12.8	11	16
OM1490	2	6	4	10.2	6	8.5
CM94	0	0	3	7.5	3	4
Others	5	15	4	10.2	9	13
Total	31	100	39	100	70	100

Majority of farmers (23%) used OM576, following by IR64 (19%), OMCS200 (17%), MTL250 (16%), OM1490 (8.5%), CM94 (4%), and 13% used other varieties (Table 4.14).

4.3.3 Seed Rate

The rice growers in the Mekong River Delta were accustomed to using high seed rate in direct seeded rice with average amount of seed rate of 200 kg/ha. In this study area, the average seed rate in direct seeded rice (broadcasting) was about 184 kg/ha (Table 4.15) that was higher than row-seeding by 71 kg/ha. For the broadcasting, mean seed rate of the fair group was the highest (193 kg/ha) compared to the remainder group. In row-seeding, the rich farmer group had the highest mean of seed rate (117 kg/ha).

Table 4. 15 The average of seed rate, labor, yields, storing loss, and amount of selling rice per ha in two seeding methods.

Items	Broadcasting				Row-seeding				Total mean
	Poor	Fair	Rich	Mean	Poor	Fair	Rich	Mean	
Number of HHs	13	10	8		8	16	15		
Seed rate (kg/ha)	182	193	174	184	113	110	117	113	144
Labors (manday/ha)	66	63	80	69	73	62	52	62	64.5
Yield (ton/ha)	5.8	5.7	6.7	6.0	6.1	6.3	6.5	6.3	6.2
Storage loss (%)	4	4	4.8	4.3	3.8	4.3	4.4	4.2	4.2
Percentage HHs selling rice	92	90	62.5	81.5	100	75	80	85	83.2
Amount of selling rice (%)	58	61	37	53	60	54	58	57	55

4.3.4 Labors Use

The mean of labors using during rice season was 69 mandays/ha for broadcasting and 64.5 mandays/ha for row-seeding. The rich group in row-seeding had much lower mean of labor (62 mandays/ha) than other groups, but the rich group in broadcasting has much higher the mean of labor (80 mandays/ha) than the remainder groups (Table 4.15).

4.3.5 Fertilizer

The result (Table 4.16) indicates that all respondents (100%) applied chemical fertilizers in rice cultivation. They used urea in combination with DAP[1], potassium, and NPK[2]. Fertilizers were usually applied three times at 10-15, 25-30, and 60-75 day

[1] DAP=(18-46-0)
[2] NPK= (16-16-8), (20-20-15), (18-18-6), (20-10-6), and (22-0-20)

after sowing. The average fertilizer used was estimated at 401 kg/ha, consisting of 132 kg urea, 73 kg DAP, 53 kg potassium, and 143 kg NPK.

In general, the broadcasting farmers used greater fertilizer than row-seeding farmers by 30 kg/ha. The average fertilizer use of the poor farmers in broadcasting was less than that in row-seeding by about 100 kg/ha.

Table 4. 16 Average fertilizer (kg/ha) used in two seeding methods by wealth in dry season.

Fertilizers	Broadcasting				Row-seeding				Grand mean
	Poor	Fair	Rich	Mean	Poor	Fair	Rich	Mean	
Urea	141	137	139	139	146	106	134	128	132
	(43)	(42)	(48)	(42)	(56)	(32)	(50)	(47)	(45)
DAP	44.7	95.5	50	67.6	89	80	65	78	73
	(28)	(57)	(26)	(47)	(40)	(17)	(39)	(31)	(38)
Potassium	37.5	51.7	89.7	59.6	45	50	48	47	53
	(60)	(86)	(75)	(92)	(17)	(16)	(14)	(15)	(34)
NPK	118	179.7	173.5	157	159	115	143	139	143
	(59)	(86)	(130)	(92)	(80)	(70)	(114)	(91)	(91)
Total	341	464	452	423.2	439	351	390	392	401

Number in parentheses is standard deviation.

In Can Tho province, the fertilizer formula that was recommended by extension agency was 100 kg N-40 kg P_2O_5-30 kg K_2O/ha (Khuong, 2002). The results presented in Table 4.17 revealed that both row-seeding and broadcasting farmers applied a higher rate in basic components (156-42-35) than the above recommended formula, especially in nitrogen (N).

Nitrogen (N) fertilizer is essential for nearly all commercial rice production in Can Tho province. Moreover, the excessive N application leads to lower yield, more lodging, and more insect and diseases. In this study, rich group in row-seeding practice used 218 kg N/ha which two times greater than recommended formula (100

kg N/ha), but poor group applied only 86 kg of N/ha that less than recommended formula by 14 kg of N per hectare.

In broadcasting practice, the N rate applied was 145, 167, 119 kg of N per hectare for the poor, fair, and rich group, respectively.

For P205 and K20, the poor group in both row-seeding and broadcasting tended to apply lower than others group and recommendatory formula.

Table 4. 17 The ratio of N, $P_2 0_5$, and $K_2 0$ using in two seeding methods in dry season, Can Tho province.

Fertilizers	Broadcasting				Row-seeding				Grand mean
	Poor	Fair	Rich	Mean	Poor	Fair	Rich	Mean	
N	145	167	119	145	86	155	218	165	156
$P_2 0_5$	27	59	38	40	39	48	42	44	42
$K_2 0$	20	37	64	37	24	31	39	33	35

4.3.6 Control of Insect, Diseases, and Weeds

Eighty-three, eighty-one, and 76 percent of farmer-respondents used herbicides, fungicides, and insecticides to control weeds, diseases, and insects in dry season for rice production, respectively.

The most important weeds were *Echinochloa cruss-galli, Echinochloa glabrescens, Echinochloa colona, Fimbristylis miliacea, Monochoria vaginalis, Leptochloa chineensis, and Cyperus difformis*. Farmer-respondents used both pre-emergenced and post-emergenced herbicides consisting of Sofit, 2,4 D (powder or liquid form), Fujione, Sirius, and Whips.

Some of the important insects damaging rice were leaffolder, brown planhopper, stembore, caseworm, and trips. Insecticides such as Bassa, Padan, Fastas, Decis, and Cyper alpha were sprayed.

Rice field was also damaged by common disease such as rice blast, sheath blight, and bacterial leaf blight. Farmer-respondents used some of the fungicides which were Tilt, Validacine, and Anvil. Fungicides were applied at about 40-50 day after sowing.

4.3.7 Post-Harvest

Rice in dry season is harvested mostly between late February and early March. Harvesting is commonly by hand. Farmers usually hire labor for cutting rice to shorten the harvesting duration.

All farmers-respondents threshed their paddy using threshers machine. Payment for the machine is around four percent of rice output. There is an advantage for farmers here that they can thresh in rice field, and then they transported their paddy by using the bag of paddy. Therefore, they saved some amount of rice which were lost by collecting and transporting from paddy field to farmyard.

All farmers-respondents in Tan Phu Thanh village dry their paddy under sunlight in dry season because there is no rain in this period. Especially, they dried their rice in rice field before threshing, after threshing they can usually sell immediately more than haft rice output for cash to return the bank and input services in locality. The remainder drying in farmyard was kept for seeds and home consumption.

Most of them stored seeds in bags and bamboo facilities. Amount of seed stored is depended on their rice area. Average amount is approximately 150 kg per hectare. Rate of rice lost in storing seeds is about 5 percent. The storage duration for home consumption is less than 4 month when the next crop start harvesting.

4.3.8 Yield

The mean yield of row-seeding practice (6.3 ton/ha) was a slightly higher than that of broadcasting practice (6 ton/ha). The mean yields of the rich group in both row-seeding and broadcasting have higher than the remainder groups, but the mean

yield of the rich group in broadcasting has higher than that in row-seeding (Table 4.15).

4.3.9 Selling and Amount of Selling Rice

The farmers usually sell their output rice immediately after harvesting. The Table 4.15 shows that about 83 and 81 percent of farmer-respondents in row-seeding and broadcasting immediately sold their paddy, respectively. The amount of rice sold depends on situation in each group. The respondents sold 55 % of their paddy, the remainder was stored for home consumption and seed stock.

4.3.10 Problems of Row Seeding Practice

The problems that have been militating in diffusing row-seeding practice are needed to identify. Although there were common shortcomings, each farmer groups has so much difference of shortcomings because they have the variation of economic and natural conditions.

Pairwise ranking was also carried out in PRA among three farmer groups. Pairwise ranking allows us to determine the main problems or preferences of individual community members, identify their ranking criteria, and easily compare the priorities of different individuals.

The results (Table 4.18) were revealed that golden snail disaster was ranked among the best in both three groups. In the poor group, poor unleveled land, lake of embankment, and small-scale of farm size were ranked second, third, and the last respectively. It means that it is difficult for the poor farmers to practice row-seeding if they have a poor leveling land, no embankment, and small land holding.

In the fair group, the problems that were rank second, third, and fourth were unsuitability for early wet season and late wet season, soaking and incubating technique, and rain damage. This one indicated that the fair farmers focused on season, technique, and weather that limited row-seeding practice.

The rich group that pay attention to quality of row seeder, output price, and input price. They thought that these are major problems that constrained row-seeding practice.

In brief, golden snail was the major problem that has been constraining in disseminating row-seeding. Moreover, on field with unleveled land, small land holding, and lake of embankment were difficult to practice row-seeding, which belongs to the poor farmers.

Table 4. 18 Problems in row-seeding practice of poor, fair, and rich group.

Farmer group	Problems	Ranking
Poor group	Golden snail	1
	Unleveled land	2
	Lack of embankment to control water	3
	Small-scale of farm size	4
Fair group	Golden snail	1
	Unsuitability for early wet season and late wet season	2
	Soaking and incubating technique	3
	Rain damage (Heavy rain that occurs immediately seeding may decrease rice plants density, resulting in expending more family labor for replanting)	4
Rich group	Golden snail	1
	Poor quality of row seeder	2
	Unstable output price (Very cheap during peak harvest)	3
	High price of chemical fertilizers	4

Sources: PRA march, 2003.

In order to control golden snail farmers in Tan Phu Thanh village used three methods including chemical, cultural and biological control. According to farmers chemical control was not efficient because it costs a lot of money.

The most common cultural controls practiced by farmers were handpicking, water depth management, and land preparation. Handpicking was conducted during the last harrowing to 20-30 days after sowing. Handpicking was carried out in rice

paddy in the early morning and late afternoon when the golden snail is most active and easy to find. For water depth management, the water was drained to saturated soil moisture condition before broadcasting the germinating seeds. At day 8, water was introduced to a depth of 5 cm only. Farmers also identified that double rice crops per year can reduce golden snail population. After harvesting the first crop, the rice field was kept dry to prevent snail from breeding. Dry plowing was carried out just before the next season to kill snails aestivating underground by exposing them to heat and dryness.

Herb duck was biological control used to decrease the golden snail density population. According to farmers duck should be introduced immediately after harvesting up to the last harrowing for the next crop and should be introduced again 20-25 days after sowing.

4.4 Costs and Returns Analysis

The input-output relationships and the costs and returns of rice cultivation in dry season (Winter-spring season) are presented in Table 4.19. The price of essential materials that were used to calculated costs and returns of rice production were the prices received by response of the farmers at the interviewed period. The price that was set by government is only used as reference indicator only in some cases.

4.4.1 Total Variable Cost

Total variable costs included cash costs (actual payment by farmers) and non-cash costs (assume that family labor costs were added). Cash costs consist of current cash inputs (fertilizer, chemicals, and seeds cost), machine, and hired labor cost. The non-cash costs in this case were family labor only.

The average of total variable cost in conventional broadcasting (4,080 thousand dong/ha) was higher than that in row-seeding method (3,456 thousand dong/ha). This was due to lower cost of fertilizer, chemical, seed, and machine in the latter than that the former.

In conventional broadcasting practice, total variable costs of rice cultivation in the poor, fair, and rich group were 3,820, 3,946, and 4,474 thousand dong/ha, respectively, compared to 3,492, 3,451, and 3,426 thousand dong/ha, respectively in row-seeding method. Table 4.19 shown that total cost of the poor group in broadcasting was also higher than that in row-seeding, but the costs of fertilizer, hired labor, and family labor were inversed. The costs of fertilizer, hired labor, and family labor in broadcasting practice were 771, 345, and 1,380 thousand dong /ha, respectively, compared to 826, 327, and 1,419 in row-seeding respectively.

4.4.2 Gross Return

In general, the differences of gross return among farmer groups between two sowing methods were substantial in quantity (yield) because the rice price was the same. The mean gross return of conventional broadcasting and row seeding were 9,441 and 9,874 thousand dong/ha, respectively. Gross return of the poor and fair groups in row-seeding was higher than that in conventional broadcasting, but the rich group was a little bit lower.

4.4.3 Net Returns

The measure of profit from the farm business operation is given by the net return or "operating surplus" (gross return minus total variable cost including family labor cost). The operating surplus in conventional broadcasting was estimated at 5,166; 5,087; and 5,832 in the poor, fair, and rich group, respectively. For row-seeding technology, operating surplus were 6,446; 6,205; and 6,603 thousand dong/ha, respectively. Therefore, the mean net returns of conventional broadcasting and row-seeding technology was 5,361 and 6,418 thousand dong/ha, respectively.

4.4.4 Return over Cash Cost

The return of cash cost or family income (gross return minus cash cost) in the poor, fair, and rich group was estimated at 6,546; 6,335; and 7,470 thousand dong/ha in conventional broadcasting, compared to 7,865; 7,477; 7,545 thousand dong/ha in row-seeding technology, respectively. The average of family income in row-seeding

technology (7,629) was higher than that in conventional broadcasting by 846 thousand dong/ha.

Table 4. 19 Economics of costs and returns (1000 dong/ha) of farmer groups in two seeding systems.

Items	Broadcasting				Row-seeding			
	Poor	Fair	Rich	Mean	Poor	Fair	Rich	Mean
Cash cost	2,440	2,698	2,836	2,658	2,073	2,179	2,484	2,245
Current input								
Fertilizer	771	1129	1,115	975	862	848	892	855
Chemical	507	377	411	440	272	252	309	278
Seeds	290	327	318	311	195	211	199	201
Machine cost	527	473	610	536	377	510	538	475
Hired labor	345	392	409	382	367	358	546	423
Non-cash cost								
Family labor	1,380	1,248	1,638	1,422	1,419	1,272	942	1,211
Total variable costs	3,820	3,946	4,474	4,080	3,492	3,451	3,426	3,456
Gross return	8,986	9,033	10,306	9,441	9,938	9,656	10,029	9,874
Return over cash cost	6,546	6,335	7,470	6,783	7,865	7,477	7,545	7,629
Net return (Operating surplus)	5,166	5,087	5,832	5,361	6,446	6,205	6,603	6,418
Total labor (manday/ha)	66	63	60	69	73	62	52	62
Return to labor (1000 dong/manday)	104	106	131	114	113	127	156	132
Benefit-cost ratio	3.68	3.34	3.63	3.55	4.79	4.43	4.03	4.39
Cost for one kg (dong)	658	692	668	675	572	548	527	549
Net return/ Total cost	1.35	1.29	1.30	1.31	1.85	1.79	1.92	1.85
Net return/ kg of output	890	892	870	883	1,056	985	1,016	1,019

4.4.5 Return to Labor (Labor Productivity)

The main factor behind an increase in household income is attributed to higher family labor employment. The net productivity of labor (return to labor) that was calculated by the value of production (gross return) minus the cost of non-labor inputs divided by total labor use. The average productivity of labor was higher than the market wage rate in rice production. Therefore, farmers gained as the scope of employment of labor increased. The labor productivity, however, declined with increase use of labor.

In rice cultivation for dry season, one hectare of land in conventional broadcasting employed 66, 63, and 80 family mandays in the poor, fair, and rich group, respectively, whereas in row-seeding, one hectare of land used about 73, 62, 52 family mandays, respectively. The net productivity of labor was estimated at 104, 106, and 131 thousand dong/day in the broadcasting, compared to 113, 127, and 156 thousand dong/day in the row-seeding in the poor, medium, and rich group, respectively.

The prevailing market wage rate was about 25,000 dong/day in 2003, substantially lower than the productivity of labor.

4.4.6 Benefit Cost Ratio

Benefit cost ratio is a proportion between gross return and the total variable cost. The result (Table 4.19) indicated that the ratio of row-seeding practice (4.29) was higher than that of broadcasting practice (3.55). In general, the three farmer groups of broadcasting were lower than that of row-seeding, suggesting that the effectiveness of capital investment in the row-seeding was better than in the broadcasting technique.

4.4.7 Production Cost of One Kilogram of Output

Cost of production per unit amount of output indicates economic efficiency of production of a commodity. Average production cost of one kilogram of paddy rice for dry season in 2002-2003 in row-seeding practice (549 dong/kg) was lower than that in broadcasting practice (675 dong/kg). In broadcasting practice, the poor group

has the smallest production cost of one kg paddy (572 dong/kg), while the rich group in row-seeding has the smallest cost of 549 dong/kg.

4.4.8 Net Returns per Total Cost and per one Output Unit

Net returns per total cost and net return per one kilogram output are also used as an indicator of economic returns. Table 4.19 showed that the proportion of net returns per the total cost in the row-seeding were much higher than that in the broadcasting in all three farmer groups. This was resulted in the mean proportion of net return per total cost in row-seeding (1.85) was also so higher than in broadcasting (1.31). In other words, farmers who practiced row-seeding obtained higher profits than broadcasting farmers.

Net returns per kilogram of output in the row-seeding (1,019 dong/kg) were higher than that in the broadcasting (883 dong/kg). In addition, net return per kilogram of output in all three farmer groups in the row-seeding were also higher than that in the broadcasting.

4.5 Cobb-Douglas Production Function Analysis

4.5.1 Model Specification

In terms of economics, the term of production imply to the process whereby a set of inputs is transformed into single and multiple outputs. Moreover, the term of technology refers to the art in combination with dissimilar inputs and processes to produce a given output. Therefore, production technology implies the art of transforming a set of inputs into single and multiple outputs. Production activity of any product consequently represents for a certain technology. In production economics, production technology is represented by a production function that defines and characterizes the exact nature of relationships between inputs and outputs. Accordingly, alternative production technologies are described through specification of alternative production functions. For given output, technological change refers to the change in the input-output relationship over time brought about either by new knowledge or by introduction of new inputs or by both. Such a change is reflected by a shift in the production function.

The objective of this section is to empirically estimate the effect of major input on rice yield. The basic model used to estimate the productivity of inputs is Cobb-Douglas production function. The results of regression estimation are presented in Table 4.22. The dependent variable (YIELD) used in the regressions is the natural logarithm of total rice output per hectare in the dry season of Can Tho province. The independent variables were used as explanatory variables consisting of nine variables, which are LABOR, AGE, LAND, CFCS, EDU, TRAIN, EXP, DTILL, and DMET. Among these variables two dummy variables are DTILL and DMET. The independent variables excepting two dummies variables and education of decision makers (EDU) were taken logarithm before running the model.

The estimated function was not separately for each seeding method. DMET (method dummy) was used to estimate the effect to yields (gross return) of two seeding methods.

The independent variables were described as follows:

LABOR included family labor and hired labor input that were used for all activities of rice production in the dry season, consisting of labor for land preparation, sowing, weeding, water management, chemical and fertilizer application, harvesting, transportation, drying, storing, and selling.

AGE was age of decision makers on rice production in household. It is a difference between head of household and decision maker on rice production because we identified that head of household sometime don not pay attention on all activities of rice production in his family. All activities were trusted on his son or other members in his family. Therefore, we chose the person who decides all activities related to rice production for analysis.

LAND was total area of cultivated rice was owned by farmer-respondents. Its unit was hectare per household.

CFCS was the costs of fertilizer, chemical, and seeds using VN dong.

Education (EDU) was number of academic years of decision makers that they had obtained at school.

Training (TRAIN) was number of times that decision makers participated in training courses about IPM and other techniques in connection with rice production.

Experience (EXP) was number of years of experience rice cultivation of decision makers obtained.

Dummy for seeding method (DMET) with zero value for conventional broadcasting and one value for row-seeding. It was used to measure the impact of two distinct direct seeded method.

Dummy for tillage (DTILL) with zero value for no-tillage practice and one value for tillage practice, it was designed to capture the impact of two land preparation methods.

4.5.2 Descriptive Statistics of Original Data

The descriptive statistics including mean, maximum, minimum, and standard deviation of each variable in model are presented in Table 4.20. This figure shows that there are sharply variation of input variables consisting of yields, labors, land, and cost of materials (fertilizers, chemicals, and seeds). The yield ranged from 3,500 to 10,000 kg per hectare. It is mean that there are risks in rice production leading to low yield. Labors requirement for rice production activities ranged from 28 to 170 mandays per hectare. The variability indicates that some of rice growers don't take care of rice fields. Land holding varies from 0.13 to 2 hectare per household. The farmers who have small land-size are difficult to adopt new technologies to improve rice yield. The cost of material used ranges from VND 555,012 to VND 3,167,500. Different levels of investment are due to either difference in household saving availability or their inconsiderate.

Table 4. 20 Descriptive statistics of original data.

Variables	Mean	Minimum	Maximum	Std.
YIELD (Kg/ha)	6,241	3,500	10,000	1,139.06
LABOR (manday/ha)	64.52	28.42	170.00	25.82
AGE (Year)	45.42	30	69	9.88
LAND (ha)	0.56	0.13	2.00	0.38
CFCS (dong/ha)	1,397,466	551,012	3,167,500	436,255
EDU (year)	6.42	0	12	2.77
TRAIN (time)	0.7	0	2	0.67
EXP (year)	20.95	1	50	11.52

4.5.3 Correlations Matrix Among Explanatory Variables

Table 4.21 presents the correlations among explanatory variables in rice production. In general, the correlations between yield and the rest of variables were low, in which three variables (labor, tillage dummy, and experience of decision maker) have negatively correlations with yields and the remainders have positively correlation. The highest correlation was 0.271 between yields and education.

Table 4. 21 Simple correlations among explanatory variables log scale for rice production

	YIELD	LABOR	AGE	LAND	CFCS	EDU	TRAIN
LABOR	0.019						
AGE	0.193	-0.212					
LAND	0.130	-0.800**	0.245*				
CFCS	0.051	0.251*	-0.123	-0.143			
EDU	0.271*	-0.135	-0.126	0.143	-0.079		
TRAIN	0.250*	-0.174	0.201	0.190	-0.037	0.232	
EXP	-0.073	-0.204	0.643**	0.264	-0.040	-0.090	0.193

Note: * and ** are significant at 10% and 5%, respectively.

4.5.4 Response of Yield to Input Uses

The coefficient (R square) and adjusted coefficient of determination (adjusted R2) were 0.529 and 0.377, respectively (Table 4.22). This indicates that the estimated functions can be used to explain effect of inputs (labor, age, land, and CFCS), social factors (education, training, and experience), and management factors (tillage dummy and method dummy) on the rice yield approximately 37.7% at significance of 1 percent level (F-test = 3.487).

Table 4. 22 Estimates of Cobb-Douglas production functions for rice production.

Variables	Coefficient	Std. Error	P value
Constant	7.328***	1.941	0.001
Ln LABOR (manday)	0.395***	0.121	0.003
Ln AGE (year)	0.341**	0.166	0.050
Ln LAND (ha)	0.286***	0.082	0.002
Ln CFCS (dong)	-0.103	0.113	0.447
Ln EDU (year)	0.237***	0.068	0.002
Ln TRAIN (times)	0.124	0.107	0.258
Ln EXP (year)	-0.113**	0.046	0.021
DTILL (0, 1)	-0.025	0.071	0.724
DMET (0, 1)	-0.0547	0.058	0.375

Adjusted R square = 0.377

F-test = 3.487; P = 0.005

Note: ** and ***are significant at 5 and 1% respectively.
DTILL = Tillage dummy: 1= tillage, and 0= no-tillage
DMET = Method dummy: 1= row-seeding, and 0= broadcasting

The coefficient of the labor variable carries a positive sign, and it is significant at 1% level. This could be interpreted that an increase of labor caused an increase of 0.395 units in log scale of rice yield. This is because the rice growers at Tan Phu Thanh village were affected of urbanization movements. There are a lot of shrimp processing factories situated at Tan Phu Thanh village or nearby, which recruits enormous young labor because of high paid. Another reason is that the outbreak of golden snail in recent years, the farmers don't take care of the rice during seedling growth stage, their rice field will have low stand, which can nullify the effect of some inputs.

The age variable is significance at 5% level and showed a positive effect on yield. It suggests that old rice growers tend to better look after their rice field.

The land variable has positive sign and significance at 1% level. Land variable was positively affected slightly rice yield, and an increase of one percent in land-size

resulted in an increase of 0.286 percent in rice yields. The reason is that mean land holding of household is only 0.56 hectare. Moreover, poor farmers only own 0.26 and 0.54 hectare in row-seeding and broadcasting, respectively. The households who have small land size get small income because they produced for home consumption not for sale, therefore they don not pay attention to applying new technology in order to improve their rice yield.

The CFCS variable that includes the cost of fertilizer, chemical, and seeds is not significant even at 10% level. The insignificance of this variable indicates that the negative influence of capital use on rice yield is rejected. A possible reason was due to small cost variation among households.

The education variable has positive sign and is significant at 1% level. It was shown that this variable affected the rice yield. It is easy to identify that the farmers who have higher education easily access mass media such as leaflets, newspapers, radio, and television talking about new techniques improving rice yield. Moreover, they can adopt advanced technologies such as new varieties that resist pest and diseases, and the fertilizer use in proper ways, which limit excessive fertilizers use.

The training variable (TRAIN) is not significant even at 10% level. It can be conclude that training variable don not affect rice yield and it should be rejected. Training courses in research site focus on two issues that are IPM techniques in rice production and on-farm variety conservation techniques. It may be that training method is not suitable, so its effectiveness is not high. Moreover, the content of training courses have not yet to meet the proper needs of the farmers, therefore they have not yet, in fact, affected rice yield.

The experience variable (EXP) related to the experience in rice production of decision makers in household has negative sign and significance at 5% level. Negative association with yield could be due to multicollinearity with AGE and LAND variables. This is because persons who are less experience in rice production are new residents. Provincial authorities have reconstructed Can Tho province, they enlarged the streets. Therefore, many residents lose their own house. Many of them bought the land for building new house in Tan Phu Thanh village because it is about

15 km far form Can Tho city where price of land was cheaper. These new residents also grow rice, and they can get high yield because they are easy to apply advanced technology.

The tillage dummy is no significant even at 10% level. This result indicated that there was no difference in rice yield between tillage and no-tillage practice. It can be explained as follows: the decision to tillage or no-tillage in dry season depended on weed infestation and soft level of soil. The dry season usually starts at the end of annual flooding (from mid-September to early December). Therefore, the soil was still enough soft to broadcast the seed. If there were so much weed the farmer would puddle, level the land and then broadcast the seed. If there were a few weed in the field the farmers who were small farm holding would weed by hand, then level the land, and broadcast the seed. Therefore, the farmers practiced no-tillage can get high yield if they take care of their own field.

The sowing methods dummy variable is not significant. This reveals that rice production of row-seeding practice in dry season was the same as one of conventional broadcasting. Although mean yield of row-seeding practice was higher than conventional broadcasting by 5%, but in terms of statistic the increase is not significant.

In brief, the variables consist of number of farm labors, age of the household's head, land size, level of education, and experiences of decision maker are important in influencing rice yield in dry season of Tan Phu Thanh village of Can Tho province. The remainder variables including the cost of chemical fertilizer, chemical, and seeds; training; tillage dummy; and sowing method dummy that were explained in the Cobb-Douglas production functions were not significant.