Chapter 6

TECHNICAL PERFORMANCE

6.1 Introductory Remarks

In this chapter, output variations for irrigated rice farming and the technical performance of the sample farms will be described. The yield variation derived from an examination of Cobb-Douglas production functions are discussed in the first section. Results of the estimated frontier production functions are discussed in the second section. Based on the parameters derived from them, the level of technical efficiency of individual farms will be measured. A discussion of the factors affecting technical efficiency then follows.

The aim of this section, is primarily to identify factors affecting output performance; to measure input-output elasticities and to use them as a basis for measuring the farm efficiency.

The following hypotheses will be tested in this chapter:

That farmers are equally efficient in technical terms for different farm sizes, tenancy status and regions.

(a) That 'small' and 'large' farmers are equally efficient in technical terms.

(b) That owners and sharecroppers are equally efficient in technical terms.

(c) That farmers in each of the regions are equal in terms of technical efficiency.

6.2 Production Function Analysis

The postulated production relationship used is the Cobb-Douglas production function (equation (4.17)). The variables used in the Cobb-Douglas production function are, namely, production, land, labour, current expenses and fixed capital. The definitions of these variables are presented in Appendix E. These variables were chosen as a result of the work of others (discussed in Section 3.2.6) and consideration of the local factors affecting production in the particular villages.

The data used for the regression analysis is contained in Appendix H. The data were examined for multicollinearity and found to have no serious multicollinearity based on the correlation between any two explanatory variables being reasonably small.

6.2.1 Production Functions for Different Farm Sizes

In this section output variations for the irrigated ricefarms are explained by using a Cobb-Douglas production function estimated by the method of ordinary least squares. The estimated parameters of the Cobb-Douglas production function for small and large farms in different seasons are presented in Tables 6.1 and 6.2. In order to test the differences between the two sets of data the Chow test was used (Chow 1960). To clearly indicate the results of the tests the same equation is presented in alternative ways in the two tables.

Table 6.1

Estimated Coefficients of the Cobb-Douglas Production Functions for Irrigated Ricefarms by Seasons, East Java, 1978[a]

Variables	Wet season	Dry season
	1	2
Intercept (ln a)	2.377	2.267
Land (ln hectare/ farm/season)	0.559***	0.506***
	(0.115)	(0.144)
Labour (ln mandays/ farm/season)	0.102	0.301***
	(0.102) [b]	(0.130)
Current expenses(ln Rp'000/farm/season)	0.519***	0.343***
	(0.069)[c]	(0.069)
$F_{0.01}$	217.94***	121.38***
Degrees of freedom	3/138	3/97
Returns to scale parameter	1.180	1.150
$\bar{R}^2$	0.82	0.78
Standard error of ln Y	0.56	0.63
Sample size	143	101

[a]The dependent variable, Y, is production adjusted for crop damage (qt/farm).

[b] *** means that t-statistics were significant at the 1 per cent levels (using one-tailed t-tests).

[c]Figures in parentheses are standard errors.

Equality between sets of coefficients in two linear regressions (wet and dry seasons) was tested by Chow's technique (Chow 1960). F-tests for both equations = 0.808 which was not significant at the 5 per cent level (F-table = 2.37).

Table 6.2

Estimated Coefficients of the Cobb-Douglas Production Functions for Irrigated Ricefarms by Farm Groups, East Java, 1978[a]

Variables	Small farms	Large farms
	1	2
Intercept (ln a)	2.649[b]	2.514
Land (ln hectare/farm)	0.539***	0.563***
	(0.182)[c]	(0.104)
Labour (ln mandays/farm)	0.416***	0.170**
	(0.164)	(0.093)
Current expenses (ln Rp'000/farm)	0.295***	0.461***
	0.112)	(0.052)
$F_{0.01}$	81.24***	252.15***
Degrees of freedom	3/66	3/170
Returns to scale parameter	1.250	1.194
$\bar{R}^2$	0.78	0.81
Standard error of lnY	0.68	0.55
Sample size	70	174

[a]The dependent variable, Y, is production adjusted for crop damage (qt/farm).

[b] ** and ***, respectively, mean that the t-statistics were significant at the 5 and 1 per cent levels (using one-tailed t-tests).

[c]Figures in parentheses are standard errors.

Equality between sets of coefficients in two linear regressions (small and large farms) was tested by Chow's technique (Chow 1960). F-tests for both equations = 1.234 which was not significant at the 5 per cent level (F-table = 2.37).

The value of the adjusted R^2 in all cases turned out to be high. The included variables explained 78 per cent and 81 per cent of the variation in the data for small farms and large, respectively. Equality between the sets of coefficients in each of the two pairs of linear regressions was tested using Chow's technique. The results were that all pairs of regressions were not significantly different at the 5 per cent level. A tentative conclusion, therefore, is that the farm-production process is similar for both types of farms, small and large, and in both seasons. This reflects the assumption of not allowing for the possibility of non-neutral technological changes.

From Tables 6.1 and 6.2, it can be seen that the coefficients are mostly significant at or above the 5 per cent level. The coefficient for land was positive in all the equations and was significant at the 1 per cent level, The coefficient of labour was positive and significant at the 1 per cent level for equation (2) in Table 6.1 and at the 1 per cent level for equation (1) in Table 6.2. In equation (2) in Table 6.2, the coefficient of labour was positive and significant at the 5 per cent level. All coefficients on current expenses were positive and were significant at the 1 per cent level.

The high level of significance of farm area is not surprising because land is a major input in the study area. It generally has the highest elasticity compared with other inputs. The elasticity of output with respect to the labour input turns out to be not only positive but also statistically significant for the pooled regressions. Finally, the modern inputs (such as, chemical fertilizers, pesticides, herbicides and modern seed varieties), make up the variable of current expenses. This variable has highly significant parameters in all equations. These findings are consistent with a large number of studies which suggest that 'small area' crops are characterized by high production elasticities for land and small land-to-labour ratios (Davidson et al. 1967, Bardhan 1973 and Chadha 1979).

6.2.2 Production Functions for Different Regions

As indicated earlier, the study covers three different regions, each of which have different agricultural environments. Dummy variables were used as shift factors in the regression analysis to separate out the regional effects. For example, if Region 1 was given a value of one, the other regions would be given a value of zero, etc. The results of separating out the regional effects are shown in Tables 6.3 and 6.4 with Table 6.4 including the effects of farm size. Equation (1) in both tables does not include the regional effects.

Because all farms in each of the seasons had similar production functions, any further analysis was carried out by using the seasonally pooled data. In addition, an analysis was carried out using dummy variables for farm size and tenancy status.

Introduction of the regional dummy variables does not increase the value of the adjusted R^2 very much. Equations (2), (3) and (4) (Table 6.3), which include dummy variables, have adjusted R^2 varying between 80 and 85 per cent; whereas equation (1) (Table 6.3) which does not include dummy variables, has a value of 80 per cent.

Introducing a regional dummy in each region changes the estimated parameters to some extent. For example, in Region 1 (equation (2) in Table 6.3), the introduction of the regional dummy increases the coefficients on land and current expenses, but decreases the coefficient on labour.

The regression coefficients on the regional dummy variables in Regions 1 and 2 are positive and highly significant. This means that rice production is higher in Regions 1 and 2 than in Region 3. This result was expected and is consistent with the finding reported in Chapter 5. The reasons underlying this phenomenon have also been discussed in Chapter 5.

Table 6.4 provides the results of the estimated coefficients of the Cobb-Douglas production function by introducing dummy variables on land and regions simultaneously. Regression coefficients on all the variables were mostly highly significant. This is interesting in that variation of input use is thus significant in explaining variation of

Table 6.3

Estimated Coefficients of Cobb-Douglas Production Functions for Irrigated Ricefarms by Regions, East Java, 1978[a]

Variables	Pooled data (farm groups and seasons)				
	1	2	3	4	5
Intercept (ln a)	2.572	3.196	2.035	4.555	4.908
Land (ln hectare/farm)	0.567***[b]	0.627***	0.486***	0.575***	0.604***
	(0.090)[c]	(0.095)	(0.091)	(0.079)	(0.084)
Labour (ln mandays/farm)	0.233***	0.212***	0.299***	0.358***	0.345***
	(0.081)	(0.081)	(0.082)	(0.073)	(0.074)
Current expenses (ln Rp'000/farm)	0.317***	0.360***	0.413***	0.139***	0.117***
	(0.043)	(0.056)	(0.048)	(0.054)	(0.058)
Region-dummies					
R2,3 (D=1 for Region 1 and D=0 for other regions)		0.198***			
		(0.098)			
R1,3 (D=1 for Region 2 and D=0 for other regions)			0.274***		
			(0.081)		
R1,2 (D=1 for Region 3 and D=0 for other regions)				-0.909***	
				(0.108)	
R2) (D=1 for Region 1 and D=0) for other regions)					-0.094
					(0.087)
R3)					-0.986***
					(0.130)
$F_{0.01}$	326.60***	249.12***	253.31***	333.18***	226.93***
Degrees of freedom	3/240	4/239	4/239	4/239	5/238
Returns to scale parameter	1.117	1.199	1.198	1.072	1.066
$\bar{R}^2$	0.80	0.80	0.81	0.85	0.85
Standard error of ln Y	0.56	0.59	0.58	0.52	0.52
Sample size	244	244	244	244	244

[a]The dependent variable, Y, is production adjusted for crop damage (qt/farm).

[b]*** means that the t-statistics were significant at the 1 per cent level. Two-tailed tests apply to coefficients of the dummy; one tailed tests to all other variables.

[c]Figures in parentheses are standard errors.

Table 6.4

Estimated Coefficients of Cobb-Douglas Production Functions for Irrigated Ricefarms by Farm Groups and Regions, East Java, 1978[a]

Variables	Pooled data (farm groups and seasons)				
	1	2	3	4	5
Intercept (ln a)	2.526 [b]	3.153	1.887	4.496	4.760
Land (ln hectare/farm)	0.550*** [c]	0.615***	0.442***	0.525***	0.549***
	(0.094)	(0.099)	(0.097)	(0.082)	(0.087)
Labour (ln mandays/farm)	0.232***	0.212***	0.304***	0.362***	0.352***
	(0.081)	(0.082)	(0.082)	(0.072)	(0.073)
Current expenses (ln Rp'000/farm)	0.418***	0.360***	0.409***	0.123***	0.107**
	(0.049)	(0.057)	(0.048)	(0.054)	(0.058)
Dummy for farm groups (D=1 for large farm and D=0 for small farm)	-0.063	0.040	0.140	0.192**	0.182**
	(0.104)	(0.104)	(0.103)	(0.092)	(0.093)
Regional dummies					
R2,3 (D=1 for Region 1 and D=0 for other regions)		0.194**			
		(0.098)			
R1,3 (D=1 for Region 2 and D=0 for other regions)			0.297***		
			(0.083)		
R1,2 (D=1 for Region 3 and D=0 for other regions)				-0.946***	
				(0.109)	
R2)) D=1 for Region 1 and					-0.069
					(0.088)
R3) D=0 for other regions)					-1.001***
					(0.129)
$F_{0.01}$	244.40***	198.62***	207.73***	271.16***	225.71***
Degrees of freedom	4/239	5/238	5/238	5/238	6/237
Returns to scale parameter	1.198	1.187	1.155	1.010	1.008
$\bar{R}^2$	0.80	0.80	0.81	0.85	0.85
Standard error of ln Y	0.59	0.59	0.58	0.52	0.52
Sample size	244	244	244	244	244

[a] The dependent variable, Y, is production adjusted for crop damage (qt/farm).

[b] ** and ***, respectively, mean that t-statistics were significant at the 5 and 1 per cent levels. Two-tailed tests apply to the coefficients of the dummy; one-tailed tests to all other variables.

[c] Figures in parentheses are standard errors.

output for farmers in each region. The negative coefficient of the regional dummy in equation (4) (Table 6.4) indicates a lower production in Region 3 than in the other regions. This finding is consistent with a similar finding reported in Chapter 5 and has been discussed there. The lower production is thought to be mainly due to the poorer agricultural environment and extension services in that region than in the other two regions.

6.2.3 Production Functions by Region and Tenancy Status

In the following analysis, an attempt has been made to explore the importance of tenancy status in different regions. In Table 6.5 the results of the regression analysis for different farm groups after introducing tenancy status into the model are provided. From Table 6.5, it can be concluded that tenancy status does not affect farm production when pooled data is used.

The Chow test of equality between sets of coefficients in two linear regressions (equations (1) and (2) in Table 6.5) shows no significant difference at the 5 per cent level, therefore an attempt was made to run the pooled data as shown in equation (5) in Table 6.5. All regression coefficients were highly significant at the 5 per cent level except for the tenancy dummy variable. The coefficient for tenancy status was only significant at the 20 per cent level when the pooled data was used. This means that all variables included in this analysis, except for the tenancy dummy variable, are important in explaining the variation of output.

To provide detailed information as to whether tenancy status plays an important role in different regions, an attempt was made to separately analyze the data in the different regions. The results are presented in Table 6.6. From this table, it can be concluded that farm tenancy status does not play an important role in determining the output of the sample farms.

Table 6.5

Estimated Coefficients of Cobb-Douglas Production Functions for Irrigated Ricefarms by Farm Groups, Seasons and Incorporating Tenancy Status, East Java, 1978[a]

Variables	Farm Groups		Seasons		Pooled data
	Small farms	Large farms	Wet season	Dry season	
	1	2	3	4	5
Intercept (ln a)	2.781	2.645	2.560	2.205	2.710
Land (ln hectare/farm)	0.543***	0.556***	0.559***	0.506***	0.567***
	(0.186)[b]	(0.104)	(0.115)	(0.145)	(0.090)
Labour (ln mandays/farm)	0.417***	0.167**	0.100	0.402***	0.231***
	(0.165)	(0.093)	(0.102)	(0.131)	(0.082)
Current expenses (ln Rp'000/ farm)	0.292***	0.460***	0.516***	0.344***	0.416***
	(0.117)	(0.053)	(0.069)	(0.070)	(0.009)
Tenancy dummy (D=1 for owner and D=0 for sharecropper)	-0.101	-0.131	-0.161	0.046	-0.081
	(0.710)	(0.132)	(0.165)	(0.224)	(0.135)
$F_{0.01}$	60.03***	189.33***	163.64***	90.14***	244.38***
Degrees of freedom	4/65	4/169	4/138	4/96	4/239
Returns to scale parameter	1.252	1.183	1.175	1.252	1.214
$\bar{R}^2$	0.77	0.81	0.83	0.79	0.81
Standard error of ln Y	0.68	0.55	0.56	0.63	0.59
Sample size	70	174	143	101	244

[a] The dependent variable, Y, is production adjusted for crop damage (qt/farm).

[b] Figures in parentheses are standard errors.

** and ***, respectively, mean that the t-statistics were significant at the 5 and 1 per cent levels.

Two-tailed tests apply to the coefficients of the dummy; one-tailed tests to all other variables.

Equality between sets of coefficients in two linear regressions (small and large farms) was tested by Chow's technique (Chow 1960). F-tests for both equations = 1.234 which was not significant at the 5 per cent level (F-table = 2.37).

Table 6.6

Estimated Coefficients of Cobb-Douglas Production Function for Irrigated Ricefarms by Tenancy Status and Regions, East Java, 1978[a]

Variables	Pooled data (farm groups and seasons)				
	1	2	3	4	5
Intercept (ln a)	2.671 [b]	3.202	2.231	4.646	4.910
Land (ln hectare/farm)	0.567***	0.641***	0.475***	0.575***	0.601***
	(0.090)[c]	(0.096)	(0.091)	(0.079)	(0.084)
Labour (ln mandays/farm)	0.231***	0.215***	0.304***	0.356***	0.346***
	(0.082)	(0.082)	(0.083)	(0.073)	(0.074)
Current expenses (ln Rp'000/farm)	0.416***	0.356***	0.408***	0.138***	0.118***
	(0.049)	(0.057)	(0.048)	(0.054)	(0.058)
Tenancy-dummy (D=1 for owner and D=0 for share-cropper)	-0.181	0.027	-0.219	-0.075	-0.036
	(0.135)	(0.143)	(0.137)	(0.118)	(0.126)
Regional dummies					
R2,3 (D=1 for Region 1 and D=0 for other regions)		0.214**			
		(0.105)			
R1,3 (D=1 for Region 2 and D=0 for other regions)			0.311***		
			(0.084)		
R1,2 (D=1 for Region 3 and D=0 for other regions)				-0.900***	
				(0.108)	
R2) (D=1 for Region 1 and					-0.085
					(0.093)
R3) D=0 for other regions)					-0.979***
					(0.133)
$F_{0.01}$	244.38***	192.10***	208.54***	265.95***	221.60***
Degrees of freedom	4/239	5/236	5/238	5/238	6/237
Returns to scale parameter	1.14	1.212	1.187	1.069	1.065
$\bar{R}^2$	0.81	0.80	0.81	0.85	0.81
Standard error of ln Y	0.59	0.59	0.58	0.52	0.53
Sample Size	244	242[d]	244	244	244

[a]The dependent variable, Y, is production adjusted for crop damage (qt/farm).

[b]** and ***, respectively, mean that the t-statistics were significant at the 5 and 1 per cent levels. Two-tailed tests apply to coefficients of the dummy; one tailed tests to all other variables.

[c]Figures in parentheses are standard errors.

[d]Two extreme observations were discarded in order to obtain a solution to the regression problem.

Finally, before going further with the analysis, care should be taken in interpreting the coefficients of the Cobb-Douglas production function. As with most econometric estimates problems of specification in terms of functional form, unobserved variables, autocorrelation, heteroskedasticity, and measurement errors can all impact on the results. In the case of the above analysis it is encouraging to note that no major shifts in coefficients occurred as a result of making the minor changes in specification reported in Tables 6.1 to 6.6. Recognising these difficulties and the limitations of a production function, as opposed to a frontier production function, it seems reasonable to conclude (based on the differences in intercepts of the equations in Tables 6.1 to 6.6) that differences in technical efficiency are likely to exist between the various farm groupings. These will be examined more carefully in the subsequent sections using frontier production functions.

6.3 Frontier Production Function Analysis

In the following section, the technical production efficiency of both individual farms and groups of farms is discussed. In order to understand the detailed information regarding farm efficiency, factors affecting technical efficiency will also be discussed. The Cobb-Douglas frontier production function, as specified in Chapter 4, Section 4.3.4, is used in this section.

6.3.1 Technical Efficiency of Individual Farms

Technical efficiency of the individual farms can be measured by using equation (4.19). Following Aigner and Chu (1968) and Timmer (1970, 1971) estimates of the Cobb-Douglas frontier production function were made with various probability levels, (see Chapter 4, Section 4.3.4). Results of the analysis are presented in Table 6.7. Estimates of the Cobb-Douglas frontier production function using linear programming and utilizing all of the sample farms was labelled LP-100, whereas using probabilities of 98 per cent and 97 per cent the results were labelled LP-98 and LP-97 respectively (probabilities of 100 to 97 per cent were examined). From these estimates (LP-100, LP-98 and

Table 6.7

Estimated Average and Frontier Cobb-Douglas Production Function Parameters for Irrigated Ricefarms by Seasons, East Java, 1978[a]

Items	Wet season				Dry season			
	OLS-100	LP-100	LP-98	LP-97	OLS-100	LP-100	LP-98	LP-97
Intercept (ln a)	2.377	2.851	2.329	2.922	2.267	0.001	2.371	2.371
Land (ln hectare/farm)	0.559***[b]	0.373	0.439	0.364	0.506***	0.242	0.531	0.531
	(0.115)[c]				(0.144)			
Labour (ln mandays/farm)	0.102	0.091	0.299	0.262	0.301***	0.945	0.369	0.368
	(0.102)				(0.130)			
Current expenses (ln Rp'000/ farm)	0.519***	0.323	0.226	0.337	0.343***	0.036	0.048	0.048
	(0.069)				(0.069)			
$\bar{R}^2$	0.82				0.78			
Sample size	143	143	140	138	101	101	99	98

[a] OLS for wet and dry seasons were taken from the production functions presented in Table 6.5.

[b] *** means that the t-statistic was significant at the 1 per cent level on a one-tailed test.

[c] Figures in parentheses are standard errors.

LP-97), LP-98 appeared better than the other two in the sense that the resulting estimated coefficients were stable. The estimated coefficients from LP-98 were also most similar to the coefficients estimated by using ordinary least squares. Appendix F.1 and F.2 provide the technical efficiency ratings of the individual farms in both the wet and dry seasons. It is notable that 65 per cent of the sample farmers (i.e. 93 out of 143 sample farmers) grew irrigated rice in the dry season, and 6 per cent of the sample farmers (i.e. 6 out of 99 sample farmers) who grew rice in the dry season did not grow irrigated rice in the wet season. When the average of the technical efficiency ratings in both seasons are compared, it can be seen that the average technical efficiency ratings do not differ significantly, that is, 70 per cent and 64 per cent respectively in the dry and wet seasons (Table 6.7).

By using the individual technical efficiency ratings, the distributions of these ratings among the sample farmers, can be measured. Distributions based on 10 per cent intervals in the technical efficiency ratings, and according to farm groups and seasons are presented in Figures 6.1 and 6.2. Figure 6.1 shows that 70.1 per cent of large farms have technical efficiency ratings of more than 70 per cent. On the other hand, only 26.2 per cent of small farmers (relative to the total sample of small farmers) have technical efficiency ratings of more than 70 per cent. These findings indicate that the higher technical efficiency ratings are skewed in favour of large farms. This result may be due to the different level of 'entrepreneurship' among farmers as indicated in Section 5.4.1. If the sample farmers are classified by season, as shown in Figure 6.2, it can be seen that most farmers (52.5 per cent and 64.0 per cent of sample farmers in wet and dry seasons, respectively) achieve more than a 70 per cent technical efficiency rating. These findings suggest that most farmers achieve reasonable levels of technical efficiency (more than a 70 per cent) in their farming in this study area.

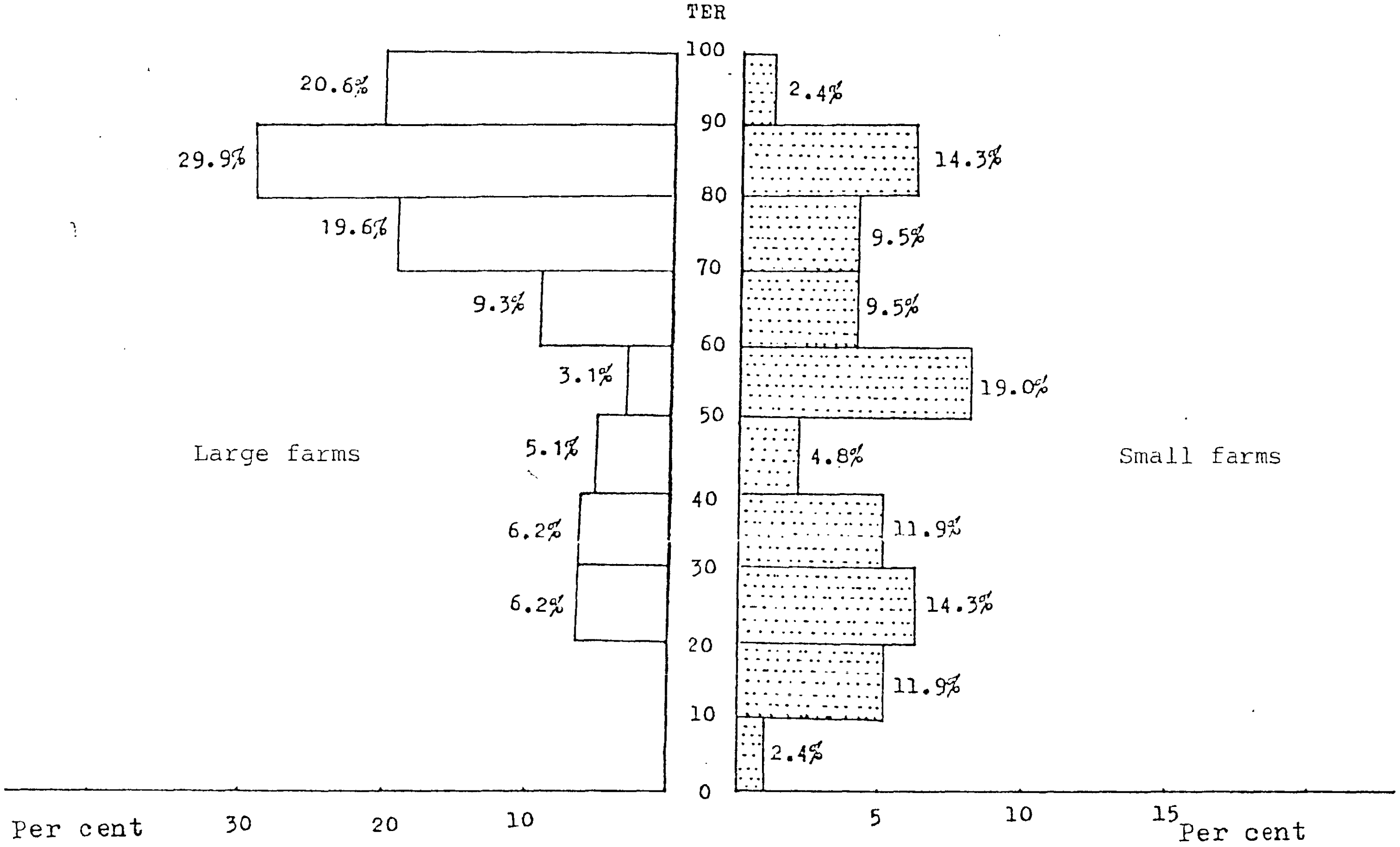

Figure 6.1 Technical efficiency ratings (TER) for sample irrigated rice farms by farm groups, East Java, 1978.

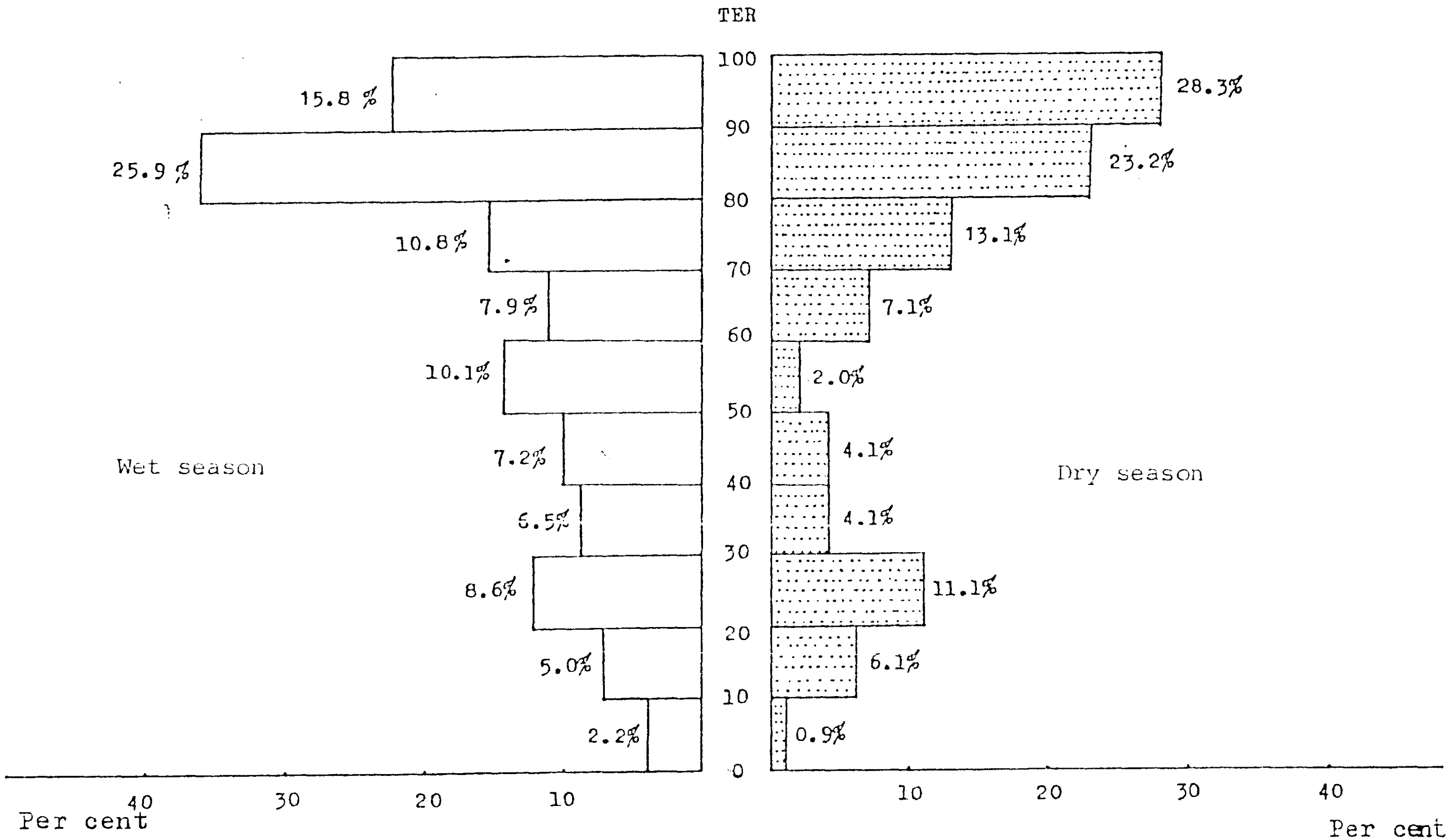

Figure 6.2 Technical efficiency ratings (TER) for sample irrigated ricefarms by seasons, East Java, 1978.

6.3.2 Technical Efficiency of Groups of Farms

The measurement of the technical efficiency of groups of farms was also derived from the technical efficiency ratings calculated using LP-98. The sample farmers in the wet season (140 farmers) and dry season (99 farmers) were pooled. Then, these pooled observations were classified into different categories, namely, large and small farmers, owners and sharecroppers, wet and dry seasons, and Regions 1, 2 and 3. Results of the analyses are presented in Table 6.8. Several conclusions can be drawn from this table. First, there are significant differences in the technical efficiency ratings for large and small farmers when the pooled data are used. Also, it can be seen that average technical efficiency ratings were 48 per cent for small farmers and 73 per cent for large farmers. Second, when the sample farmers were classified into owners and sharecroppers, it can be seen that sharecroppers are technically more efficient than owners. However, when the sample farmers are classified by season and tenancy status, sharecroppers do appear to be technically more efficient in the wet season. Thus, further work relating to efficiency under different tenancy status would seem to be needed since the finding in this study is not a strong one. For example, there is no difference between owners and sharecroppers in the dry season. A similar conclusion can only be tentatively drawn for sharecroppers since the sample size was only three in the 'small' group. Third, when the sample farmers are classified by region, size of farm groups and tenancy status, it can be seen that farmers in Region 1 are technically more efficient than those in the other two regions. Large farmers are technically more efficient in all three regions. Farmers in Region 1 are technically more efficient than those in Region 2, and farmers in Region 2 are technically more efficient than farmers in Region 3. This finding suggests that different locations, which also mainly mean different physical infrastructure and soil fertility, have substantial effects on the variation in technical efficiency. Drawing together the various strands of the above discussion, it can be concluded that the large farmers were technically more efficient in their farming than small farmers; whereas owners and sharecroppers did not appear to have different levels of technical efficiency.

Table 6.8

Average Technical Efficiency Ratings for Irrigated Ricefarms by Farm Groups, Tenancy Status, Seasons, and Regions, East Java, 1978[a]

Items	n	Pooled data[b]	Farm groups				Tenancy status				Seasons			
			n	Large	n	Small	n	Owner	n	Sharecropper	n	Wet	n	Dry
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Farm groups														
Large	169	73.28***												
		(23.84)[c]												
Small	70	48.17												
		(27.76)												
2. Tenancy														
Owner	217	64.90**	150	72.41	67	47.71***								
		(27.87)		(24.32)		(28.03)								
Sharecropper	22	76.09	19	77.32	3	68.33								
		(21.27)		(21.28)		(23.86)								
3. Seasons														
Wet	140	63.63ns	98	70.61	42	47.33***	127	61.97	13	80.39***				
		(27.08)		(23.62)		(27.87)		(27.65)		(12.14)				
Dry	99	69.18	71	76.97	28	49.43ns	90	69.03	9	69.89ns				
		(27.87)		(23.80)		(28.06)		(27.82)		(29.82)				
4. Regions														
Region 1	84	82.88	73	84.29	11	73.55**	68	83.25	16	81.31ns	45	82.87	39	83.59ns
		(14.24)		(13.75)		(14.56)		(13.31)		(18.10)		(12.66)		(16.01)
Region 2	86	75.18***	58	51.71	28	62.79**	81	75.53	5	69.60ns	49	73.43	37	77.51ns
		(20.90)		(26.50)		(25.30)		(21.10)		(18.24)		(21.28)		(20.44)
Region 3	69	33.75***	38	40.11	31	25.97***	68	33.88	1	25.00ns	46	34.96	23	31.35ns
		(18.37)		(19.52)		(13.45)		(18.47)		(0.00)		(18.24)		(18.79)

[a]Calculation based on LP-98.

[b]Statistical tests were carried out between pairs (figures in columns 3, 5 and 7, 9 and 11, 13 and 15). Statistical tests for regions in column (3) were carried out based on Region 1.

ns means non-significant at the 90 per cent significance level and *, ** and *** mean that the t-statistics were significant at the 10, 5 and 1 per cent levels respectively (using two-tailed tests).

[c]Figures in parentheses are standard deviations.

Any explanation of the sources of technical inefficiency among individual farmers or groups of farmers, should include the facts that the high degree of technical efficiency of sample farmers is related to the use of the three inputs (land, labour and current expenses) fitted into the production function. Thus, a high degree of technical efficiency depends on the level of use of those inputs. If different types of production functions were used, which included different inputs, different technical efficiency ratings would be produced. In other words, the choice of production function affects the technical efficiency rating obtained. Thus the results obtained are conditional on the particular production function and further work in this area should include different functions and variables.

The factors affecting technical inefficiency will be discussed in the following section and analyzed by using factor analysis. In the first section, the technique of factor analysis and the variables used in the model will be discussed.

6.4 Factor Analysis

As was mentioned in Chapter 1, Section 2, there are five factors which seem to have made a significant contribution to the low farm productivity, namely, economic, social, physical, institutional and information factors. Not all of these factors are examined in this section. A set of 24 variables, as listed in Table 6.9, was used. Factor analysis is used to group together the variables into common factors and the factors closely related to technical efficiency are then considered.

The assumption used in this approach is that all farms had potential access to the same technology, but that some were more successful than others in exploiting it.

In examining factors affecting technical efficiency, most neo-classical economists have used variables relating to farmers' education and have argued that the differences in the levels of technical efficiency were due mainly to the different levels of management of the farmers (Shapiro 1983, Chandra 1976, Asnawi 1981).

Tab..e 6.9

Variables Used in the Factor Analysis

Variables	Unit (S=scale, D=dummy)	Mean	Standard Deviation	Adopters No.	Adopters %
	1	2	3	4	5[b]
I. Farmers' education					
1a. Junior or senior high school	4(S)			7	3
1b. 4 to 6 years schooling at PS[a]	3(S)	2.908	0.912	49	21
1c. 1 to 3 years schooling at PS[a]	2(S)			92	38
1d. Never at school	1(S)			91	38
II. Ability to use language					
2a. Indonesian and local languages	2(S)	1.318	0.467	76	32
2b. Local language	1(S)			163	68
III. Ability to read					
3. Old farmers (≥ 30 years old)	1(D)	0.377	0.486	30	13
4. Young farmers (< 30 years old)	1(D)	0.126	0.332	90	38
IV. Source of general information					
5. Television	nos.	0.004	0.065	1	0.04
6. Radio	nos.	0.188	0.413	45	19
V. Source of agr. information					
7. Visits from agr. extension workers	nos.	1.482	9.229	39	16
8. Attendance at intensification prog.	1(D)	0.632	0.484	151	63
VI. Knowledge of local agr. services					
9. Farmers' Water Use Organization	1(D)	0.063	0.243	7	3
10 Local agricultural office	1(D)	0.172	0.378	41	17
11 Agricultural cooperative	1(D)	0.256	0.437	61	26
12 'Contact'(progressive) farmers	1(D)	0.465	0.500	111	46
13 Village Unit Cooperative	1(D)	0.544	0.499	130	54

Table 6.9 continued

Variables	Unit (S=scale, D=dummy)	Mean	Standard Deviation	Adopters	
				No.	%
	1	2	3	4	5
VII. Agricultural practices employed					
14 Spacing recommendation	1(D)	0.055	0.228	124	52
15 Modern equipment for weeding	1(D)	0.026	0.157	140	59
16 Chemical fertilizers	1(D)	0.038	0.191	151	63
17 Sprayers	1(D)	0.063	0.243	156	65
18 Pesticides	1(D)	0.059	0.236	198	83
19 Modern varieties	1(D)	0.051	0.219	202	85
VIII. Transport used for seeking information					
20 Four wheel vehicles	nos.	0.008	0.092	2	1
21 Wagon or cart	nos.	0.008	0.092	2	1
22 Motorcycle	nos.	0.071	0.258	17	7
23 Bicycle	nos.	0.559	0.808	142	60
IX. Agricultural equipment					
24 Value of agricultural equipment[c]	1(D)	0.013	0.112	239	100

[a]PS means primary school.

[b]Per cent relative to total sample.

[c]D=1 for greater than 15 thousand rupiahs and D=0 for less or equal than 15 thousand rupiahs.

This argument was also put forward by Henderson and Quandt (1980, p. 66). They argued that:

> 'The entrepreneur's technology is all the technical information about combination of inputs necessary for the production ... and ... the best utilization of any particular input combination is a technical, not an economic problem'.

In this study most of the farmers have a low level of formal education. This situation is likely to be similar to that of other subsistence or semi-subsistence farmers in less developed countries. To improve farmers' knowledge levels, the Government has tried to give additional information to farmers by offering agricultural training and using extension methods. Given these circumstances, the use of the variable formal education alone will result in bias. It has been argued in the literature (for example, Lindner et al. 1979) that the level of technical efficiency is associated with the learning process involving the collection of information about the profitability of innovations. This means that the more agricultural information used by farmers the greater the output is likely to be. The agricultural information used by farmers depends on the condition of both the economic and non-economic environments. Thus, the objective was to determine the inter-relationship among the set of variables used, and to measure the effects of the set of variables on the technical inefficiency.

6.4.1 Variables Used in Explaining Sources of Technical Efficiency

Some 25 variables were selected (including a variable of technical efficiency) for use in the factor analysis. Details of these variables are given in Table 6.9. From this table, it can be seen that most farmers (76 per cent) did not graduate from primary school. On the other hand, only 21 per cent and 3 percent of farmers graduated from primary and high schools respectively. This means that the farmers were poorly educated. From the 62 per cent (24 per cent plus 38 per cent) of farmers who had been at primary and high schools only 32 per cent of the farmers were able to use the Indonesian language. In other words, most farmers probably had difficulty in accessing the additional information provided by radio or mass media because it was given mostly in

Indonesian. However, they might get some of the additional information from other sources such as visits from agricultural extension workers and progressive farmers. This situation might explain why only a small number of farmers (18 per cent of the sample) have a radio. There were 65 per cent of sample farmers attending an intensification programme, but they accessed very little (less than 20 per cent) of the agricultural information from other sources. This situation was not in accord with the hypothesis that the more frequently farmers seek agricultural information the better they manage and therefore the greater their output.

Visits from agricultural extension workers were relatively rare, only 16 per cent of the total sample farms being visited. However, farmers who attended the intensification programme made up 65 per cent of the total number. In order to accelerate agricultural development in the rural areas of Indonesia, the Government has established agri-support facilities (i.e. the rural bank, an agricultural extension worker and a village unit cooperative in every sub-district).

However, the variable 'knowledge of the name of the village unit cooperative' was indicated by 50 per cent of the sample farmers; knowledge of other agricultural services was indicated by less than 50 per cent of the sample farmers in each case. In contrast, most farmers (more than 50 per cent) employed some form of 'modern' agricultural practices as reflected in variable 7. On the basis of all the above information, it can be concluded that farmers do employ modern agricultural practices but with only a small proportion of them acquiring knowledge from the various sources of agricultural information (for example, television and radio).

6.4.2 Determinants of Technical Efficiency

The rotated factor matrix for the 25 variables used in the factor analysis for rice farms is shown in Appendix G. The four dominant factors are presented in Table 6.10. There were three major factors which might play an important role in determining technical efficiency. These variables were the use of modern inputs and their availability (the first factor), farmers education (the second factor) and

Table 6.10

Determinants of Technical Efficiency for Irrigated Ricefarms, East Java, 1978: Varimax Rotated Factor Matrix

Variables	F1	F2	F3	F4	R^2
1. Spacing recommendation	0.691	-0.120	0.018	0.083	0.55
2. Landak (modern weeding equipment)	0.710	-0.153	-0.036	0.034	0.54
3. Pesticides	0.766	0.217	-0.007	0.088	0.75
4. Chemical fertilizers	0.847	0.062	-0.049	0.097	0.77
5. Modern varieties	0.686	0.070	0.030	0.115	0.53
6. Ability to read (old farmers)[a]	-0.063	0.633	0.041	-0.097	0.63
7. Level of education	0.136	0.878	0.018	-0.050	0.71
8. Ability to use language	0.016	0.738	0.126	0.068	0.65
9. Radio	-0.092	0.272	0.541	0.033	0.60
10 Bicycle	-0.059	0.146	0.863	0.057	0.62
11 Knowledge of BUUD[b]	0.179	0.048	0.251	0.823	0.55
12 Knowledge of contact farmers	0.130	-0.105	0.343	0.617	0.55
13 Technical efficiency	0.036	0.084	0.519	0.375	0.48
14 Knowledge of local agr. cooperative	0.061	-0.027	0.600	0.244	0.51
15 Member of intensification programme	-0.126	0.087	-0.065	0.364	0.34
16 Ability to read (young farmers)	-0.063	0.210	-0.046	-0.008	0.63
17 Use of sprayers	0.161	-0.061	0.248	-0.049	0.29
18 Knowledge of local agr. office	0.061	0.217	-0.017	-0.164	0.41
19 Contact with agr. extension workers	-0.039	0.060	-0.031	0.045	0.25
20 Owning wagon or cart	-0.023	0.088	0.070	-0.022	0.18
21 Value of agricultural equipment	-0.024	0.236	0.139	-0.075	0.29
22 Owning motorcycle	-0.080	0.219	0.136	0.147	0.49
23 Television	0.001	-0.043	0.008	0.015	0.24
24 Owning 4 wheel vehicles	-0.010	-0.126	0.096	-0.135	0.33
25 Member of P3A[c]	-0.022	-0.009	0.040	0.041	0.28
Per cent of variance	24.6	21.2	16.4	10.5	
Cummulative per cent	24.6	45.8	62.2	72.7	

[a] Indonesian and local languages.

[b] BUUD stands for Badan Usaha Unit Desa or Village Unit Cooperative.

[c] P3A stands for Persatuan Petani Pemakai Air of Farmers' Water Use Organization.

agricultural information (the third factor). The first factor, F_1, accounted for 24.6 per cent of the total variation in the variable set. It included the use of spacing recommendations, the use of <u>landak</u> (modern weeding equipment), pesticides, chemical fertilizers and modern varieties. The important variables in the first factor were all modern inputs. The second factor, F_2, accounts for 21.2 per cent. The F_2 includes the ability to read (for farmers who are more than 30 years old), level of education and ability to use Indonesian and local languages. The third factor, F_3, accounts for 16.4 per cent, whereas the fourth factor, F_4, accounts for 10.5 per cent. The third factor, which was highly associated with the variable of technical efficiency, includes the use of a radio, use of a bicycle, knowledge of the village unit coperative, knowledge of the contact (progressive) farmers, technical efficiency, knowledge of the local agricultural cooperative. Farmers seek information from the radio, and by using bicycle to contact others with whom they can discuss their farming problems and to obtain financial and marketing support from the local agricultural cooperative or from the village unit cooperative.

Collecting together these four factors, it appears that the modern inputs, farmer education, and agricultural information may increase the level of output. It is indicated that better information is a most important variable that can be used to aid the adoption of modern inputs. Farmers used radios, travelled by bicycle to seek information, and went to the village unit cooperative or local agricultural cooperative to obtain modern inputs or capital and went to the contact farmers to get some information or some help to solve their farm problems. From the policy point of view, this finding is important in the sense of planning to provide agricultural information. It can be seen from Table 6.9 that contact with the local agricultural extension workers (variable 19) does not seem to have a significant relationship to technical efficiency. This is understandable since only one extension worker has been provided to support 4000 farm families, a task which is likely to be very difficult to accomplish. It can be seen from this that contact farmers have a positive contribution to make to improving technical efficiency. Therefore, the policy option suggested is that the number of contact farmers, currently about 20 persons per village, be increased. These contact farmers should have an adequate knowledge of agriculture as well as an adequate education.

6.4 Concluding Remarks

In this chapter, the output variations, technical efficiency and factors which influence these have been discussed. The analytical techniques used were cross-tabulation and the Cobb-Douglas and the frontier Cobb-Douglas production functions along with factor analysis. It was postulated that various differences in farm organization, such as small and large farm areas, tenancy arrangements, farm location and seasons result in different technical performances.

Several main conclusions that can be summarized from this chapter are:

First, that all variables included in the Cobb-Douglas production function, except for the tenancy dummy, are important in explaining the variation of output.

Second, on the basis of the analysis of the technical efficiency of individual farms and groups of farms, it was found that large farmers were, on average, technically more efficient than small farmers (hypothesis (a) rejected). It was also found that owners were not technically more efficient than sharecroppers (hypothesis (b) not rejected). Furthermore, farmers in Region 1 were technically more efficient than those in Region 2 while farmers in Region 2 were technically more efficient than in Region 3 (hypothesis (c) is rejected). This is consistent with the Schultzian model of agricultural development, for it suggests that farmers in less developed countries respond to changes in the benefits and costs associated with infrastructure. This is because different regions in the study area have different physical infrastructures, and therefore, they have different degrees of access to facilities providing agricultural information.

Finally, an attempt was made to examine the sources of technical inefficiency using factor analysis. It was found that a set of variables relating to agricultural information was associated with technical efficiency of the sample farms.

With the above facts in mind, it will be argued that the theoretical framework presented in Chapter 4, in conjunction with other research on the characteristics of agricultural technology presented in Chapter 3, suggest that, first, investment in the human capital of farm people is necessary to provide farmers with the ability to learn about and use the new technologies. Second, the land tenure system is not responsible for inter-farm differences in productivity, resource allocation or the adoption of new technology in the case of the three villages in the study area. Third, investment in infrastructure is expected to give farmers access to technical information associated with new productivity-raising technology.

Finally, it should be noted that the discussion presented in this chapter is mainly based on the technical performance of the sample farms. However, it has been argued that farmers who are technically efficient in their farming are not necessarily also economically efficient. Therefore, to provide a detailed explanation from the economic point of view, an analysis of the economic performance of the sample farms has been carried out, and will be presented in the following chapter.

Chapter 7

ECONOMIC PERFORMANCE

7.1 Introductory Remarks

This chapter, which deals with the economic performance of the sample farms, is organized into four sections. The first section contains some introductory remarks. In the second section a discussion of the allocative and economic efficiency ratings derived from the Cobb-Douglas frontier production function is provided. The relationship of these to some of the characteristics of farms both individually and as groups is discussed. In the third section, a discussion of the measurement of relative economic efficiency which is based on the work of Lau and Yotopoulos (1971) is provided. The analysis is focussed on irrigated rice crops in regard to the impact of the prices of rice, seed, fertilizer and labour. Finally, in the Section 4 some concluding remarks are provided.

The main purpose of this chapter is to test whether or not farmers who are technically efficient in their farming are also economically efficient. The main hypothesis to be tested is that there is equal relative economic efficiency between various groups of farms in the study area. More specifically, the following hypotheses will be tested.

(a) That 'small' and 'large' farmers are equal in terms of economic efficiency.

(b) That tenants and owners are equal in terms of economic efficiency.

(c) That farmers in each of the regions are equal in terms of economic efficiency.

7.2 Frontier Production Function Analysis

The LP-98 results, which were derived from the frontier production function analysis, discussed in Chapter 5, were chosen as the basis for calculating allocative and economic efficiency ratings. First, individual economic efficiency ratings for wet and dry seasons, using equation (4.28), were calculated. Second, economic efficiency ratings for groups of farms, both large and small, and owners and sharecroppers in different seasons and regions were calculated. The difference between each of the pairs of groups of farms was tested by using Freund and Williams's technique as shown in equation (4.1) or (4.1a). This sequence was also applied to the development of allocative efficiency ratings. Finally, the relationships between each of the allocative and economic efficiency ratings were considered.

The variables used in the model were the same as those variables used in the LP-98, that is, land, labour and current expenses. The definitions of these variables are shown in Appendix E.

7.2.1 Economic Efficiency Ratings for Individual Farms

The adjusted net profit and the maximum adjusted net profit (adjusted for crop damage), and the technical, allocative, and economic efficiency ratings for individual farms are presented in Appendix Tables F.1 (wet season) and F.2 (dry season). These data reflect the fact that farmers who are allocatively efficient in their farming are not necessarily economically efficient as well. For example, in the wet season, the economic efficiency ratings of farmers numbered 2, 116 and 7 were 47.45, 47.22 and 46.84 per cent; whereas, the allocative efficiency ratings were 57, 58 and 53 per cent respectively. In a situation where farmers had a 100 per cent level of economic efficiency rating, they also had a 100 per cent allocative efficiency rating. Since the economic efficiency rating is the product of the technical efficiency rating and the allocative efficiency rating then even though the economic rating cannot exceed 100 per cent it is possible for the allocative efficiency rating to exceed 100 per cent provided there is a lower technical efficiency rating. Because only 98 per cent of the points were inside the frontier some allocative efficiency ratings were observed to be greater than 100 per cent. This is one of the problems of using frontier production functions for individual farms and arises because of a desire not to give full weight to extreme observations.

To assess the relationships between the technical and economic efficiency ratings the two variables were plotted. The plots are given in Figures 7.1 and 7.2. From these figures, it was indicated that an exponential function was more appropriate than a semilog or linear function in depicting the relationship. This is indicated by the fact that an exponential function produces a higher value of the adjusted R^2. The estimated relationship between technical and economic efficiency ratings is presented in Table 7.1. From this table, it can be seen that technical and economic efficiency ratings are positively related. This means that the greater the technical efficiency, the greater the economic efficiency. Because technical and economic efficiency appear to have a close relationship to size of farm, an attempt was also made to relate technical and economic efficiency ratings to farm area. The plot of the two sets of variables (crop area and technical efficiency rating and crop area and economic efficiency rating) indicated that a semilog function would be an appropriate model to estimate the relationship between these variables. They are presented in Table 7.2 and the plots of these variables are given in Figures 7.3, 7.4, 7.5 and 7.6. From this table, it can be seen that the values of the adjusted R^2 are relatively poor, which indicates that the variation between technical and economic efficiency cannot be adequately explained by the farm area. This finding is not surprising, because the technical and

Table 7.1

The Relationship Between Technical and Economic Efficiency Ratings for Sample Irrigated-Ricefarms, East Java, 1978[a]

Season	Sample size	Intercept	Independent variable	$\bar{R}^2$
Wet season	140	0.843	0.034*** TER (0.003)[b]	0.54
Dry season	99	1.132	0.030*** TER (0.002)	0.77
Wet and dry seasons	239	1.102	0.033*** TER (0.002)	0.61

[a]Calculations based on the function, $EER = b^{TER}$ or ln EER = (ln b) TER, where TER is the technical efficiency ratings, EER is economic efficiency ratings, and a and b are parameters to be estimated. *** means that the t-statistics were significant at the 1 per cent level (using a two-tailed t-test).

[b]Figures in parentheses are respective standard errors.

Table 7.2

The Relationship Between Technical Efficiency Ratings, Economic Efficiency Ratings and Crop Area of Sample Irrigated Ricefarms, East Java, 1978[a]

Season	Sample size	Dependent variable	Intercept	Independent variable	$\bar{R}^2$
Wet season	140	TE	79.460	16.024*** ln CA	0.20
				(2.711)[b]	
Dry season	99	TE	86.805	19.640*** ln CA	0.33
				(2.815)	
Wet season	140	EER	10.570	2.079*** ln CA	0.10
				(0.521)	
Dry season	99	EER	8.953	1.770*** ln CA	0.11
				(0.496)	

[a]Calculations based on the semilog functions. TER and EER are technical and economic efficiency ratings, respectively, and CA is crop area.

[b]Figures in parentheses are standard errors. *** mean that the t-statistics were significant at the 5 and 1 per cent levels, respectively (using two-tailed t-tests).

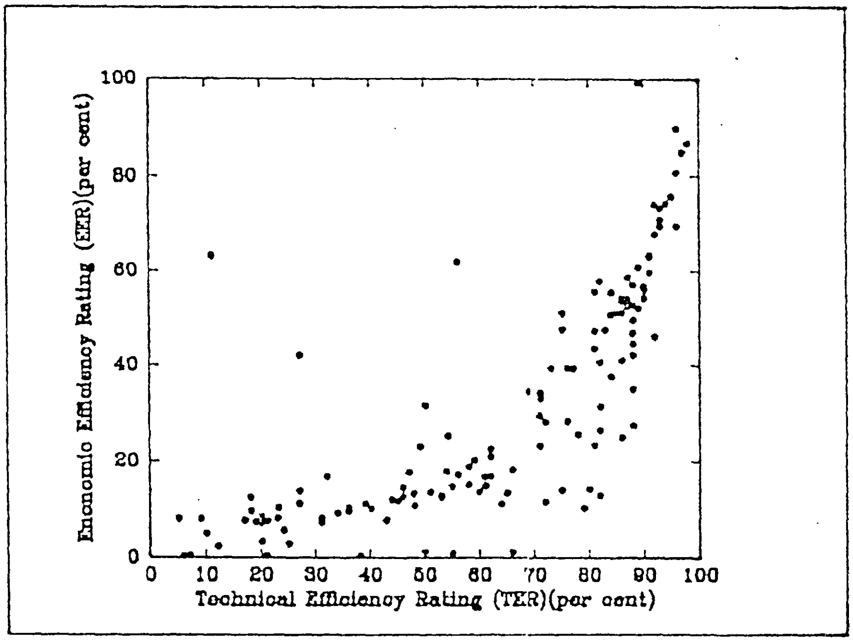

Figure 7.1 The relationship between technical and economic efficiency ratings for sample irrigated ricefarms, East Java, wet season, 1978.

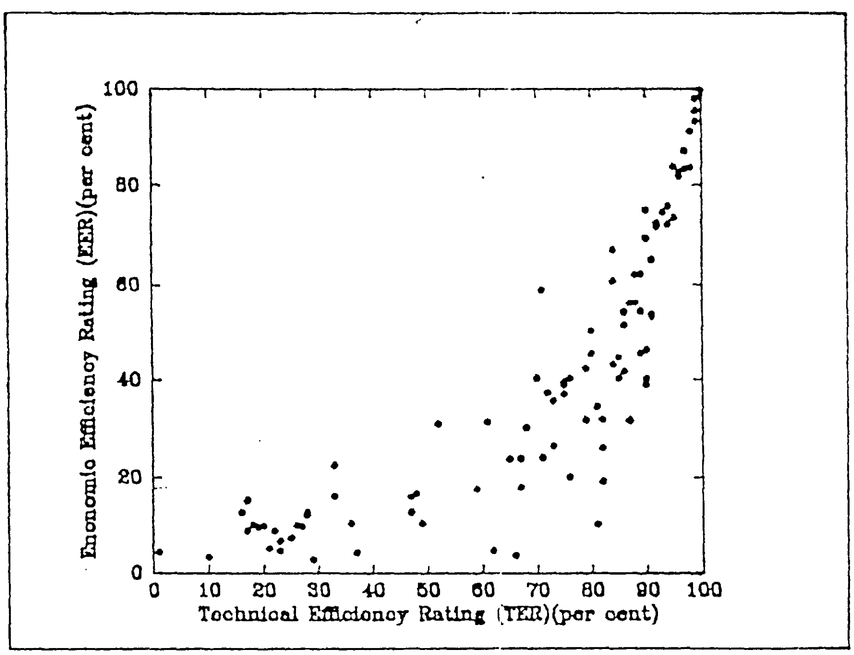

Figure 7.2 The relationship between technical and economic efficiency ratings for sample irrigated ricefarms, East Java, dry season, 1978.

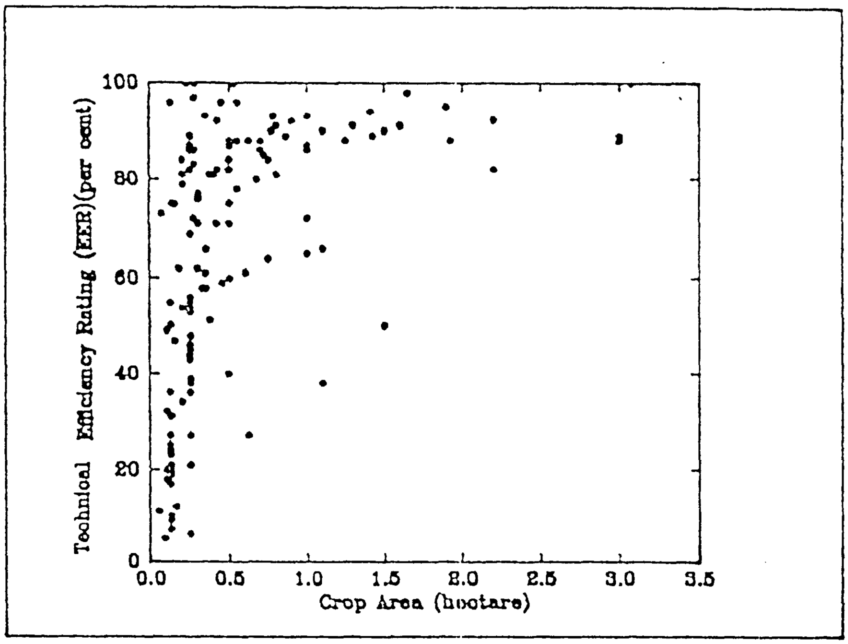

Figure 7.3 The relationship between crop area and technical efficiency ratings for sample irrigated ricefarms, East Java, wet season, 1978.

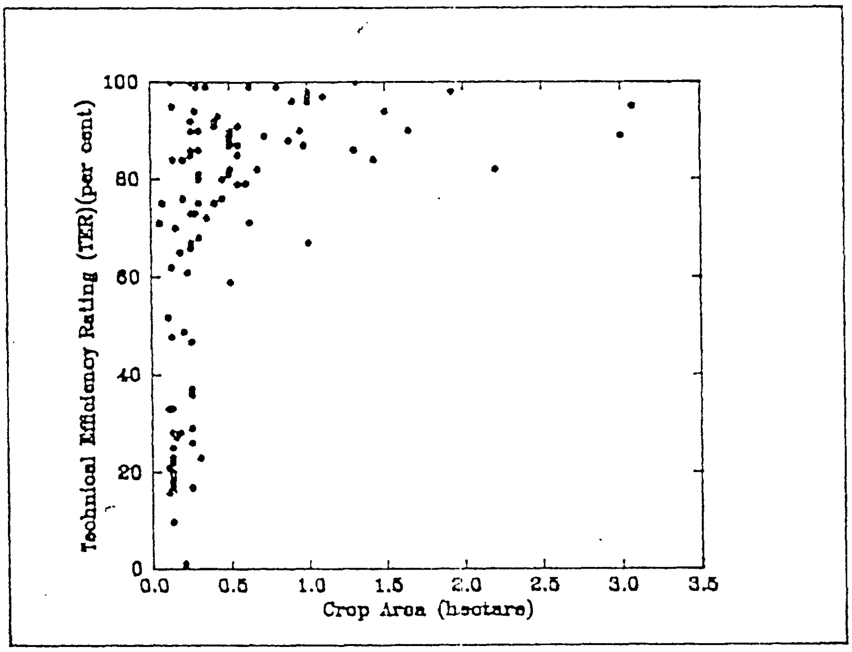

Figure 7.4 The relationship between crop area and technical efficiency ratings for sample irrigated ricefarms, East Java, dry season, 1978.

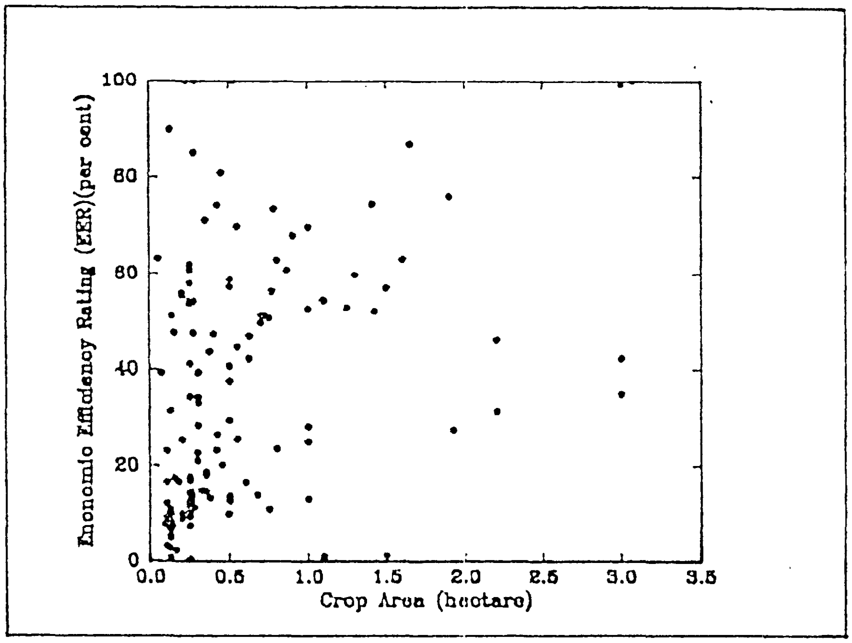

Figure 7.5 The relationship between crop area and economic efficiency ratings for sample irrigated ricefarms, East Java, wet season, 1978.

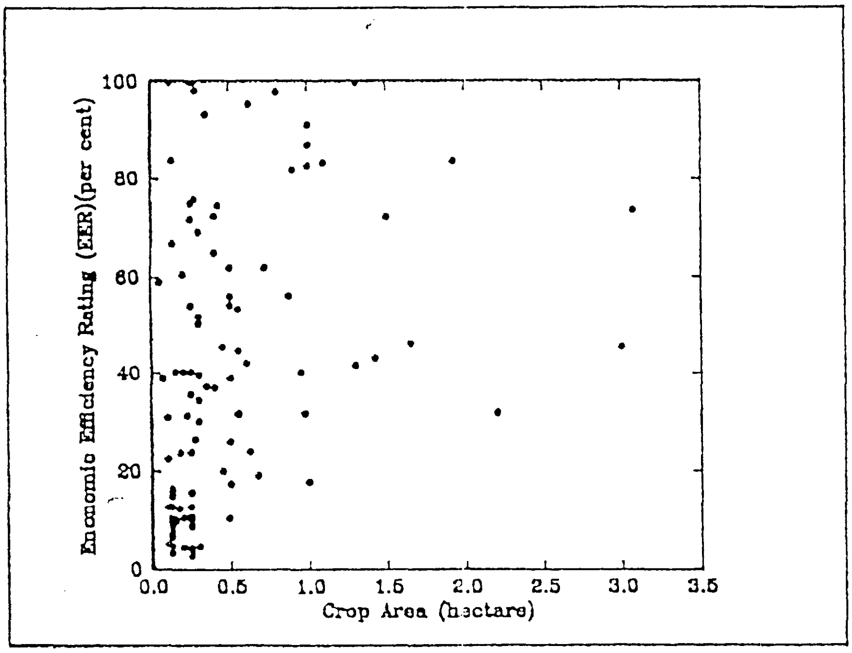

Figure 7.6 The relationship between crop area and economic efficiency ratings for sample irrigated ricefarms, East Java, dry season, 1978.

economic efficiency ratings were not only calculated on the difference between the actual and maximum level of output by using only farm area as an explanatory variable but also the combination of three inputs used by farmers, namely, farm area, labour, and current expenses. However, given the values of the adjusted R^2, the relationship of farm area and technical efficiency ratings, or farm area and economic efficiency ratings, were both positive and significant. It should be noted that the largest farm area under rice crop was only 3.075 hectare.

7.2.2 Economic Efficiency Ratings for Groups of Farms

The economic efficiency ratings for groups of farms, both large and small, and owners and sharecroppers in different regions and seasons are shown in Table 7.3. From this table, several conclusions can be drawn.

First, there are significant differences (at the 5 per cent significance level on a two-tailed t-test) in the economic efficiency ratings for large and small farmers, indicating that large farmers are economically more efficient than small farmers. When this finding is compared with the technical efficiency ratings, it can be seen that large farmers are not just technically more efficient in their farming but are also economically more efficient. Thus, the hypothesis that large farmers are economically as efficient as small farmers can be rejected. The reason for this difference can be clearly seen in the graphs where the small farms cover the whole range of efficiency levels while the larger farms tend to be generally efficient.

Second, when the sample farmers are classified into different groups, owners and sharecroppers, in the different seasons, it can be seen that sharecroppers do not have statistically higher economic efficiency ratings than owners. Thus, sharecroppers who have higher technical efficiency ratings in the wet season do not have higher economic efficiency ratings than owners. Thus the second hypothesis that owners and sharecroppers are equally efficient economically cannot be rejected on this evidence.

Table 7.3

Average Economic Efficiency Ratings for Sample Irrigated Ricefarms by Farm Groups, Tenancy Status, Seasons, and Regions, East Java, 1978[a]

Items	n	Pooled data	Farm groups				Tenancy Status				Seasons			
			n	Large	n	Small	n	Owner	n	Sharecropper	n	Wet	n	Dry
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Farm groups														
Large	169	41.70**[b]												
		(28.52)												
Small	70	25.55												
		(23.20)												
2. Tenancy														
Owner	217	36.70^{ns}	150	41.62	67	25.70***								
		(28.61)		(29.10)		(24.11)								
Sharecropper	22	38.80	19	38.10	3	43.40^{ns}								
		(21.82)		(21.40)		(28.41)								
3. Seasons														
Wet	140	33.52**	98	37.38	42	24.42***	127	32.81	13	40.30^{ns}				
		(26.40)		(26.60)		(24.00)		(27.11)		(16.50)				
Dry	99	41.80	71	47.62	28	27.20***	90	42.70	9	36.31^{ns}				
		(29.52)		(30.10)		(22.41)		(29.60)		(28.69)				
4. Regions														
Region 1	84	45.80[c]	73	47.80	11	32.80*	68	47.20	16	40.00^{ns}	45	42.20	39	49.92^{ns}
		(26.52)		(26.10)		(26.60)		(27.61)		(21.16)		(25.22)		(27.70)
Region 2	86	47.92	58	51.70	28	40.00*	81	48.35	5	41.45^{ns}	49	46.10	37	50.32^{ns}
		(26.00)		(26.55)		(23.61)		(26.20)		(23.70)		(25.40)		(26.60)
Region 3	69	12.40**	38	14.50	31	9.80^{ns}	68	12.50	1	7.48^{ns}	46	11.40	23	14.50^{ns}
		(13.43)		(17.08)		(6.10)		(13.50)		(0.00)		(9.32)		(19.25)

[a]Calculation based on LP-98. Statistical tests were carried out between pairs (figures in columns 3; 5 and 7; 9 and 11; 13 and 15).

[b]Figures in parentheses are standard deviations.

ns means non-significant at the 10 per cent significance level and *, ** and ***, respectively, mean that the t-statistics were significant at the 10, 5 and 1 per cent levels (using two-tailed t-tests).

[c]The t-statistic between Regions 1 (and Region 2) and 3 was significant at the 5 per cent level (using two-tailed t-tests). -

Unlike other studies which suggest that most sharecroppers are small farmers who sharecrop the large farmers' land, this study shows that 86 per cent (19 out of the 22 sharecroppers were large farmers or only 8 per cent out of total sample of 239) were large farmers. However, the number of sharecroppers was not large enough so that the average economic efficiency ratings could differ significantly from those of the owners. The fact that sharecroppers are also large farmers is in accord with the result of the World Bank's study of land tenure and labour markets in Indonesia (World Bank 1982).

Third, farmers in Regions 1 and 2 are economically more efficient than farmers in Region 3. Economic efficiency ratings of farmers in Regions 1 and 2, and Region 3 differ significantly at the 10 per cent level on a two-tailed t-test. This finding suggests that different locations can have a substantial effect on the variation in technical efficiency and economic efficiency. Factors such as soil types, nearness to agricultural advice and sources of inputs, differences in infrastructure, among other things, will all have an effect. Thus the third hypothesis that farms in different regions will be equally efficient economically can be rejected.

The fact that there are regional differences must be tempered by the fact that the economic efficiency ratings discussed in this section are subject to the limitations of the concept of a non-stochastic frontier production function. They were calculated directly from observed data. Threfore, the analysis of economic efficiency ratings is also in one sense normative in that it is assessed against an economic ideal. It must also be tempered by the fact that farmers may have different attitudes towards risk and time preference in their decisions to buy their inputs and to sell their products and that different farmers face different environmental risks which cannot be controlled.

The above discussion has been concerned with economic efficiency and its relationship to technical efficiency. It is apparent that economic efficiency varies with farm size groups and region of activity but not with tenancy status. It has also been shown that farmers, who are allocatively efficient in their farming, are not necessarily also economically efficient and vice versa. Therefore, an attempt will be made, in the following section, to examine the relative (economic) efficiency. The profit function, as specified in equation (4.42), will be used for this purpose.

7.3 Profit Function Analysis

The relative (economic) efficiency of the sample farms will be estimated by using the unit-output-price profit function. Equation (4.42) will be used for this purpose and the variables used in the model will be discussed in the following section.

7.3.1 Variables Used in the Model

The selection of variables was based on the theory underlying the short-run profit function. The variables chosen were, namely, price of seed, fertilizer and labour, normalized by the price of rice, and land. The first three variables were treated as variable inputs while farm area was considered to be a fixed input in the profit function. They were viewed as the main physical inputs into the production process.

Detailed definitions of the variables used in the profit function analysis are provided below.

Farm Area

Land, in hectares, was treated as a fixed input for this analysis. For this reason it was used as the basis on which to measure output. Viewed in this way it implies the profit function is a short-run function.

Price of Seed

The price of seed, in rupiah per kilogram, was based on the price paid by farmers who purchased seed from outside their farms. If farmers used their own self-produced seed, the price of seed was valued at an estimated purchase price.

Price of Fertilizer

The price of fertilizer, in rupiah per kilogram, was based on the price paid by farmers who purchased fertilizer either from the private market or from the Government. Because farmers used mostly urea and triple superphosphate (TSP), the price used in the model was the average price computed by dividing the total expenses for these fertilizers by their quantity.

Price of Labour

In this study, the price of labour used, in thousand rupiah per manday, was the weighted average wage computed by dividing the total labour costs for hired male labour by the total number of mandays excluding harvesting labour. The value of family labour used was computed at its going market price.

Profit

Profit, in thousand rupiah per farm, was defined as total revenue less variable cost. Total revenue was computed by multiplying the quantity of output by its price. The value of the variable costs were calculated by adding up the total cost of seed, fertilizer and labour.

7.3.2 Relative Economic Efficiency

The unit-output-price profit function as stated in equation (4.42) is extended as follows:

$$(7.1) \qquad \ln\pi^{*} = \ln A + \beta_1 \ln S + \beta_2 \ln F + \beta_3 \ln L + \alpha_1 \ln Z$$

By adding dummy variables, equation (7.1) can be written as follows:

$$(7.2) \qquad \ln\pi_1^{*} = \ln A_1 + \gamma_1 D_L + \gamma_2 D_T + \gamma_3 D_2 + \gamma_4 D_3 + \beta_{11} \ln S + \beta_{21} \ln F + \beta_{31} \ln L + \alpha_{11} \ln Z,$$

where: π^* and π_1^* are the normalized profit; A and A_1 are the neutral shift parameters for the sample farms; D_L is the dummy variable for farm area (D_L = 1 for large farms and D_T = 0 for small farms; D_T is the dummy variable for farm tenancy (D_T = 1 for owners and D_T = 0 for sharecroppers); D_2 is the dummy for Region 2 (D_2 = 1 for Region 2 and D_2 = 0 for other regions); D_3 is the dummy for Region 3 (D_3 = 1 for Region 3 and D_3 = 0 for other regions); S is the normalized price of seed; F is the normalized price of fertilizer; L is the normalized price of labour; Z is the farm area; α, β and γ are the parameters to be estimated.

To test whether or not there is a difference in relative economic efficiency among groups of farms, dummy variables were introduced to the model; these were, the farm area and the farm tenancy dummies. As has been discussed in Chapter 4, when the normalized profit function is in a logarithmic form, the coefficient of a dummy variable differentiates the two groups of farms and the test of relative economic efficiency is whether or not the coefficient of the dummy variable is significantly different from zero.

To test the relative economic efficiency, an analysis was carried out for all sample farms and for sample farms in Regions 1 and 2. The reason for emphasing Regions 1 and 2 was that the sample sharecroppers were in these regions, and, also, in these regions the rice crop is cultivated more intensively than in Region 3. Results of the analysis are presented in Table 7.4. The first three columns (columns (1), (2) and (3)) in Table 7.4 are the Cobb-Douglas profit functions for sample farmers in Regions 1 and 2, whereas the other columns (columns (4), (5) and (6)) are based on the estimates for all sample farmers.

From Table 7.4, it can be seen that all computed F-values, ranging from 12 to 67, were very much higher than the tabulated-F. They were significantly different at the 1 per cent level. However, not all of the input coefficients were statistically significant even at the 10 per cent level of significance on a one-tailed test. The coefficients for the price of seed and fertilizer, in all cases, were not significantly

Table 7.4

Cobb-Douglas Profit Functions and Related Statistics for Sample Irrigated-Ricefarms, East Java, 1978[a].

Variables	Regions 1 and 2			All farms		
	Wet	Dry	Wet and Dry	Wet[e]	Dry	Wet and Dry
	1	2	3	4	5	6
Intercept (ln A)	0.675	0.283	0.429	0.983	0.538	0.731
Price of seed	0.178	0.116	0.152	0.278	0.059	0.204
(ln S)	(0.242)[d]	(0.257)	(0.173)	(0.207)	(0.239)	(0.154)
Price of ferti	-0.825	0.344	-0.115	-0.143	0.247	0.056
lizer (ln F)	(0.681)	(0.484)	(0.400)	(0.389)	(0.403)	(0.280)
Price of labour	-0.209	-0.208	-0.274**	0.075	-0.443**	-0.204**
(ln L)	(0.244)	(0.229)	(0.166)	(0.220)	(0.219)	(0.123)
Farm area	0.783***	0.947***	0.843***	1.105***	1.116***	1.110***
(ln Z)	(0.128)	(0.130)	(0.090)	(0.098)	(0.108)	(0.073)
D_L[b]	0.306	0.333	0.335*	0.169	0.126	0.159
	(0.264)	(0.263)	(0.186)	(0.189)	(0.214)	(0.142)
D_T[c]	-0.110	-0.166	-0.267	-0.379	-0.028	-0.228
	(0.264)	(0.283)	(0.189)	(0.249)	(0.273)	(0.181)
$F_{0.01}$	12.333***	19.157***	29.658***	35.739***	33.023***	66.667***
Degrees of freedom	6/90	6/71	6/168	6/136	6/94	6/237
Adjusted R^2	0.42	0.59	0.50	0.60	0.66	0.62
Sample size	97	78	175	142	101	244

[a]S, F, and L are the normalized price of seed, fertilizer, and labour, respectively. Z is the farm area.

[b]D_L = farm-area dummy (D_L = 1 for large farm and D_L = 0 for small farm).

[c]D_T = farm-tenancy dummy (D_T = 1 for owner and D_T = 0 for sharecropper).

[d]Figures in parentheses are respective standard errors. *, ** and *** mean that the t-statistics were significant at the 10, 5 and 1 per cent levels, respectively.
Two-tailed tests apply to the coefficients of the dummy; one-tailed tests to all other variables.

[e]One extreme observation was discarded in order to obtain a solution to the regression problem.

different at the 10 per cent level. These results are not surprising because most farmers received fertilizer from the Government via the intensification programme and seed was a small component of the total expenditure. The variability in the price of fertilizer was small, for example, the coefficients of variation on the price of fertilizer were 6.75 per cent and 8.95 per cent respectively in the wet and dry seasons.

Even though a few extreme observations were discarded in order to obtain a better estimate, not all coefficients have the correct signs. For example, the coefficients on the price of seed in all cases, and fertilizer in columns (2), (5), and (6) were positive, but were not significant. The positive coefficient for seed can only be attributed to misspecification of this variable that is due to the implicit assumption of a wide range of the input prices in the area studied. As expected, the coefficients of the price of fertilizer and labour were mostly negative and generally not significant, indicating a negative relationship with profits; and the coefficients of the fixed input, farm area, were positive, indicating a positive relationship with profits.

Coefficients for the price of labour have the correct (negative) signs and were significant at the 10 and 5 per cent levels respectively for the combined Regions 1 and 2 (column (3)), in the dry season (column (5)), and in the wet and dry seasons (column(6)). The coefficients on the fixed input, farm area, all had the correct (positive) signs and were statistically significant at the 1 per cent level. Variation in land area would thus appear to have considerable explanatory power for the variation in normalized profit. Most studies using the same method, of the unit-output-price profit function, indicate similar results. For example, Yotopoulos and Lau (1973) found that the coefficient on the fixed input, land, varied from 1.459 to 1.797 for ricefarms in India, and from 0.917 to 0.923 for ricefarms in Malaysia (Tamin 1979).

Considering the dummy variables for the groups of farms (large and small farms, and owners and sharecroppers) in the model, all the coefficients on D_L (farm area) had positive signs; however, only in column (3) was the coefficient D_L statistically significant at the 10 per cent level on a two-tailed t-test. There is thus a tentative indication that 'large' farms are relatively more efficient than small farms. Unlike studies of farmers in India, which showed the relative economic efficiency to be in favour of the small farms (less than 10 acres) (Lau and Yotopoulos 1971), this study shows that large farmers were likely to be relatively more efficient in their farming than small farmers. From earlier parts of this study, it can be concluded that the large farmers, are technically and economically more efficient. Thus the second hypothesis that large and small farms are equally economically efficient is again rejected although only very weakly so on evidence from the profit function analysis.

Further, the coefficients of D_T (owners) were not statistically significant at the 10 per cent level on a two-tailed t-test. This finding confirms the previous findings reported in Chapter 6, and Section 7.3 in this chapter that sharecroppers were technically more efficient but not economically more efficient in their farming than owners. The third hypothesis that owners and tenants are equally economically efficient therefore cannot be rejected on this evidence.

As agronomic, climatic and infrastructure conditions differ in different regions, an attempt was made to capture the effects of the regional differences by including dummy variables for the regions. The dummies included in the model were D_2 (D_2 = 1 for Region 2 and D_2 = 0 for other regions) and D_3 (D_3 = 1 for Region 3 and D_3 = 0 for other regions). The results of the analysis are presented in Table 7.5. From this table, it can be seen that the computed F-values, tested at the 1 per cent level, indicated that not all regression coefficients were equal to zero. The coefficient on the price of labour in the dry season, and the coefficients on the farm size variable in both seasons, were significantly different from zero at the 1 per cent level on a one-tailed t-test. This indicates that labour in the dry season and farm area are important determinants of normalized profit. As expected, the coefficients of D_3 were negative (and statistically significant at 1 per cent) indicating that farmers in Region 3 were relatively less efficient in their farming than those in Regions 1 and 2. This finding also conforms to the previous finding presented in Chapter 6, and

Table 7.5

Cobb-Douglas Profit Functions and Related Statistics for Different Regions for Sample Irrigated-Ricefarms, East Java, 1978[a]

Variables	Wet season	Dry season[c]
Intercept (ln A)	0.818	0.665
Price of seed (ln S)	0.141	-0.044
	(0.190)[b]	(0.229)
Price of fertilizer (ln F)	-0.069)	0.271
	(0.161)	(0.369)
Price of labour (ln L)	-0.010	-0.480***
	(0.201)	(0.201)
Farm area (ln Z)	0.883***	1.101***
	(0.086)	(0.094)
Region 2 (D_2)	-0.033	-0.078
	(0.161)	(0.164)
Region 3 (D_3)	-0.931***	-0.819***
	(0.190)	(0.211)
$F_{0.01}$	46.130***	40.122***
Degrees of freedom	6/136	6/92
Adjusted R^2	0.66	0.71
Sample size	143	99

[a]S, F, and L are the normalized prices of seed, fertilizer, and labour, respectively. Z is the farm area.

[b]Figures in parentheses are respective standard errors.
*** means that the t-statistics were significant at the 1 per cent level.
Two-tailed tests apply to the coefficients of the dummy; one-tailed tests to all other variables.

[c]Two extreme observations were discarded in order to obtain a solution to the regression problem.

Section 7.3 that farmers in Region 3 were technically and economically less efficient than those in Regions 1 and 2. The fourth hypothesis can again be rejected on this evidence.

From Tables 7.4 and 7.5, it can be seen that the value of the adjusted R^2 in all cases turned out to be reasonably high. The included variables explain 42 to 72 per cent of the variation in the logarithms of the profits.

7.4 Concluding Remarks

It is now possible to draw together the various strands of this chapter and provide an interpretation of the results of the economic performance of the sample farmers. Based on the results and the discussion presented in Sections 7.2 to 7.3, the following conclusions can be drawn:

(a) It was found that large farmers, as well as being technically more efficient, were also economically and relatively more efficient than small farmers. The first hypothesis of equal economic efficiency can thus be rejected.

(b) As well, it was also found that sharecroppers were not economically more efficient than owners. Thus the second hypothesis that owners were equally as efficient as sharecroppers cannot be rejected.

(c) With regard to each region, the different locations appear to have substantial effects on the variation in technical efficiency and economic efficiency, particularly Regions 1 and 2 relative to Region 3. Unlike Regions 1 and 2, Region 3 is further away from the local source of (agricultural) information which is located 43 km from the local regency office (kabupaten). With relatively poor physical infrastructure in Region 3, the access to such technology is also relatively poor; therefore, farmers in this region are likely to be technically and economically less efficient. In other words, if farmers in Region 3 were sufficiently skilled in allocating their farm-inputs, the inefficiency may not have occured. Thus, the third hypothesis that farmers in each of the regions are equal in terms of economic efficiency can be rejected.

Although the above conclusions are somewhat tentative in terms of the empirical evidence presented, they conform with the author's judgment that most farmers in the study area are responsive to their economic opportunities, and that they make adjustments in their resource-use. However, such a conclusion diverges from Schultz's hypothesis that there are no significant economies to be achieved when farmers reallocate their resources. In the case of ricefarms, the findings of this study suggest that, except for changes in the use of labour (for large farms and in the dry season) and the use of land (for small farms), net farm income may still be increased and therefore a greater agricultural output can be achieved than that which is currently being obtained. This must be subject to the qualification that the effects of risk and uncertainty have not been considered.

It has been mentioned in the previous chapter that the Indonesian Government has long considered rice production to be a key to development. This is mainly because rice is the staple food of Indonesia. Consequently, rice intensification programmes have been operating since 1960. However, particularly after the end of the first Five-Year Development Plan in 1974/75, the agricultural intensification programme appeared to be causing a new problem, which is that the rich farmers became richer and the small farmers as well as landless labourers, became poorer (see, for example, Gibbons et al. 1980). Implicitly, the large farmers gained from technology and benefited from the green revolution to a greater extent than small farmers. To understand the underlying structure of such gains from technology, particularly for rice growing, the gains from achieving efficiency and the distribution of profits of the sample farmers are discussed in the following chapter. The effects of various (price) policies on the changes in output and the use of inputs, particularly for the most efficient farmers, are also discussed.

CHAPTER 8

FARM EFFICIENCY AND INPUT-OUTPUT PRICE POLICIES

8.1 Introductory Remarks

As previously mentioned, among the policy goals for agricultural development in Indonesia are increased rice production and a more equal distribution of farm income among farmers. To attain these objectives, the Indonesian Government has adopted policies with regard to rice and fertilizer. In order to explain some of the effects of Government policy, particularly the rice price policy, on output and on the use of modern inputs and labour, it is necessary to carry out further analysis. In particular, the analysis will be focused on the effect of the alternative price policies on the changes in output and the use of inputs.

In this chapter, an effort will also be made to relate the findings presented in the previous chapters to the Government policies on rice. The discussion in this chapter is presented in five sections. The first section contains some introductory remarks. A discussion of the joint estimation of unit-output-price profit functions and factor demand functions is presented in Section 8.2. It contains the output supply and factor demands derived from the unit-output-price profit function analysis. In Section 8.3 a discussion of the elasticities of output supply and factor demand is presented while in Section 8.4 alternative price policies are discussed in the light of these elasticities. The conclusion is in Section 8.5.

The hypothesis to be tested is that: Farm profits per unit of output are not affected by changes in farm wages, the price of seed or price of fertilizer.

8.2. Output Supply and Factor Demand Functions

Lau and Yotopoulos (1972) suggest that the estimation of output supply and factor demand functions should be carried out under restricted profit maximization. Constant returns to scale for all inputs may also be imposed. To discuss this condition, equations (4.35) the unit-output-price profit function, and (4.47) the factor demand functions, are written as follows:

$$(8.1) \qquad \ln \Pi^* = \ln A + \sum_{j=1}^{m} \beta_j \ln (c_j/p) + \sum_{j=1}^{n} \alpha_j \ln Z_j,$$

$$(8.2) \qquad (-c_j^* X_j)/\Pi^* = \beta_j^* \qquad j = 1, 2, \ldots, n.$$

for input j, and where Π^* is the normalized profit ; A is the intercept of the normalized profit function; c_j. is the price of input j; p is the price of output; Z_j. is the fixed input j; c_j^*. is the normalized price of input j; X_j. is the quantity of input j; and α, β, β^* are the parameters to be estimated.

The conditions of profit maximization and constant returns to scale can be achieved, using equations (8.1) and (8.2) if, and only if, $\beta j = \beta j^*$ and $\alpha_j = 1$ respectively. To meet these conditions, the unit-output-priçe profit function (output supply) and factor demand functions should be estimated jointly by assuming that farmers maximize profits subject to unknown exogenous disturbances. According to Lau and Yotopoulos (1972), the covariances of the errors of the profit function and the factor demand equations corresponding to different farm groups are assumed to be identically zero. Following Lau and Yotopoulos (1971, 1972, 1979), the joint estimation of the output supply and factor demand functions may be carried out by the asymptotically efficient method suggested by Zellner

Table 8.1

Results of the Joint Estimation Using Zellner's Method of the Unit-Output-Price Profit Functions and Factor Demand Functions of Sample Irrigated Ricefarms, East Java, Wet Season 1978

Variable	Parameter	Profit maximization restriction imposed		Profit maximization and constant returns to scale restriction imposed	
		All farms	Farms in Regions 1 and 2	All farms	Farms in Regions 1 and 2
		1	2	3	4
UOP profit functions					
Constant	A	0.895***[a]	0.937***	0.645***	1.001***
		(0.139)[b]	(0.109)	(0.126)	(0.099)
Price of seed	β_1	-0.032**	-0.036***	-0.018	-0.037***
		(0.017)	(0.014)	(0.018)	(0.014)
Price of fertilizer	β_2	-0.091	-0.181*	-0.181**	-0.191**
		(0.103)	(0.113)	(0.100)	(0.113)
Price of labour	β_3	-0.146*	-0.230**	-0.450***	-0.239**
		(0.107)	(0.105)	(0.104)	(0.105)
Farm area	α	1.337***	0.898***	1.000***	1.000***
		(0.078)	(0.071)	(0.000)	(0.000)
Factor demand functions					
Price of seed	β_1^*	-0.032**	-0.036***	-0.018	-0.037***
		(0.017)	(0.014)	(0.018)	(0.014)
Price of fertilizer	β_2^*	-0.091	-0.181*	-0.181**	-0.191**
		(0.103)	(0.113)	(0.100)	(0.113)
Price of labour	β_3^*	-0.146*	-0.230**	-0.450***	-0.239**
		(0.107)	(0.105)	(0.104)	(0.105)

[a] *,** and *** mean that the t-statistics were significant at the 10, 5 and 1 per cent levels, respectively (using one-tailed t-tests).
[b] Figures in parentheses are respective asymtotic standard errors.

Table 8.2

Results of the Joint Estimation Using Zellner's Method of the Unit-Output-Price Profit Functions and Factor Demand Functions of Sample Irrigated Ricefarms, East Java, Dry Season 1978

Variable	Parameter	Profit maximization restriction imposed		Profit maximization and constant returns to scale restriction imposed	
		All farms	Farms in Regions 1 and 2	All farms	Farms in Regions 1 and 2
		1	2	3	4
UOP profit functions					
Constant	A	0.766***[a]	0.909***	0.414***	0.921***
		(0.161)[b]	(0.121)	(0.128)	(0.098)
Price of seed	β_1	-0.064**	-0.034	-0.060**	-0.034
		(0.035)	(0.043)	(0.035)	(0.043)
Price of fertilizer	β_2	-0.244***	-0.191***	-0.235***	-0.191***
		(0.068)	(0.076)	(0.068)	(0.076)
Price of labour	β_3	-0.383***	-0.243***	-0.376***	-0.243***
		(0.081)	(0.059)	(0.081)	(0.059)
Farm area	α	1.340***	0.986***	1.000***	1.000***
		(0.095)	(0.083)	(0.000)	(0.000)
Factor demand functions					
Price of seed	β_1^*	-0.064**	-0.034	-0.060**	-0.034
		(0.035)	(0.043)	(0.035)	(0.043)
Price of fertilizer	β_2^*	-0.244***	-0.191***	-0.235***	-0.191***
		(0.068)	(0.076)	(0.068)	(0.076)
Price of labour	β_3^*	-0.383***	-0.243***	-0.376***	-0.243***
		(0.081)	(0.059)	(0.081)	(0.059)

[a] *,** and *** mean that the t-statistics were significant at the 10, 5 and 1 per cent levels, respectively (using one-tailed t-tests).
[b] Figures in parentheses are respective asymtotic standard errors.

(1962) to allow relaxation of this assumption. The regression package SHAZAM was used to perform the required restricted seemingly unrelated regression estimations (White 1982). It should be noted that imposition of the profit maximization and constant returns to scale constraints will impose a bias on the parameters if these constraints do not exist in reality.

The results of using Zellner's method are presented in Tables 8.1 (for wet season) and 8.2 (for dry season). The first set of equations (1) and (2) had the profit maximization restriction imposed while (3) and (4) also had a restriction of constant returns to scale in all factors of production imposed. Results of tests of the various restrictions imposed in the model are presented in Table 8.3. A chi-squared test statistic was used to test the validity of the restrictions implied by the hypotheses of profit maximization and constant returns to scale. The test of profit maximization involved testing whether the β_i from the normalized profit function (equation (4.35)) and the β^*_i from the factor demand function (equation (4.47)) were equal.

From Table 8.3 it can be seen that farmers in Regions 1 and 2 in both seasons, wet and dry, and all farmers in the dry season appeared to maximize profit in the short run, as indicated by the fact that the calculated chi-squared values were less than the critical chi-squared values at 0.01 level for the unrestricted function versus the restricted profit function. It can also be seen from Tables 8.1 and 8.2 that the significance of the variables in the normalized profit function was increased when the restriction for constant returns to scale was imposed. For example, column (1) in the wet season, in which the coefficient of fertilizer was not significant with the profit maximizing restriction became significant when the restriction of constant returns to scale was also imposed on the model (equation (4)). Moreover, if parameters derived from the unrestricted profit functions (Tables 7.4 and 7.5 in Chapter 7) are compared with restricted profit functions (Tables 8.1 and 8.2), it can be seen that the estimation using Zellner's method with restrictions, appears to produce better estimates since more signs were correct and there was a greater number of significant parameters.

Table 8.3

Tests of Restrictions of Coefficients of Restricted Profit Functions for Sample Irrigated-Ricefarms, East Java, 1978*

Equation	Chi-squares tests: Computed value of chi-squares	Chi-squares tests: Critical values (0.01 level)
	Wet season	
1	15.44	
2	1.34	
3	13.79	11.345
4	3.12	
	Dry season	
1	9.96	
2	0.78	
3	16.16	11.345
4	0.90	

*The computed value of chi-squares were calculated using the following formula: $2 (L_1 - L_2)$, where L_1 is the log likehood of the restricted system and L_2 is the log likelihood of the unrestricted system (J.B. Guise, personal communication, 1983).

As expected, from Tables 8.1 and 8.2, the coefficients of the price of seed and fertilizer, and the labour wage were negative, indicating a negative relationship with unit-output-price profit; and the coefficient of the fixed input, land area, was positive. For example, column (4) was restricted to constant returns to scale and, in the dry season, the coefficient of the price of fertilizer was -0.19 (statistically significant at the 1 per cent level on a one tailed t-test), implying that a 1 per cent increase in the price of fertilizer would reduce the unit-output-price profit by 0.19 per cent.

It can also be seen from Tables 8.1 and 8.2 that the unit-output profit elasticities for rice in the dry season show that rice supplies were more sensitive to changes in input prices than those in the wet season. This is indicated by the β_i which varies from -0.65 to -0.69 in the dry season and -0.25 to -0.65 in the wet season. A similar result has been obtained by Sugianto (1982) for rice farmers in West Java (-0.56 in the dry season 1979), by Adulavidhaya et al. (1979) for Thai farmers (-0.88) and by Tamin (1979) for Malaysian farmers (-0.98). Moreover, the farmers' demand for fertilizer is also sensitive to changes in rice prices, whereas the demand for seed is less sensitive to the output-price changes. For example, the coefficient on the price of labour (labour wage) in column (4) of Table 8.2 for the dry season, which was -0.24 (statistically significant at the 1 per cent level on a one-tailed t-test), indicates that a one per cent increase in real wages reduces the unit-output-price profit by 0.24 per cent. The coefficient of labour was always negative and greater than the coefficient on the price of fertilizer, and in all cases, it was greater than the coefficient on the price of seed. This indicates that unit-output-price farm profit is more sensitive to wage changes than the price of seed and fertilizer.

It is of considerable interest that the unit-output-price farm profit elasticities for rice with respect to land input (farm area) exceeds 0.89 in the case of imposing the profit maximization restrictions only. This means that within the range of farm sizes studied, an increase in farm size by one per cent would have approximately a 0.89 per cent impact on unit-output-price farm profits.

Finally, on the basis of results presented in Tables 8.1 and 8.2, own- and cross-price elasticities for inputs and output can be measured. These will be discussed in the following section.

8.3. Elasticities of Output Supply and Factor Demand

In this section the own-and cross-price elasticities for inputs (derived from the factor demand functions) and outputs (derived from the output-supply functions) are presented. The formulae presented in equations (4.49), (4.50) and (4.51) were used to calculate own- and cross-price elasticities for inputs, and equation (4.54) was used to calculate elasticities for output. The objective of the analysis was to assess the implications for the policies of subsidizing fertilizer and of supporting the price of rough rice. In addition, alternative policies on subsidizing seed and supporting the labour wage will be examined. Results of the analysis are presented in Tables 8.4 and 8.5 for the wet and dry seasons respectively.

As expected the coefficients have the correct signs, negative with respect to own price and positive with respect to output price. The cross-price elasticities both for output supply and factor demands were negative, suggesting that all the variable factors are complements. The output supply was inelastic (varied from 0.47 to 0.67) with respect to the price of rough rice. A 10 per cent increase in the price of output can be expected to increase output supply only by 5 to 7 per cent. Compared with other studies, the output supply elasticity with respect to the price of rough rice in the study area was similar. For example, Tamin (1979) found that the output supply elasticity for Malaysian farmers was 0.417 and Sugianto (1982) found that it was 0.60 in the dry season 1979 and 0.46 in the wet season 1979/80 for farmers in West Java.

For the wet season of 1978 and the dry season 1978, the own-price elasticities of the variable inputs were elastic. For seed, the own-price elasticities varied from -1.02 to -1.06. For fertilizer, the own-price elasticities varied from -1.18 to -1.24. For labour, the own-price elasticities varied from -1.38 to -1.45.

Table 8.4

The Own- and Cross-Price Elasticities of Output and Inputs of Sample Irrigated-Ricefarms, East Java, Wet Season 1978[a]

Variables	Price of rough rice	Price of variable inputs			Land
		Seed	Fertilizer	Labour	
All farms					
Rice supply	0.244	-0.018	-0.181	-0.045	1.000
Seed demand	1.244	-1.018	-0.181	-0.045	1.000
Fertilizer demand	1.244	-0.018	-1.181	-0.045	1.000
Labour demand	1.244	-0.018	-0.181	-1.045	1.000
Farms in Regions 1 and 2					
Rice supply	0.467	-0.037	-0.191	-0.239	1.000
Seed demand	1.467	-1.037	-0.191	-0.239	1.000
Fertilizer demand	1.467	-0.037	-1.191	-0.239	1.000
Labour demand	1.467	-0.037	-0.191	-1.239	1.000

[a]Based on the estimates presented in columns (3) and (4) presented in Table 8.1.

Table 8.5

The Own- and Cross-Price Elasticities of Output and Inputs of Sample Irrigated-Ricefarms, East Java, Dry Season 1978[a]

Variables	Price of rough rice	Price of variable inputs			Land
		Seed	Fertilizer	Labour	
		All farms			
Rice supply	0.671	-0.060	-0.235	-0.376	1.000
Seed demand	1.671	-1.060	-0.235	-0.376	1.000
Fertilizer demand	1.671	-0.060	-1.235	-0.376	1.000
Labour demand	1.671	-0.060	-0.235	-1.376	1.000
		Farms in Regions 1 and 2			
Rice supply	0.468	-0.034	-0.191	-0.243	1.000
Seed demand	1.468	-1.034	-0.191	-0.243	1.000
Fertilizer demand	1.468	-0.034	-1.191	-0.243	1.000
Labour demand	1.468	-0.034	-0.191	-1.243	1.000

[a]Based on the estimates presented in columns (3) and (4) presented in Table 8.2.

Among the variable inputs, labour appears to be most sensitive in both seasons. For example, in the dry season (equation 1 in Table 8.2), a 10 per cent decrease in the labour wage rate would result in a 3.8 per cent increase in output supply. This result indicates that the demand elasticities for labour are higher than that for seed and fertilizer for farms in Regions 1 and 2 (in both seasons) and for all farms in the dry season. This implies that unit-output-profits are more sensitive to the changes in farm wages rather than the changes in the price of seed or fertilizer. This is not surprising since labour is a major share of the inputs into rice farming operations. Thus, the hypothesis that farm profits per unit of output are not affected by changes in farm wages, the price of seed or price of fertilizer can be rejected.

Finally, as has already been mentioned in Chapter 4, the demand elasticities, referred to by Lau and Yotopoulos (1972, p.17), must be interpreted _mutatis mutandis_, that is, a change in one input will always be followed by an adjustment toward the optimal use of other inputs and output. Thus, the interpretation of the demand elasticities is different from the conventional _ceteris paribus_ elasticities. The conventional elasticity shows a change in the dependent variable as a result of a one per cent change in an independent variable while other independent variables remain unchanged.

On the basis of the results presented in Tables 8.4 and 8.5, consideration can now be given to alternative policies to support rice production. These are discussed in the following section.

8.4. Alternative Input and Output Price Policies

Two main price policies have been used by the Indonesian Government to increase rice production. They are a subsidy on fertilizer use and on rice production. The rice price support policy, involves procurement of rice at harvest time at an announced price. This policy provides ceiling prices and floor prices in order to give some incentive to farmers to increase their production. The Government buys rice immediately after harvest, when supply is in excess of market needs, and sells it during the course of the season. Since fertilizer is one of the most important inputs and is needed to increase rice productivity, a fertilizer policy was also found to be necessary. These policies were implemented as part of the intensification programme introduced in the 1960s.

Several techniques can be used to assess the merits and weaknesses of the input and output policies. Barker and Hayami (1976) have examined the relative efficiency of output price support and a fertilizer subsidy in the case of the Philippines rice economy by applying a partial equilibrium model. They found that the net social benefit produced by the price support policy was negative due to higher Government costs. In contrast, the total social benefit was quite large. Barker and Hayami indicated that a fertilizer policy was more effective than an output price support policy.

On the other hand, by using a profit function model, Sidhu and Baanante (1979) found that an output subsidy was more effective in obtaining an increase in wheat productivity than a fertilizer price subsidy. They jointly estimated profit and factor demand functions for Mexican wheat varieties in the Indian Punjab using cross-section data. Similar results, using similar tools of analysis (profit functions),have been obtained by Tamin (1979) for rice farms in Malaysia, by Adulavidhaya et al. (1979) for rice farms in Thailand, and by Sugianto (1982) for rice farms in West Java, Indonesia.

In this study, an effort has been made to determine the effects of various price subsidies on output and on the use of inputs. Following Sidhu and Baanante (1979), Tamin (1979), Adulavidhaya et al. (1979), and Sugianto (1982), the unit-output-price profit function is also used in this study to examine these impacts.

The effects of the different policy alternatives on the output of rice and on the use of inputs are calculated on the basis of the own- and cross-price elasticities, presented in Tables 8.4 and 8.5. These effects have been calculated for all farms and farms in Regions 1 and 2. The results are presented in Tables 8.6 and 8.7.

Table 8.6

Effects of Various Input-Output-Price Policies on the Changes in Output and the Use of Inputs of Sample Irrigated-Ricefarms, East Java, Wet Season 1978[a]

Policy alternative	Percentage effect on			
	Use of seed	Use of Fertilizer	Use of Labour	Rough rice output
	All farms			
1 % subsidy in price of rough rice	1.244	1.244	1.244	0.244
1 % subsidy in price of seed	1.018	0.018	0.018	0.018
1 % subsidy in price of fertilizer	0.181	1.181	0.181	0.181
1 % subsidy in price of labour	0.045	0.045	1.045	0.045
	Farms in Regions 1 and 2			
1 % subsidy in price of rough rice	1.467	1.467	1.467	0.467
1 % subsidy in price of seed	1.037	0.037	0.037	0.037
1 % subsidy in price of fertilizer	0.191	1.191	0.191	0.191
1 % subsidy in price of labour	0.239	0.239	1.239	0.239

[a]Based on the estimates presented in Table 8.4.

Table 8.7

Effects of Various Input-Output-Price Policies on the Changes in Output and the Use of Inputs of Sample Irrigated-Ricefarms, East Java, Dry Season 1978[a]

Policy alternative	Percentage effect on			
	Use of seed	Use of Fertilizer	Use of Labour	Rough rice output
		All farms		
1 % subsidy in price of rough rice	1.671	1.671	1.671	0.671
1 % subsidy in price of seed	1.060	0.060	0.060	0.060
1 % subsidy in price of fertilizer	0.235	1.235	0.235	0.235
1 % subsidy in price of labour	0.376	0.376	1.376	0.376
		Farms in Regions 1 and 2		
1 % subsidy in price of rough rice	1.468	1.468	1.468	0.468
1 % subsidy in price of seed	1.034	0.034	0.034	0.034
1 % subsidy in price of fertilizer	0.191	1.191	0.191	0.191
1 % subsidy in price of labour	0.243	0.243	1.243	0.243

[a]Based on the estimates presented in Table 8.5.

It can be seen from Tables 8.6 and 8.7 that the output subsidy induced a greater·output than policies which subsidize seed, fertilizer or farm wages either in the wet season or dry season. For example, a one per cent increase in the price of rough rice would cause an increase of 0.25 per cent in the quantity of rough-rice supplied, and an increase of 1.25 per cent in the amounts of seed, fertilizer and labour used in rice production for farmers in the wet season. This finding is in line with the results reported by Sugianto (1982) for the case of farmers in West Java. He found that a one per cent increase for the price of rough rice caused an increase of 0.46 per cent in the quantity of rough rice supplied, and an increase of 1.46 per cent in the amounts of seed, fertilizer and labour used in rice production in the wet season 1979/80. For farmers in the dry season, a one per cent increase in the price of rough rice caused an increase of 0.67 per cent in the quantity of rough rice produced, and an increase of 1.67 per cent in the amounts of seed, fertilizer and labour used.

Thus, from Tables 8.6 and 8.7 it can be seen that a subsidy on the output price would be likely to generate a greater output than an equivalent percentage subsidy on wages or fertilizer. However, it should be noted that the elasticities were derived from cross-section data and a restricted profit function and as such may 'overstate' the short-run responsiveness because of their long-run character and the effects of the imposed restrictions.

8.5. Concluding Remarks

Output supply and factor demand functions, elasticities of output supply and factor demand and the effects of alternative policies for subsidizing output and inputs have been discussed in the chapter. For the analysis, use was made of the unit-output-price profit function. The hypothesis that farm profits per unit of output are not affected by changes in farm wages, the price of seed or price of fertilizer was tested and rejected.

Based on the results of the analysis presented in Sections (8.2) to (8.4), the following conclusions can be drawn:

Firstly, it was found that a subsidy on the price of rice will induce a greater output response than a subsidy on input prices. Secondly, among the variable inputs (price of seed, fertilizer, and wages), a subsidy on farm wages would give the greatest increase in output from a given percentage subsidy followed in effectiveness by a subsidy on the price of fertilizer and then the price of seed. It should be noted that the results of the analysis derived from the unit-output-profit function are, basically, partial and therefore nothing is indicated in relation to the gains and losses of producers, consumers and government.

However, care should be taken when interpreting the above conclusions, because:

a) These conclusions are based on the analysis of the unit-output-price profit function using cross-section data. The elasticities derived from this analysis are not likely to be representative of short-run parameters. Since they are estimated from cross-section data, the only appropriate interpretation is that the elasticities refer to longer-run responses expected after adjustment of several years to price changes. Given that the elasticities are also normative in character, having been derived from the restricted profit function, it is likely that they 'overstate' the true short-run responsiveness.

b) Even though a subsidy on farm wages will induce increased rice production, the implementation of such a subsidy is probably more difficult compared with a subsidy on price of rice and fertilizer.

c) In fact, the policy makers in Indonesia have realized that both price supports and input subsidies (particularly a fertilizer subsidy) cannot be considered separately. The Government buys rice immediately after harvest and sells it in times of shortage. By doing so it aims to even out price fluctuations and also to provide incentives to farmers to produce greater levels of output. On the other hand, the Government fixes the on-farm prices of the various types of fertilizers (mainly urea and triple-super-phosphate) at a lower level than it pays for purchasing them either from domestic or external sources of supply. The cost of these two policies has become a severe budgetary burden. For example, the

Government cost for the rice support policy has increased from 29,000 million rupiah in 1970/71 to 332,600 million rupiah in 1982/83, a 16-fold increase in 12 years. The Government cost for the fertilizer subsidy has also increased, annually, by 118,000 million rupiah from 1970/71 to 1981/82.

Based on this information, it is clear that the combined policies (a support price and a fertilizer subsidy) have been implemented simultaneously by the Government of Indonesia due to the reason that they complement each other. On the one hand, individual producers, particularly large farmers, tend to gain most from a rice price policy because of the high proportion of production marketed. Alternatively, small farmers would tend to gain most from a fertilizer subsidy because of the small proportion of the rice produced which they market.

Chapter 9

FARM EFFICIENCY AND DISTRIBUTIONAL PERFORMANCE

9.1 Introductory Remarks

It is apparent that the benefits from agricultural technologies have not been shared equally amongst groups of farmers or between regions in an area (Byres 1972, Gibbons et al. 1980). Even where agricultural technologies, such as high-yielding varieties, have been successful in terms of area and production, the benefits cannot be said to be 'automatically' equally distributed. The distribution of benefits would appear to depend very much on the distribution and ownership of operational landholdings, distribution of the input applications per unit of land, and the different yield responses from the various levels of input applications per unit of land from one group of farms to another (Kalirajan 1980). In other words, the distribution of profits is largely determined by the distribution of ownership of the operational holdings and by different levels of efficiency on farms.

In previous chapters, it was shown that large farmers were technically and economically more efficient than small farmers. Farmers in Region 3, which had a relatively poor physical infrastructure and environment, were technically and economically less efficient than those in Regions 1 and 2.

In this chapter, an effort will be made to relate the above findings to the objectives of the third Five-Year Development Plan. The plan, besides aiming to increase production and farm income, also aims to pay attention to the problem of the unequal share of benefits derived from development. The objectives of the analysis are to describe the distributional performance of the sample farmers and to examine whether or not the distribution of profits are largely determined by the distribution of ownership of operational land holdings and the different levels of farm efficiency. Thus two hypotheses are proposed for testing:

(a) The distribution of farm profits is the same as the distribution of the area under rice.

(b) The distribution of farm profits is the the same as the distribution of the economic efficiency ratings.

9.2 The Distribution of Profits

One of the objectives of this study is to determine the effects of the adopted technology and to see how the gains of such technology are distributed. To meet this objective and to relate it to the objectives of agricultural development in Indonesia, an analysis of the distribution of profits from irrigated ricefarms and the factors influencing the distribution is needed. The results of the analysis are discussed in this section. The discussion involves an examination of the distribution of profits among farmers in their respective deciles.

The distributions of adjusted net profit and maximum adjusted net profit per hectare (adjusted for crop damage) are presented in Table 9.1. In the wet season, the average adjusted net profit was about 143 thousand rupiahs per hectare and in the dry season, it was about 159 thousand rupiahs per hectare. These results were not significantly different at the 10 per cent level on a two-tailed t-test. If these

Table 9.1

Distribution of Adjusted Net Profit and Maximum Adjusted Net Profit per Hectare for Sample Irrigated Ricefarms, East Java, 1978[a]

Profit level	Average of adjusted net profit				Average of maximum adjusted net profit			
	Wet season		Dry season		Wet season		Dry season	
(Rp'000)	Value (Rp'000)[b]	Nos. of farmers[c]	Value (Rp'000)[b]	Nos. of farmers[c]	Value (Rp.000)[b]	Nos. of farmers[c]	Value (Rp'000)[b]	Nos. of farmers[c]
	1	2	3	4	5	6	7	8
0 - < 50	28.445	36	25.748	16	35.994	2	0	0
	(17.714)	(25.7)	(9.585)	(15.2)	(10.847)	(1.4)	(0.0)	(0.0)
50 - < 100	71.653	32	69.659	25	0	0	0	0
	(12.442)	(22.9)	(14.999)	(26.2)	(0.0)	(0.0)	(0.0)	(0.0)
100 - < 150	125.297	16	126.843	15	126.408)	1	0	0
	(16.340)	(11.4)	(11.338)	(15.2)	(0.0)	(1.1)	(0.0)	(0.0)
150 - < 200	172.934	17	172.085	13	197.791	1	187.937	4
	(13.276)	(12.1)	(18.386)	(13.1)	(0.0)	(1.1)	(14.051)	(4.0)
200 - < 250	223.565	15	224.339	8	221.815	5	220.933	6
	(13.987)	(10.8)	(14.009)	(8.1)	(17.035)	(3.7)	(15.911)	(6.1)
250 - < 300	275.009	9	274.631	7	281.485	10	272.922	9
	(13.679)	(6.4)	(9.919)	(7.0)	(20.999)	(7.3)	(11.750)	(9.1)
300 - < 350	324.829	6	322.885	9	321.946	11	326.415	17
	(21.408)	(4.3)	(16.436)	(9.1)	(17.114)	(7.8)	(19.676)	(17.2)
350 - < 400	365.387	2	365.877	3	374.434	19	371.740	18
	(10.584)	(0.7)	(11.555)	(3.1)	(15.671)	(13.6)	(13.109)	(18.1)
≥ 400	471.381	7	565.554	3	556.497	91	499.561	45
	(105.040)	(5.7)	(257.983)	(3.0)	(137.558)	(64.8)	(87.252)	(45.5)
All farms	143.411[d]	140	158.692[d]	99	468.692[e]	140	396.507[e]	99
	(121.722)	(100.0)	(129.569)	(100.0)	(170.550)	(100.0)	(120.201)	(100.0)

[a] Adjusted net profit is profit adjusted for crop damage. Maximum adjusted net profit was calculated using equation (4.36) and was also adjusted for crop damage.

[b] Figures in parentheses are standard deviations.

[c] Figures in parentheses are percentages.

[d] The difference between these two figures was not significant at the 5 per cent level using a two-tailed t-test.

[e] The difference in these two figures was significant at the 1 per cent level using a two-tailed t-test.

findings are compared with other studies, they suggest that the profits from rice growing in the study area were not very different from those of other areas. For example, Collier (1979) found that the average profit was 154 thousand rupiahs per hectare in East Java. Widodo et al. (1979) reported an average profit of 103 thousand rupiahs in Central Java in the wet season 1979 and 92 thousand rupiahs per hectare in West Java in the dry season 1979 (Sugianto 1982).

The distribution of profits per hectare for rice farming in the study area were found to be similar both in the wet and dry seasons. From Table 9.1, columns (1 to 4), it can be seen that 68 per cent of the total sample farmers in the wet season and 56 per cent in the dry season received an adjusted net profit which was less than the average adjusted net profit Thus, there was a heavy concentration of farmers who received less than 150 thousand rupiah per hectare in both seasons.

Literature on the 'green revolution' suggests that the variation in farm profits per unit of land might be connected with the size of holding (Gibbons et al. 1980, Kalirajan 1980). In this study, the variation in farm profits might be connected with either the size of landholdings or the level of efficiency of individual farms.

To examine the concentration of net profits among the recipients, the decile distribution of net profits in the study area was calculated for the wet and dry seasons. Results of the analysis are provided below.

9.3 Landholdings, Farm Efficiency and Distribution of Profits

An important aspect of development is the 'degree' of inequality of benefits from development. Several techniques can be used to measure this. The most common way to measure the degree of inequality is by the index of concentration, or, as it is often termed, the Gini coefficient. 'Inequality' can also be portrayed with what is commonly known as the Lorenz curve. This curve can be constructed by plotting the cumulative percentage of farmers on the horizontal axis against their cumulative percentage share of profits. Thus, the Lorenz curve can be used to show the actual quantitative relationship between the percentage of profit recipients and the percentage of the total profit they received during a given time. The Gini coefficient and the Lorenz curve can be illustrated by using Figure 9.1. From this figure, the Gini coefficient can be calculated as follows (more details, see Gini 1962):

(9.1) Gini index = (shaded area D)/Total area ABC).

Using equation (9.1), the Gini coefficients vary from zero (perfect equality) to one (perfect inequality).

The distribution of profits and their inequalities, measured by Gini coefficients, are presented in Tables 9.2 and 9.3, respectively, for wet and dry seasons. Lorenz curves derived from figures in Tables 9.2 and 9.3 are presented in Figures 9.2 and 9.3. Two main conclusions can be drawn from these figures. First, the distributions of maximum adjusted net profit in both wet and dry seasons are almost the same. This is indicated by relatively similar Gini coefficients for maximum adjusted profits compared to adjusted profits. The lower Gini coefficients for maximum adjusted profits compared to adjusted profits indicate that if farmers allocated their resources with perfect efficiency, the distribution of profits per hectare would be more evenly distributed. Second, the Gini coefficient of the adjusted net profits in the wet season (0.465) is higher than that in the dry season (0.348). This means that the distribution of profits in the wet season was more unequal. In the wet season, 40 per cent of the sample farmers with the smallest profits (deciles I to IV) received 17.18 per cent of total adjusted net profits; whereas in the dry season they received 20.12 per cent. However, 20 per cent of sample farmers with the highest adjusted net profits (deciles IX and X) received 47.19 per cent of the total adjusted net profits in the wet season and 44.90 per cent in the dry season. Compared with other studies, the Gini coefficients in this study were similar. Oshima (1976) found that the Gini coefficients for the distribution of income in East and South East Asia were respectively 0.40 and 0.50 in 1975; Soejono and Birowo (1976) reported that, for the distribution of rice-farmers' income, was 0.564 in Central Java in the

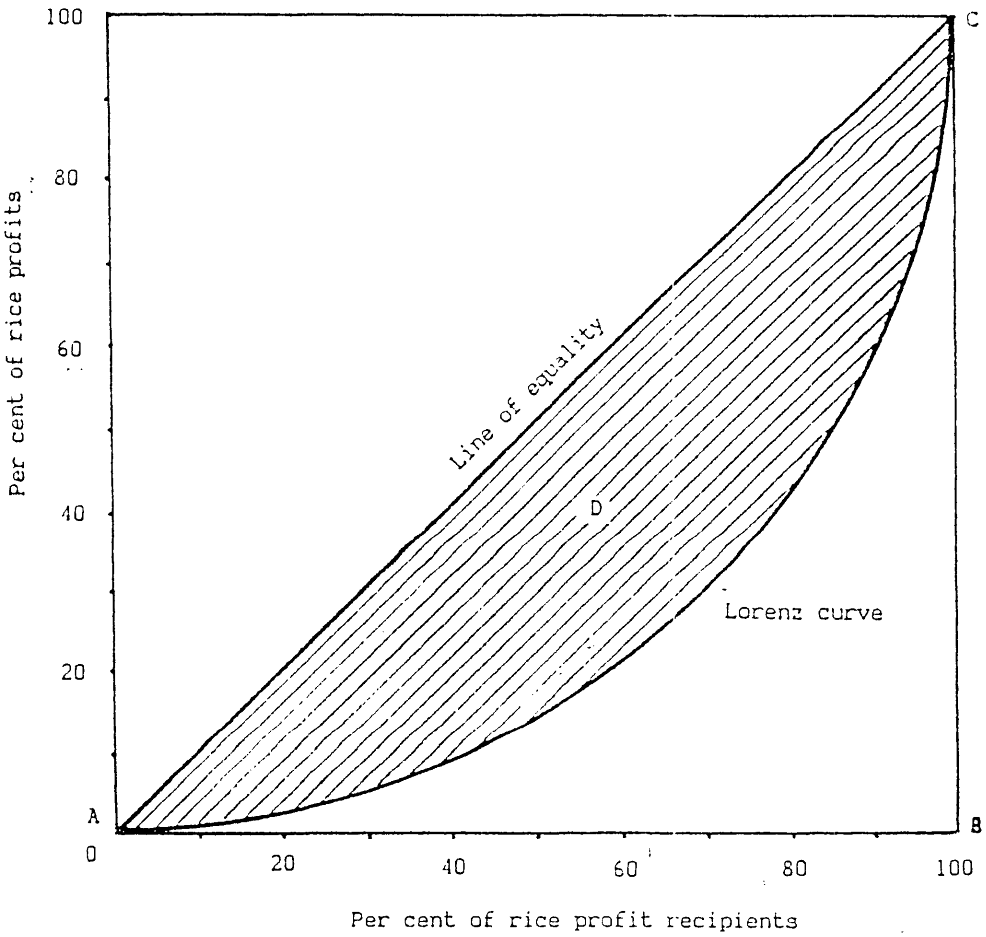

Figure 9.1 Hypothetical Lorenz curve of rice profits.

Table 9.2

Distribution of Adjusted Net Profit (ANP)[a], Maximum Adjusted Net Profit (MANP)[a], and Gini Coefficients (GC) for Sample Irrigated Ricefarms, East Java, Wet Season, 1978

Farmer decile group	Average in each decile		Percentage in each decile		Cumulative percentage in each decile	
	ANP (Rp'000)	MANP (Rp'000)	ANP	MANP	ANP	MANP
	1	2	3	4	5	6
I	7.803	18.967	0.55	4.20	0.55	4.20
II	35.308	39.566	2.47	6.57	3.02	10.77
III	50.588	60.135	3.54	7.70	6.56	18.47
IV	66.639	82.889	4.67	8.57	11.23	27.04
V	84.990	116.525	5.95	9.36	17.18	36.40
VI	128.369	144.128	8.99	10.07	26.17	46.47
VII	168.823	176.964	11.83	10.68	38.00	57.15
VIII	211.449	231.904	14.81	12.16	52.81	69.31
IX	268.122	294.961	18.78	13.35	71.59	82.66
X	405.599	414.876	28.41	17.34	100.00	100.00
Gini coefficients					0.465	0.196

[a]per hectare

Table 9.3

Distribution of Adjusted Net Profit (ANP)[a], Maximum Adjusted Net Profit (MANP)[a], and Gini Coefficients (GC) for Sample Irrigated Ricefarms, East Java, Dry Season 1978

Farmer decile group	Average in each decile		Percentage in each decile		Cumulative percentage in each decile	
	ANP (Rp'000)	MANP (Rp'000)	ANP	MANP	ANP	MANP
	1	2	3	4	5	6
I	18.967	204.786	1.20	5.19	1.20	5.19
II	39.566	269.056	2.50	6.82	3.70	12.01
III	60.135	312.915	3.81	7.93	7.51	19.94
IV	82.889	348.247	5.24	8.83	12.75	28.77
V	116.525	368.945	7.37	9.35	20.12	38.12
VI	144.128	399.710	9.12	10.13	29.24	48.25
VII	176.964	433.973	11.19	11.00	40.43	59.25
VIII	231.904	475.185	14.67	12.04	55.10	71.29
IX	294.961	512.384	18.66	12.99	73.76	84.28
X	414.092	620.599	26.24	15.72	100.00	100.00
Gini coefficients					0.348	0.166

[a]per hectare

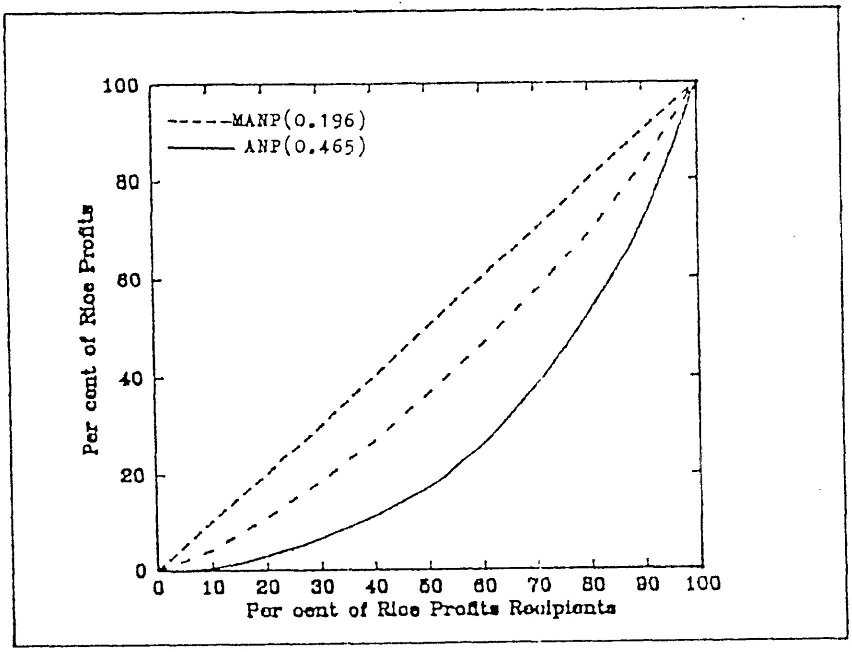

Figure 9.2 Lorenz curve of adjusted net profit (ANP) and maximum adjusted net profit (MANP) for sample irrigated ricefarms, East Java, wet season, 1978.

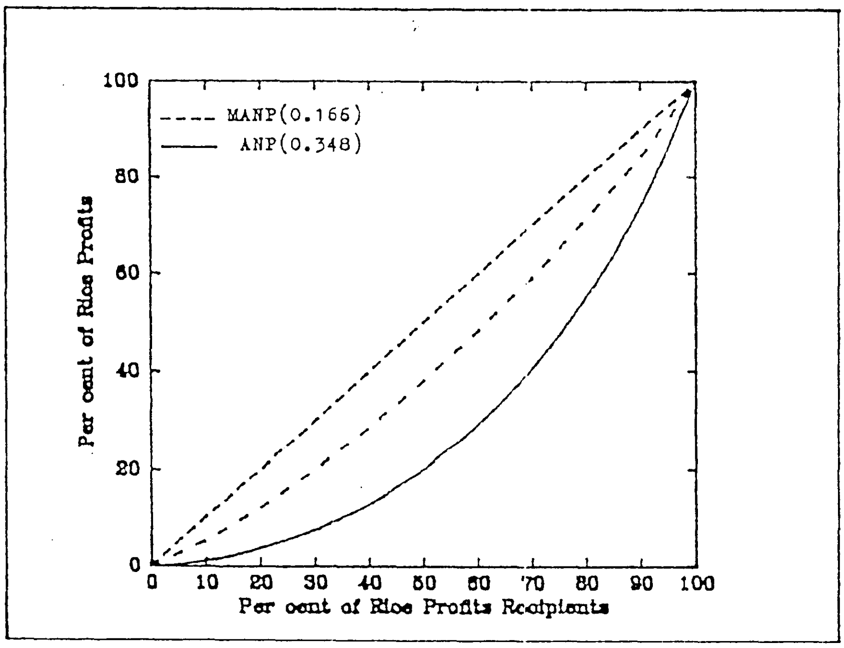

Figure 9.3 Lorenz curve of adjusted net profit (ANP) and maximum adjusted net profit (MANP) for sample irrigated ricefarms, East Java, dry season, 1978.

wet season of 1973/74, and Asnawi (1981) found that for the distribution of rice profits in West Sumatra they were 0.248 in 1978/79.

Theoretically, given resource prices and utilization levels for each type of productive factor (land, labour and current expenses), the distribution of profits can be examined in order to know what factors determine inequality in the distribution of profits in the study area. Four main variables were considered to have contributed to the inequality of the distribution of profits, namely, total farm area, farm area under rice crop, level of technical efficiency, level of allocative efficiency, and level of economic efficiency. The reason for choosing these variables is that they are expected to have a close relationship with farm profits. Therefore, an attempt has been made to examine these relationships. The sample farmers were ranked from the lowest to the highest values for each of the variables, and decile distributions for each variable were then calculated for both seasons. The technique used for this purpose was similar to the technique used for calculating the Gini coefficients.

Results of the analyses are presented in Tables 9.4 and 9.5 for wet and dry seasons, respectively. Lorenz curves derived from figures in Tables 9.4 and 9.5 are presented in Figures 9.4 and 9.5. In the wet season, the Gini coefficients for farm area, allocative efficiency ratings, and economic efficiency ratings were, respectively, 0.500, 0.405, and 0.432.

A comparison of the distribution of adjusted net profit per hectare (Tables 9.2 and 9.3) with the distribution of the total farm area, farm area under rice, allocative efficiency, and economic efficiency rating (Tables 9.4 and 9.5) shows great similarities. From Tables 9.2 (column (3)) and 9.3 (column (3)), it can be seen that 40 per cent of the smallest farmers (that is, deciles I to IV) earned one-eleventh and one-twelveth of the profits in the wet and dry seasons respectively. In contrast, 20 per cent of largest farms (that is, deciles IX and X) earned 48 per cent and 45 per cent in the wet and dry seasons respectively. A similar situation occurs in the distribution of landholdings. From columns (11) and (12) in Tables 9.4 and 9.5, it can

Table 9.4

Distribution of Total Farm Size (TFS), Crop Area (CA), Technical Efficiency Ratings (TER), Allocative Efficiency Ratings (AER), and Economic Efficiency Ratings (EER) for Sample Irrigated Ricefarms, East Java, Wet Season, 1978

Farmer decile group	Average of farms					Percentage of farms in each decile					Cumulative percentage in each decile				
	TFS (ha)	CA (ha)	TER (%)	AER (%)	EER (%)	TFS	CA	TER	AER	EER	TFS	CA	TER	AER	EER
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I	0.337	0.104	13.72	8.36	2.32	1.96	1.89	2.16	1.83	0.67	1.96	1.89	2.16	1.83	0.67
II	0.485	0.125	27.29	22.07	8.37	2.82	2.27	4.30	4.82	2.50	4.78	4.16	6.46	6.65	3.17
III	0.611	0.177	43.36	27.50	11.38	3.55	3.21	6.83	6.00	3.43	8.33	7.37	13.25	12.65	6.60
IV	0.820	0.250	54.43	32.86	14.37	4.77	4.54	8.57	7.18	4.30	13.10	11.91	21.86	19.83	10.90
V	0.959	0.259	65.07	39.50	20.68	5.57	4.70	10.25	8.62	6.18	18.17	16.61	32.11	28.45	17.08
VI	1.301	0.327	75.72	48.77	31.51	7.57	5.94	11.93	10.65	9.42	26.24	22.55	44.04	39.10	26.50
VII	1.566	0.476	82.22	55.92	44.21	9.10	8.63	12.95	12.21	13.21	35.34	31.18	56.95	51.31	39.71
VIII	1.989	0.637	87.00	63.08	53.23	11.56	11.55	13.70	13.77	15.91	46.90	42.73	70.65	65.08	55.62
IX	2.805	1.059	89.93	70.38	62.09	16.30	19.21	14.16	15.37	18.56	63.20	61.94	84.85	80.45	74.18
X	6.329	2.099	96.22	89.54	86.45	36.80	38.06	15.15	19.55	25.82	100.00	100.00	100.00	100.00	100.00
Gini Coefficients											0.463	0.500	0.236	0.405	0.432

Table 9.5

Distribution of Total Farm Size (TFS), Crop Area (CA), Technical Efficiency Ratings (TER), Allocative Efficiency Ratings (AER), and Economic Efficiency Ratings (EER) for Sample Irrigated Ricefarms, East Java, Dry Season, 1978

Farmers decile group	Average of farms					Percentage of farms in each decile					Cumulative percentage in each decile				
	TFS (ha)	CA (ha)	TER (%)	AER (%)	EER (%)	TFS	CA	TER	AER	EER	TFS	CA	TER	AER	EER
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I	0.314	0.086	16.10	15.77	4.32	1.76	1.72	2.32	2.88	0.01	1.76	1.72	2.32	2.88	0.01
II	0.495	0.125	27.50	28.44	9.40	2.78	2.49	3.96	5.19	2.27	4.54	4.21	6.28	8.08	2.28
III	0.657	0.172	49.80	35.70	14.07	3.68	3.42	7.17	6.51	3.39	8.22	7.63	13.45	14.58	5.67
IV	0.838	0.248	69.00	43.40	23.42	4.70	4.94	9.94	7.92	5.65	12.92	12.57	23.39	22.50	11.32
V	0.975	0.261	76.80	45.30	33.36	5.47	5.21	11.06	8.26	8.05	18.39	17.78	34.45	30.76	19.37
VI	1.383	0.315	83.00	55.50	40.54	7.75	6.28	11.95	10.13	9.78	26.14	24.06	46.40	40.89	29.15
VII	1.604	0.467	87.10	65.30	50.18	8.99	9.30	12.54	11.91	12.10	35.13	33.36	58.94	52.80	41.25
VIII	2.005	0.595	90.50	77.90	64.46	11.24	11.85	13.03	14.21	15.55	46.37	45.21	71.97	67.01	56.80
IX	2.828	0.960	95.50	86.80	78.63	15.86	19.14	13.75	15.84	18.96	62.23	64.35	85.72	82.85	75.72
X	6.734	1.789	99.33	94.00	96.26	37.77	35.65	14.28	17.15	23.24	100.00	100.00	100.00	100.00	100.00
Gini Coefficients											0.469	0.479	0.215	0.421	0.417

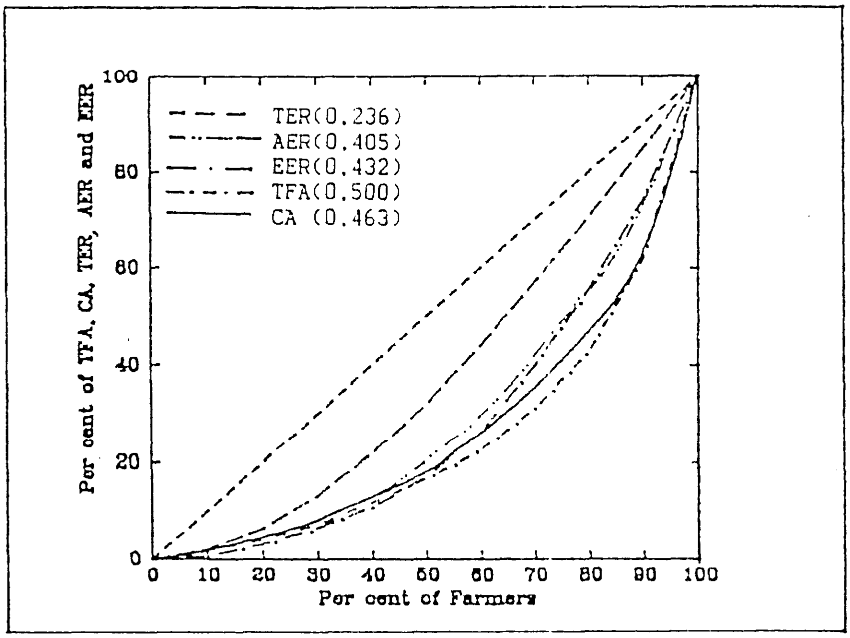

Figure 9.4 Lorenz curve of technical efficiency ratings (TER), allocative efficiency ratings (AER), economic efficiency ratings (EER), total farm area (TFA), and crop area (CA) for sample irrigated ricefarms, East Java, wet season, 1978.

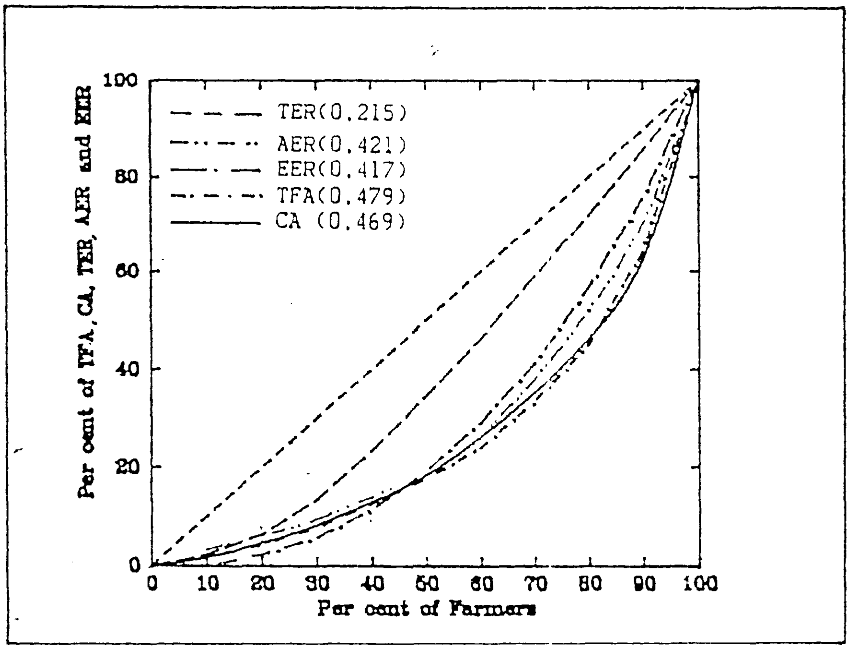

Figure 9.5 Lorenz curve of technical efficiency ratings (TER), allocative efficiency ratings (AER), economic efficiency ratings (EER), total farm area (TFA), and crop area (CA) for sample irrigated ricefarms, East Java, dry season, 1978.

be seen that 40 per cent of the smallest farmers (that is, deciles I to IV) owned about 13 and 12 per cent of the total farm area and total farm area under rice in both seasons respectively. In contrast, 20 per cent of the largest farms (that is, deciles IX and X) owned about 53 per cent and 55 per cent of the total farm area and total farm area under rice in both seasons respectively. The distribution of adjusted net profits, total farm area and farm area under rice were also similar to the distribution of the economic efficiency ratings. The first four deciles (deciles I to IV) contain the 11 per cent of farms with the lowest economic efficiency ratings in both seasors, whereas the top two deciles (deciles IX and X) contained 45 per cert and 42 per cent of the farms with the highest economic efficiency ratirgs in the wet and dry seasons respectively. The two Lorenz curves (profits and total farm area, profits and farm area under rice crop, prcfits and allocative efficiency rating, profits and economic efficiency rating) almost coincide, which suggests that the distributions of land ownership and level of economic efficiency are keys in determining the distribution of profits.

Before concluding that both small and large farms benefited according to their share of area of total landholdings, total operational holdings under rice crop, and level of economic efficiency, it is necessary to determine whether the difference in equality between the two distributions is statistically significant.

Statistical tests to compare the differences in values of the Gini coefficients are not available. Therefore, an alternative technique was used. Theil has suggested that a test of the variance of the logarithms of the variables used in measuring the inequality may be used to test the difference (more details can be seen in Theil 1967, pp. 121-5; 1972, pp. 106-9). The variances of the logarithms of the variables, such as adjusted net profit, can be computed using the formula presented in equation (9.2).

(9.2) $$\text{Var (ANP)} = (1/m)[\sum_{i=1}^{m} (\log X_i - \log X)^2] = (1/m)[\sum_{i=1}^{m} \log X_i/X)^2],$$

where Var (ANP) is the variance of adjusted net profit, X_i is the adjusted net profit of the ith farm; X is the geometric mean of adjusted net profit and m is the total sample farms. According to Theil, the ratio of the variances follows an F-distribution and the difference between the variances are significant if the calculated F-ratio is significant statistically. By using equation (9.2), F-ratios between pairs of variables can be calculated and they are presented in Table 9.6.

Using the above test the two distributions that were consistently not different from each other were adjusted net profit per hectare and farm area under rice. For the dry season adjusted net profit was not significantly different from the distribution of the technical efficiency rating. The distribution of the maximum adjusted net profit was significantly different from each of the measures tested. Thus it seems possible to tentatively conclude that the distribution of the farm area under rice may be a significant determinant of the distribution of net profits. Such a conclusion relies on there being direct causal links between rice crop area and net profits and that levels of technical and economic efficiency do not intervene to change any link between profits and crop area. This conclusion also begs the important question of what has determined the crop area in the first place and ignores the many socio-economic and structural influences that might be present.

9.4 Concluding Remarks

In this chapter, the distribution of profits and factors which influence the distribution of profits have been examined for a sample of East Javanese ricefarms. The first part of this chapter involved examining the distribution of profits among farmers in their respective deciles, and the calculation of the Gini coefficients. The variables of total farm-area, farm area under rice crop, and level of technical and economic efficiencies were used to explain the pattern of distribution and the unequal distribution of profits.

Table 9.6

Computed F-Ratio Values for Pairs of Variables Used in Calculating the Gini Coefficients for Sample Irrigated Ricefarms, East Java, 1978

Variables[a]	Computed F-Ratio[b]	
	Wet season	Dry season
ANP and TER	1.800	1.155^{ns}
ANP and AER	1.402	1.305^{ns}
ANP and EER	1.385	1.208^{ns}
ANP and TFA	2.750	3.683
ANP and FA	0.895^{ns}	1.097^{ns}
MANP and TER	3.983	5.623
MANP and AER	2.790	4.260
MANP and EER	2.876	4.657
MANP and TFA	11.111	20.705
MANP and FA	3.562	6.164

[a]ANP is the adjusted net profit, MANP is the maximum adjusted net profit, TER is the technical efficiency rating, EER is the economic efficiency rating, TFA is the total farm area and FA is the farm area under rice.

[b]All computed F-ratios were statistically significant at the 1 per cent level ($F_{(140,140)}$ for the wet season was 1.000 and $F_{(99,99)}$ for the dry season was 1.769); ns is the non significant.

On the basis of the above discussion, four main conclusions can be drawn:

(a) Ricefarm profits in the study area were relatively high compared to the official figures reported by the Agricultural Office of East Java (a value of 125 thousand rupiahs was reported for 1978 (Dinas Pertanian Rakyat 1979)). In this study profits were found to be 143 thousand and 158 thousand rupiahs in the wet and dry seasons, respectively. However, only 40 per cent (in the wet season) and 44 per cent (in the dry season) of farmers received an adjusted net profit of more than 150 thousand rupiahs. In other words, this indicates an unequal distribution of profits in the study area.

(b) An attempt was made to measure the inequality of the distribution of profits using Gini coefficients. It was found that the distribution of the adjusted net profit was not equal, as indicated by the Gini coefficients which were 0.465 and 0.348 in the wet and dry seasons respectively. However, the Gini coefficients of the maximum adjusted net profit (based on the frontier production function) were relatively low, that is, 0.196 and 0.166 in the wet and dry seasons respectively. The implication of this is that if farmers allocated their resources with perfect efficiency, the distribution of profits per hectare would be much more even.

(c) An attempt was also made to examine some of the factors that may contribute to the inequity of the distribution of profits. It was expected that the variables of total farm-area, farm area under rice crop, the technical efficiency rating and economic efficiency rating would have a significant relationship with profits. Therefore, the distribution for each of these variables was calculated. The results of the analysis showed that the distribution of total farm-area, farm area under rice, allocative efficiency rating, and the economic efficiency rating were unequally distributed, as indicated by the Gini coefficients of more than 0.4, whereas the distribution of the technical efficiency rating was much more equal.

(d) It was found that both small and large farms benefited (in terms of farm profits per hectare) according to their share of the area of land under rice and the level of technical, allocative and economic efficiencies. In other words, the distribution of the land cropped with rice seemed to determine the distribution of net profits. However, such was not the case for the maximum adjusted net profit. When farmers farm perfectly efficiently, the distribution of profit would seem to be more equal. The fact that the greater the inequality of total area of operational landholdings the greater the inequality of profits can be found elsewhere in the literature (Siahaan 1977, Swenson 1976, and Kalirajan 1980).

On the basis of the above findings, the distribution of benefits would seem to depend to a considerable extent on the distribution of land ownership and the distribution of the level of farm efficiencies. In other words, the hypothesis that the distribution of farm profits is the same as the distribution of the farm area and economic efficiency ratings cannot be rejected. Implicit, therefore is the conclusion that land reform policies have the potential to provide a more equitable distribution of profits. However, care must be taken with land reform in that the levels of technical and economic efficiency are not changed in adverse ways at the same time so that the distribution of profit is not made more unequal.

Chapter 10

SUMMARY, CONCLUSIONS, POLICY IMPLICATIONS, AND DIRECTIONS FOR FURTHER RESEARCH

10.1 Introductory Remarks

A summary of the thesis is provided in this chapter along with some conclusions relating to the hypotheses tested, some policy implications, and directions for further research. In the first section some introductory remarks are provided, in the second a summary of the thesis and the conclusions are summarized in the third section. On the basis of these conclusions some policy implications are suggested and presented in the fourth section. These implications relate to policies for increasing farm efficiency and yield, policies for obtaining greater equity in the distribution of farm income and implications for general agricultural development. In the final section some directions for further research are provided.

10.2 Summary

The agricultural sector plays an important role in the Indonesian economy as reflected by the fact that some 70 per cent of the Indonesian population live in rural areas with most of them engaged in agriculture. Also, some 51 per cent of the gross domestic product is accounted for by agriculture.

In East Java, food-crop yields, particularly the secondary crops (maize, cassava, groundnut and soybean), have increased slowly and it has been indicated that farmers, particularly small farmers, seem to farm inefficiently (Dinas Pertanian Jawa Timur 1979). Further, the agricultural sector is confronted with a considerable task if it is to meet the objectives laid down for it in Repelita III; namely, growth with increased equity and national stability. The task will have to go beyond increasing agricultural productivity so that the benefits of increased agricultural productivity will be shared. Other things being equal, the benefits of increasing agricultural productivity, reflected by farm incomes, are determined largely by the efficiency with which farmers use resources. To devise appropriate policies it is necessary to decide whether or not farmers are efficient. There are two alternatives. First, if farmers are efficient in the allocation of their resources, an additional contribution from agriculture to economic growth can come only through a growth-oriented development of agriculture itself; for example, through technical change (i.e shifts in the production functions). Second, if farmers are not efficient in the allocation of their resources then there is an unexploited potential for increasing this efficiency, raising farm income and generating larger surpluses which can then become the source of further economic growth. Even though Schultz (1964, p. 37) argued that there are comparatively few significant inefficiencies in the allocation of the factors of production in traditional agriculture, much evidence supports the opposite view (Hardaker 1975, Shapiro 1983). This point is still being debated. Given the above discussion, the study of farm resource allocation and efficiency at the farm level in less developed countries, such as in Indonesia, becomes an important issue in determining the existing opportunities in agriculture for increasing farm income and economic growth and in determining the nature of policies designed to foster this growth.

To attain the objectives set for agricultural development in Indonesia, the Government has developed programmes such as that under the Agrarian Law of 1960, particularly Articles 2 and 5, and the intensification programme,. This has involved subsidizing fertilizer, controlling the price of rice, providing credit and attempting to meet the needs of agricultural development. These policies affect the allocation of the resources used by farmers. After a comparison of the objectives of the Government policy on agricultural development and the problems emerging from this study, an attempt has been made to determine which factors have contributed to the 'levelling off' in the rate of yield increase and which affect farm-resource allocation and efficiency and farm profits. More specifically, this study has been designed to achieve five broad objectives as indicated in Chapter 1. Briefly these are to examine the characteristics of the use of technology, the level of input usage, to compare technical, allocative and economic efficiency, to examine the effects of input and output subsidies and to describe the distribution of profits all in a range of different farm situations.

Several techniques were used to meet the objectives of the study. Simple cross tabulations were used in order to describe the characteristics of sample farms. These techniques enabled the presentation of partial productivity measures. To provide an adequately detailed explanation of the underlying structure of the relationships between inputs and outputs, Cobb-Douglas production functions were used. Cobb-Douglas frontier production functions were also used in the study. As suggested by Timmer (1970, 1971), the frontier production functions can be used to measure efficiencies for individual sample farms. Using a frontier production function the 'best' technical and economic performance of each farm was estimated.

It has been argued that farmers who are technically efficient in their farming are not necessarily economically efficient. Therefore, the combined effect of technical and price efficiencies, measured as relative economic efficiency, was estimated using the Lau-Yotopoulos profit function. The use of this approach requires the assumption that the sample farmers in the study area are profit maximizers.

Unlike most neo-classical economists who have used the level of farmers' education to explain those factors influencing technical efficiency, this study has used an alternative approach of factor analysis. Some 24 variables, as listed in Table 6.9, were expected to make a contribution to the level of technical efficiency and, therefore, these variables were included in the analysis.

A summary of the main hypotheses tested is presented in Table 10.1.

The data used in this study were farm level data collected for the Rural Dynamics Study, Agro Economic Survey, East Java--in cooperation with the Brawijaya University and the University of Jember. They were collected from three villages in 1978.

The conclusions to this study are presented in the following section.

10.3 Conclusions

Based on the various strands of the work and interpretation of the results of the analysis as discussed in the previous chapters, it is now possible to draw together the conclusions of the whole project.

First, several factors have contributed to higher yields. On the basis of an interpretation of the partial productivity measures and production function analyses, the input variables, land, labour and current expenses, all play an important role in the variation of output. From the results of the production function analyses, it appears that output is highly responsive in the study area to these agricultural inputs. This finding supports that suggested in the literature (Davidson et al. 1967, Bardhan 1973, and Chadha 1979), that 'small area' crops are characterized by high production elasticities for land and small land-to-labour ratios.

Table 10.1

The Summary of the Main Hypotheses Tested

Hypotheses	Rejected/ Not rejected
Yield performance (Chapter 5)	
(a) That farm yields obtained by farmers are the same for different tenancy status and region.	
(a.1) That yields obtained by survey farmers are the same as the regional and national average yields.	Rejected
(a.2) That yields obtained by 'small' farmers are the same as those 'large' farmers.	Rejected
(a.3) That yields obtained in one region are the same as those in any other region.	Rejected
(a.4) That yields obtained by owners are the same as those of tenants (sharecroppers).	Not rejected
Technical performance (Chapter 6)	
(b) That farmers are equally efficient in technical terms for different tenancy status and region.	
(b.1) That 'small' and 'large' farmers are equally efficient in technical terms.	Rejected
(b.2) That owners and tenants (sharecroppers) are equally efficient in technical terms.	Rejected
(b.3) That farmers in each of the regions are equal in terms of technical efficiency.	Rejected
Economic efficiency (Chapter 7)	
(c) That farmers are equally efficient in economic terms for different tenancy status and regions.	

Table 10.1 continued

Hypotheses	Rejected/ Not rejected
(c.1) That 'small' and 'large' farmers are equal in terms of economic efficiency.	Rejected
(c.2) That tenants (sharecroppers) and owners are equal in terms of economic efficiency.	Not rejected
(c.3) That farmers in each of the regions are equal in terms of economic efficiency.	Rejected
Farm profits (Chapter 8)	
(d) That farm profits per unit of output are not affected by changes in farm wages, the price of seed or price of fertilizer.	Not rejected
Distribution of profits (Chapter 9)	
(e) That the distribution of farm profits is the same as the distribution of the area under rice and economic efficiency ratings.	
(e.1) That the distribution of farm profits is the same as the distribution of the area under rice.	Not rejected
(e.2) That the distribution of farm profits is the same as the distribution of the economic efficiency ratings.	Not rejected

Second, from the partial productivity measures it is clear that the yields of rice and other crops are lower than the regional and national average yields. Rice yields on the survey farms were 31 per cent less than those calculated from 'crop-cutting data' or from the Insus system. This finding indicates the likely yield gap between the actual yield and the potential yield at the farm level. This gap, for rice, was rather less on the large farms. Thus, the observation that small farmers obtained higher yields than large farmers, as suggested in much of the literature, should be rejected for crops other than rice for the sample farms in this study. The finding of a higher yield for rice on 'large' farms than 'small' farms may not be valid for situations where the variation in farm size is large, for example in the Philippines where it ranges from 0.6 to 49.9 hectares (Roumasset, 1976, p. 99). In a situation where the range of farm sizes is large it might be expected that large farms would have a relatively lower yield performance because of the declining marginal product of land and the fact that the level of other inputs used by large farmers tends to shift the total product of land to the right. Unlike farms in the Philippines, the farm size in the study area ranged between 0.050 to 3.075 hectares.

Third, with regard to each region, it was found that different locations, which also implies a different physical infrastructure (for example, irrigation, transport and communication), have substantially different yields. Higher yields were found in Regions 1 and 2 which had relatively better agricultural environments, such as irrigation and good extension services. However, for farmers in Region 3, with relatively poor physical infrastructure, the ability to benefit from such technology was relatively low. Therefore, lower yields tended to be found for farmers in Region 3 (significantly different at the 10 per cent level on a two-tailed t-test). This finding supports the hypothesis that higher yields will be obtained in regions with better agricultural environments and information.

Fourth, in the case of rice production, the yields achieved by sharecroppers and owners did not differ statistically. Therefore, it is not possible to reject the hypothesis that owners achieve higher yields than sharecroppers.

Fifth, several factors made a significant contribution to the technical performance of the sample irrigated ricefarms. On the basis of an interpretation of the results of the factor analysis, it was concluded that, from 24 variables which might *a priori* make a significant contribution to the technical performance of the sample farms, a set of variables relating to 'agricultural information' played an important role in the technical efficiency of the sample farms. Therefore, this finding confirms the hypothesis that better agricultural information is important in increasing farm productivity. As well, it was found that the use of modern inputs did not appear to be directly related to the technical efficiency of the farms. Although output might be increased by the use of modern inputs it does not seem that their use implies that they will be used efficiently or inefficiently.

Sixth, farmers who are technically efficient in their farming are not necessarily economically efficient. On the basis of the results from the linear programming it was found that the average technical efficiency rating was 67 per cent and the average economic efficiency rating was 37 per cent. However, there was a positive relationship between technical efficiency rating and economic efficiency rating which indicated that both technical and economic efficiencies have a significant effect on the gross revenue from rice. The greater the technical and economic efficiencies, the greater the gross revenue from rice. It was also found that the profits from rice would be increased substantially with the existing technology, if both technical and economic efficiency could be improved. Thus, this finding is in line with the earlier conclusion (the third) that higher yields will be obtained in the regions with better agricultural support systems (such as, better irrigation and provision of input supplies) and supply of information.

Seventh, with regard to the land-tenure system and groups of farms, it was found, using both linear programming and profit function analyses, that sharecroppers were technically more efficient, but were not economically or relatively more efficient than owners. This finding confirms the fourth conclusion of the study as discussed above. Moreover, it was found that 'large' farmers were also technically and economically more efficient than 'small' farmers which confirms the fifth conclusion, above. As has also been deduced, on the basis of results of the profit-function analyses, 'large' farmers in Regions 1 and 2 were relatively more efficient than 'small' farmers in Regions 1 and 2. Farmers in Regions 1 and 2 were also technically, economically and relatively more efficient than those in Region 3.

Eighth, there is a strongly held view that increases in productivity have as a major consequence increased farm income but at the same time widen the inequality of the income distribution (Kalirajan 1980, Gibbons et al. 1980). In this study, the underlying structure of such gains from technology in rice growing, the gains from achieving efficiency, and the distribution of profits of the sample farms have also been reviewed. It was found that average rice-farm profits per hectare in the study area were relatively high compared to the official figures, accounting for 143 and 158 thousand rupiahs in the wet and dry seasons, respectively. However, the distribution of profits was markedly unequal as indicated by the Gini coefficients which were 0.465 and 0.348 in the wet and dry seasons, respectively. In other words, at this stage of the 'green revolution' in East Java, it was found that the input of 'technology' which was offered to farmers, was bound to have a greater effect on profit generation of large farmers than small farmers. On the basis of the analysis of the distribution of profits, as indicated by Gini coefficients, the benefits of the new technology (viz. high-yielding varieties) have not been shared equally between groups of landholders in the study area. In conjunction with this conclusion, it was indicated that the variables of total farm area, farm area under rice, technical efficiency rating, allocative efficiency rating, and economic efficiency rating had a significant relationship to profits. The distributions of total farm area, technical efficiency rating, allocative efficiency rating, and economic efficiency rating appeared to be significant determinants of the distributions of profits (both adjusted and maximum adjusted net profits per hectare).

Ninth, on the basis of an interpretation of the results of the profit function analyses and under the condition of profit maximization and constant returns to scale in rice production in East Java, it was found that the output supply elasticities were uniformly very elastic with respect to the price of output. The own-price elasticities of demand for the factors of production were also uniformly above unity. However, the cross-price elasticities were relatively small for all inputs, seed, fertilizer and wages. On the basis of these elasticities, a given percentage subsidy on rice output would induce a greater production increase than would the same percentage subsidy on seed, fertilizer or wages.

Before discussion of the policy implications and directions for further research, four things should be noted. First, the results of this study were deduced from evidence of a sample of farmers in three villages and should not be generalized to other regions and villages with substantially different characteristics. Second, results of this study are subject to the qualification that the effects of risk have not been considered. For other regions where risk considerations are of dominant importance, risk should be taken into account. Third, despite the advantages of the Cobb-Douglas function as a means of obtaining direct estimates of production, the method is by no means free from shortcomings. The use of cross-section data in this study may result in inconsistency in the production elasticities over time. Even though an effort has been made to eliminate this inconsistency, the conclusions of the study should be interpreted with caution. Further, the elasticities obtained from the unit-output-price profit function using cross-section data are not likely to be representative of short-run parameters. Fourth, even though this study was carried out in 1978, the conclusions are still relevant since various changes in the use of modern seed varieties for rice production do not appear to have affected yields very much (Minister of Agriculture R.I. 1981). However, changes in policy toward agricultural institutions may be important in differences being observed in yields under different land tenure systems. However, as also argued by Wijaya (1981), the new policy on land tenure developed in 1980 is still not fully implemented.

The following section presents some policy implications of the study.

10.4 Implications for Policy with Particular Emphasis on Rice Production

Based on the above discussion, it is now possible to draw some policy implications. These are directed to policies for increasing farm efficiency and yield and toward a more equitable farm income distribution. Five policy implications are suggested as follows:

First, it is clear that raising the level of farm efficiency through a neutral technological shift would have a significant effect on farm profits. Consequently, in the long-run, in order to have a higher yield, policies accelerating technological innovation, for example via agricultural research and extension, are therefore suggested. Investment in agricultural research is necessary to create the new technology which is needed for productivity growth. This suggestion is in line with the sixth conclusion of the study. However, since the local agricultural extension workers very seldom visited farmers to advise them, as indicated in Table 6.9, these farmers did not use the best practices. This is made worse by the fact that most farmers in the study area, as indicated in Table 6.9, were uneducated so it is more difficult for them to adopt such new technology. In other words, the problem is how to get farmers to efficiently use the current technology. Thus, accelerating technological innovation via agricultural research should be simultaneously carried out with improvements in the ability of the local agricultural extension workers to visit and teach farmers. The duties of the extension workers should be modified so as to reduce their administrative duties in relation to field visits and demonstration plots. In other words, investment in both the extension workers and farm people is necessary so as to provide farmers with the ability to learn of and use the new technology.

Second, since the 'green revolution' in East Java is at a stage where the input of 'technology' is most-likely to have a relatively larger effect on the profits of rich farmers and thus to increase inequality, any policy on agricultural support should place more emphasis on the development of small-farm agriculture. The aim, besides increasing income for small and marginal farmers, is to bring about a more even farm income distribution in the rural areas. Among other things that can be suggested for this purpose, as also suggested by Mellor (1976) and Hart and Sisler (1978), is the use of a labour-intensive strategy for adopting new technology. Of course, this suggestion is put forward on the assumption that the development of small-farm agriculture under a free market economy can be based on that strategy and that it will favour greater income equality. The Indonesian Government has already established a trial project called 'promotion of small-farm income' since 1982 which aims to increase income for the small and marginal farmers in a few of villages in Java (BPLPP 1983). In the near future the Government is likely to expand it to more villages in Indonesia. However, care should be taken if this policy is applied. This is because, as suggested by Gotsch (1972, p. 339), small farmers can become better off relative to their previous position but worse off relative to their larger neighbours. In other words, as also argued by Gibbons et al. (1980, p. 211), absolute poverty would be reduced, but inequality would increase. Further, in considering such policies it should be remembered that there will be costs involved in their implementation and some parts of society will gain and others lose. Thus, there is likely to be various political pressures both for changes and against such changes which are oriented to greater equality.

Third, in conjunction with the land tenure system, this study showed that the owners were not economically more efficient in their farming when compared to sharecroppers. Thus no support on the basis of differences in efficiency is provided for the current Government policy on the land tenure system, particularly Article 10 of the Basic Agrarian Law of 1960, which favours land ownership as opposed to tenancy.

Fourth, with regard to the effects of different locations, it was indicated that regions with poor physical infrastructure are likely to have low technical and economic efficiencies and therefore low yields. Efforts should therefore be made to overcome this problem by increasing investment in the physical infrastructure (for example, irrigation, transportation and communications). This policy is important in its effects on the agricultural development process, and on growth and equity. Other studies (Schultz 1964, Antle 1982) have shown that investment in the stock of physical infrastructure plays an important role in the diffusion and adoption of new technology and may also lead to a more equitable distribution of the benefits of agricultural growth among farmers.

Fifth, since output supplies were found to be uniformly elastic with respect to the price of rice and more elastic than with respect to input prices. These results lend support to the argument in favor of output price support versus input subsidization for accelerating growth of rice output in the developing economies, as argued by, for example, Krishna (1967) and Sugianto (1982). However, this conclusion should be interpreted with caution for two reasons. First, as has been mentioned previously, the elasticities obtained from the unit-output-price profit function using the cross-section data are not likely to be representative of short-run parameters. Second, the conclusion is not meant to imply that an output subsidy is the most effective means of support when producer, consumer, and Government interests are taken into account. If they are taken into account, input subsidies may be a more cost-effective way of encouraging output (Baker and Hayami 1976, Parish and McLaren 1982). This may also be the reason why the Indonesian Government has adopted both price support and input (fertilizer) subsidies.

In the short-run, a price support policy is being relied upon to provide farmers with incentives to increase rice production by fixing the level of the floor and ceiling prices of rice. The fact that, in some instances, the actual price received by farmers is below the floor price, means that a more effective implementation of the floor price would be likely to stimulate rice production. In the long-run, input (fertilizer) policy is being relied upon by the Government to encourage farmers to increase rice production by fixing the farm-level prices of fertilizers. By reducing the cost of fertilizers, it is anticipated that the rice production will be expanded. Such a policy is supported by the findings in this study but only in the context of producing more rice. Nothing is indicated in relation to the gains and losses of producers, consumers and Government.

10.5 Directions for Further Research

A review of recent economic literature dealing with the measurement of farm resource allocation and efficiency (Chapter 3) indicates that there is considerable interest in discovering the best measurement for 'efficiency'. The intent and analytical content of the models used for measuring 'efficiency' have varied from the normative approach to the positive approach, and from simple models to complex dynamic models. The model used in this study lies within the limitations of the concepts of non-stochastic production functions, frontier production functions, and profit functions. As has been argued in Chapter 7, the analysis of the technical efficiency ratings is positive in the sense that variations occur within the domain of actual behaviour since the frontier production function is an envelope around yields actually achieved. However, in the regions where risk considerations are of dominant importance (for example, farmers having different attitudes towards risk and time preference in their decision to buy their inputs and to sell their products in a risky environment) the use of a stochastic production function is suggested.

Even though a discussion of the factors causing the yield gaps is provided in this study, further research on the yield gaps, particularly towards the gap between potential yield and the actual yield at the farm level is suggested. This, at least in the short term, is very important in determining those factors currently constraining the upward shift in yields. Ideally, three data sets should be used in determining yield gaps, namely, the data from experimental treatments (under the control of the researchers), demonstration plots (under the control of the local agricultural extension workers) and farm level (under the control of the farmers). Thus, complete information on the factors that are constraining the upward shift in yields can be gathered. Classifications of farmers into different farm sizes (large and small farms), tenure systems (owners and sharecroppers) and different regions could then be used.

With regard to the land tenure system, further research which is concerned with sharecropping is suggested. The aim, besides testing whether or not the findings of this study can be generalized, would also help to evaluate any effect of the current Government policy on sharecropping as ruled under Presidential Instruction number 13, 1980.

With regard to the problems of the small and large farms, and in particular the danger of introducing policies which increase relative poverty, a multi-disciplinary approach to the study of small farms is suggested. The study should be designed to test whether or not agricultural aid and labour-intensive strategies focussed on the problems of the small and marginal farmers will create a more even income distribution among farmers in the rural areas.

It should be kept in mind that the research for this study was carried out using cross-sectional data. Therefore, it is suggested for future research work that a combination of cross-sectional and time series data would be advantageous in obtaining improved parameter estimates.

Finally it should be kept in mind that the research was carried out in an area of heavy population pressure and generally very small sized farms. To cope with the low levels of income obtained from rice, small farmers generally devote a proportion of their time to the production of secondary crops, such as maize, soybean, groundnuts and cassava. Therefore, it is suggested that future research work on the problems of secondary crops as a source of income would also be advantageous. Further, small farmers also usually devote time to off-farm activities to earn income. Since this study does not concentrate on these activities, and to develop an understanding of the overall picture of resource allocation, research is needed which is concentrated on the relationships between farm and non-farm activities and their role in earning income.