The Impact of Land Tenure on Farming and Soil Conservation in the Upper Brantas River Basin, East Java, Indonesia.

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1. Introduction

The Brantas River Basin has been seriously affected by soil degradation. As an important agricultural region in East Java it is likely to become the focus of soil and natural resources conservation. Most of the villages in this region are critical or likely to become critical in terms of degradation of its soil, implying the need for care in the cultivation of land resource. Holdings in the Brantas River Basin have a slope exceeding 25 per cent.

It is postulated in this study that improper farming practices in this area have resulted in severe soil erosion, and it is likely that the soil erosion will increase. This condition has been exacerbated by the land tenure system. While there is some variety in the tenurial system, most of the farmers in the area were not owner operated. In one of the villages studied about 80 per cent of the farms were not owned by the operators. Since land is the main factor of production in agriculture, its efficient use significantly determines the villagers' standard of living, as there are few off-farm opportunities. The non-owned land as the main factor of production leads to a number of negative impacts such as:

- lack of responsibility with respect to soil conservation effort;
- lack of adoption of new technology;
- low farming productivity.

When the farmer cultivates non-owned land, there are many labour contract systems among land owners and tenants. Each of the systems will affect farming practices, the level of technology, farming productivity, farm income, and farming efficiency.

The purpose of this study of the land tenure system in the Brantas River Basin is to identify policies to improve the living standards of the farmers in this area, as well as to draw attention to the soil erosion problem and to develop policies which will protect many large projects in the Brantas River from severe sedimentation problems.

2. Objectives

This study is aimed generally to examine to what extent the land tenure system affects farming practices in the upper Brantas River Basin. Specifically the objectives are:

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a. to observe various formal and informal relationships between farm operators and land owners;
b. to examine the impact of different land tenure categories on the level of input use, farming efficiency and productivity;
c. to describe the impact of land tenure on the soil conservation effort.

3. Previous empirical Studies on land tenure systems

Many studies of the impact of land tenure on productivity and resource use efficiency have been carried out in India, Pakistan, Bangladesh, Malaysia, and the Philippines. In Indonesia, however, this kind of study is rare. The studies which have been done yielded controversial conclusions. Some studies concluded that sharecropping was inefficient relative to owner operated and rented farms while other studies reached opposite conclusions.

One such study was carried out in India by Junankar (1976). In his study Junankar applied an econometric model, using a Cobb-Douglas production function for each category of land tenure. The study concluded that owner operators were superior in terms of productivity relative to tenants, for large farms. For small farms, however the difference was not significant. Similar result were also reported by Bell (1977), and Roy,and Giri (1984). However, Rao concluded from his study of rice and tobacco cultivation in India in 1957-1960, that over a wide range, the productivity of land among the share rented farms is higher than among owner operated farms of corresponding size (Reid, J.D., Jr. 1974).

In Pakistan Chauwdry (1974) reported that owner operators employed more labour and other inputs per acre as compared with tenant farmers, whether fixed rent or share tenant. However, Ijaz Nabi (1986) reported an opposite result in this kind of study, in the same country.

In Bangladesh Jabbar (1976) indicated that owner operators were more efficient in allocating resources compared to other tenure classes. Similar conclusions were reported by Talukder (1980), Mandall (1980), and Hossain (1980).

In the Philippines Ruttan (1969) reported that share tenant farmers have higher productivity relative to owner operators. Similar results are also reported by Smith and Goethals (1965) in Malaysia. In 1979 Al Junid also reported that in Malaysia share tenancy is not inimical to productivity.

In Indonesia some researchers report that land tenure has no effect on productivity. Results of this kind are reported in the work of Sutawan (1977) and Hartoyo (1982). These studies, however, did not pay particular attention to the land tenure system, and did not adequately describe the systems of tenure which prevailed in their sample. Muslich (1984) and Wijaya (1981) reported conclusions opposed to those of Sutawan and Hartoyo. Muslich in his study in two villages in East Java on the impact of land tenure on productivity and efficiency in rice farming in East Java, concluded that land tenure significantly affects rice yields. Share tenant farmers have lower productivity as compared with the other tenure categories. With respect to resource allocation, he concluded that all categories of tenure in the two villages were inefficient. This evidence runs counter to the classical theory of share tenancy. Efficiency in this study was defined as price efficiency,

measured by using the ratio of marginal value product of input to its market price.

Wijaya's study suggested that tenurial reform will have effects on the distribution of income and may lead to an increase in efficiency, although she did not indicate conclusively whether or not abolition of land leasing will or will not improve economic efficiency.

4. Theoretical Framework

4.1. Economic Theory of Land Tenure

Many economists have focused their attention on the economic impacts of land tenure. In the debate on land tenure the relationship between share tenancy and allocative efficiency, and the choice of tenancy contract are emphasized. There is no single accepted theory on share tenancy, so that it is not possible to reach a priori conclusion, as to whether share tenancy is better or worse than lease hold tenancy or an owner operator system.

There are two lines of thought concerning share tenancy, many economists maintain that sharecropping tenancy results in inefficient resource allocation (Bardhan and Srinivasan,1971; Adam and Rask, 1968), and others follow opposed line of thought (Cheung, 1969; Huang, 1971; Reid. 1975; and Ruttan, 1979). The two lines of thought are known familiarly as 'Marshallian' and 'Cheungian' respectively.

The 'Marshallian' theory is based on marginal analysis on sharecropping. The analysis is illustrated in Figure 1.

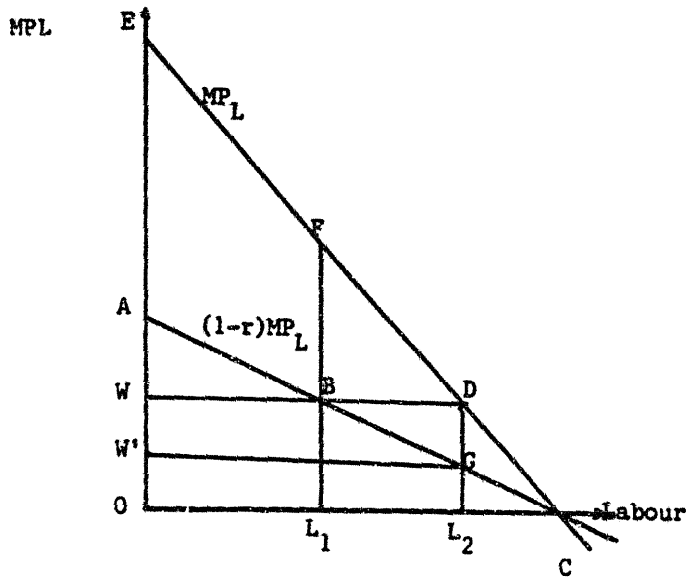

Figure 1. Labour use in owner operated and share tenant farms.

In this analysis it is argued essentially that because sharecroppers recieved only a part of marginal product of their input (e.g. labour), there are not sufficient incentives to employ their inputs to their Pareto efficient levels. For simplicity, in figure 1, EC represents MPL (marginal product of tenant labour) as a linear function, AC is marginal tenant receipts equal to (1-r)MPL where r is the percentage rental share of output. W is the wage rate.

If the owner operator is hiring labour for farming the equilibrium is at D with L2 units of labour, where MPL is equal to the wage rate. If the landowner farms his land with sharecropping, however, the equilibrium will be at B with L1 units of labour, where marginal receipt of labour (1-r)MPL equal to wage rate (marginal tenant cost). FBD represents the 'social loss' (economic waste), because at B the marginal product of tenant labour is higher than the marginal tenant cost, therefore share tenancy is inefficient.

If the cost is shared as in the output sharing arrangement, the use of labour will be the same for owner operator or fixed rent with share rent. In Figure 1, OW' represents the cost shared as the output is shared. The tenant will use his labour input at L2 units where their marginal receipts, (1-r)MPL, equal to marginal costs (W'G).

'Cheungian' theory corrected the traditional theory by equating AWB to BDG in figure 1, so that tenant labour will get exactly the same with their alternative earning, without any surplus (area of OWDL2). This is because the land owner wants to maximise his wealth by increasing the rental share of his land r to r'. Diagramatically this theory can be illustrated in figure 2.

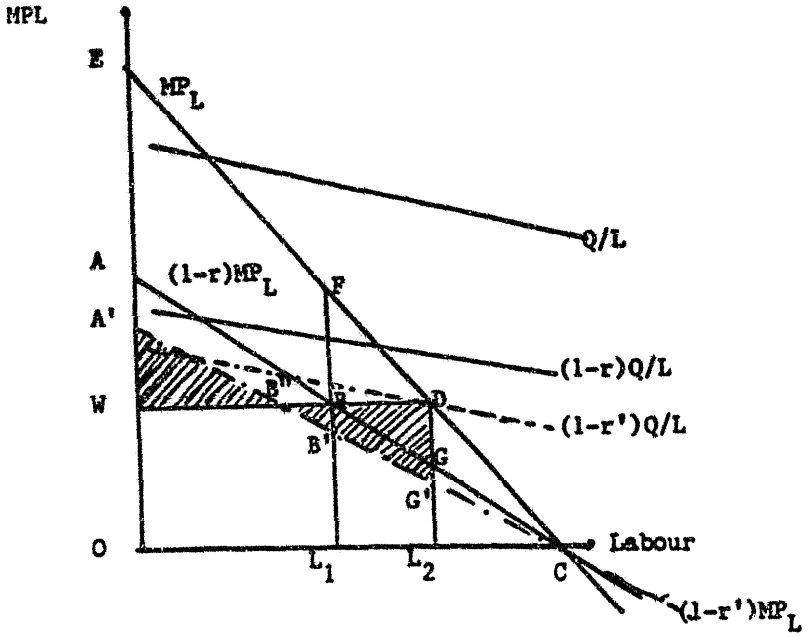

Figure 2. Correction of traditional theory of Share tenancy.

In figure 2 the area of WA'B'' is equal to B''DG', with the assumption of a competitive market for both land and labour. Q/L in the diagram is the average product of labour, EC is the marginal product of tenant labour(MPL), and AC is (1-r)MPL. The land owner's share of the total product is equal to the area of AEDG and the tenant's share equals OAGL2. The area of OWDL2 is the alternative earning of tenant labour.

From the diagram we can see that the tenant's share of output is higher than his alternative earnings with a surplus of WAB - BDG. The land owner therefore is able to maximize his wealth by raising the rental pecentage, r, to the point where the area of WAB equals BDG. In figure 2, r is raised to r' so that the area of WA'B'' equals B''DG'.

4.2. Efficiency of Farm Management

The differences among land tenure categories of farming are understandable. As owner operators, farmers have their own independence in decision making and in choosing their farming methods; farmers are free to plan and to decide what they want to plant and what technology they choose and with more sense of responsibility since they bear the brunt of the outcomes. Tenant farmers have restricted property rights in terms of the time period of sharing or leasing the land they operate, and decision making.

The impact of this form of farm management is to improve production and soil conservation practices significantly. Output of farming is affected by the efficiency of farm management, and this efficiency is affected by land tenure status, so that the greater the area land leased, the lower the efficiency of its management. Mathematically this statement may be written as:

$$M = \alpha T, \quad \alpha < 0$$ where,

M = the efficiency of farm management

T = area of land leased.

Diagrammatically the statement can be illustrated as seen in Figure 3. In the diagram, the difference between owner operator and tenant are postulated only on the efficiency of their management on farming. Following Mundlak (1961) the diagram can also illustrate the 'management bias', i.e. a bias in the production function due to exclusion of management from independent variables in its estimation.

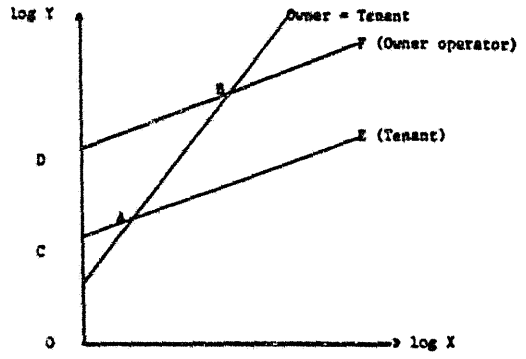

Figure 3. Production function of pure owner operator and pure tenant.

The diagram in figure 3, shows with the assumption that there are only two land tenure systems, owner operator and tenant farming, the slope of the production functions are similar; owner operators have higher production functions relative to tenant farmers, because owner operators manage their farms more efficiently than tenants. If owner operators and tenants have similar production functions, the production function can be determined by relating point A and B in Figure 3. This production function is biased as it does not includes the difference in management between owner operator and tenant. It overestimates of the output elasticity with respect to input, since at point A or B the production functions for owner operator and tenant respectively have different slopes compared with production function AB. So, AB is the production function with Management bias and CAE or DBF without management bias. 'Mixed' farmers (part owner and part tenant) will have production function in between owner operators and tenants. The larger the area of land leased, the closer the production function is to the tenant production function.

CD in the figure 3 indicates the difference in technical efficiency between pure owner operator and pure tenant due to management differences.

5.The Empirical Study

The location for this study was in the upper Brantas River Basin, since this area has a severe soil erosion problem. There is a natural resources conservation program in this area and problems have emerged in the maintenance of irrigation and electricity generation projects in the downstream sector of the Brantas River. Due to budget and time constraints two villages only were selected. Tulungrejo and Torongrejo as the respective centres for potato and red onion production. Both villages are in 'Kecamatan' Batu in the Malang regency.

A household census was carried out in the two villages to find the population in each land tenure system. From this census sample farmers were selected from the frames for each land tenure system. The population of potato and red onion farmers in the two villages are presented in Table 1.

Table 1. The population of Potato farmers in Tulungrejo and Red onion farmers in Torongrejo, 1985

Land tenure status	Farmer households	
	Tulungrejo	Torongrejo
Owner operator	214	351
Fixed rent	417	136
Share tenant	10	59.
T o t a l	641	546

The sample size is 209 farmers consisting of 138 potato and 71 red onion farmers in Tulungrejo and Torongrejo respectively. The numbers of sample farmers and their land tenure status are presented in Table 2.

Table 2. The sample farmers in Tulungrejo and Torongrejo for each land tenure status, 1985.

Land tenure status	Household sample farmers		
	Tulungrejo	Torongrejo	Total
Owner operator	42	41	83
Fixed rent	70	20	90
Share tenant	26	10	36
T o t a l	138	71	209

Data collection in this study was by personal interview of the sample farmers using a structured questionnaire, and discussions with several key informants by open interview. The data needed was: farming activities data, labour relationships between landowner and the operator for each category of land tenure. To complement the primary data secondary data was also collected from various data sources.

In this study a Cobb-Douglas production function was used to analyse the impact of the land tenure system on productivity. For that purpose two dummy variables for land tenure are introduced in the production function. The mathematical model is as follows:

$$\log Y = \log b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + c_1 D_1 + c_2 D_2$$

where,

- Y = yield (in quintals)
- X_1 = farm size (hectares)
- X_2 = labour (mandays)
- X_3 = fertilizer (quintals)
- X_4 = value of pesticide (hundred rupiah)
- X_5 = quantity of seed (kilograms)
- D_1 = dummy variable for an owner operator, taking the value of 1 for an owner operator and 0 otherwise
- D_2 = dummy variable for a fixed rent operator, taking the value of 1 if a fixed rent operator and 0 otherwise.

To analyse the efficiency of resource used, the ratio of the value marginal product to its market price was calculated from the estimate. In this analysis the estimated production function in the previous analysis was used. The criteria used in this analysis are as follows:

a. If the ratio equals 1 it is inferred that optimal use is made of the particular resource.
b. If the ratio is greater than 1 there is an implication that the resource is used at less than optimum level.
c. And if the ratio is less than 1 the resource is used excessively.

The impact of the soil conservation effort on productivity was examined using production functions by introducing a dummy variable for the level of soil conservation effort practiced by farmers. The level of soil conservation effort was measured by categorising the farmers' efforts into two categories, 'good' conservation and 'not good'. These categories were based on five suggested soil conservation practices i.e. :

1. terracing;
2. upright planting rows to the slope of the land;
3. planting elephant grass for strengthening terraces;
4. planting perrenial crops to prevent soil erosion;
5. construction of drainage ditches.

If a farmer applied three or more of the suggested conservation practices, his effort was categorized as 'good', and the dummy variable for conservation takes value of 1, and if the farmer applied two or less of the suggested soil conservation practices, is categorised as 'not good', and the value of the dummy variable is zero.

6. Characteristics of the study area

The two villages studied are located at the upper Brantas River Basin. Both are more than 800m above sea level. Tulungrejo at about 1500 m, while Torongrejo at about 850m above sea level. In Tulungrejo, potato is the most appropriate plant to grow while in Torongrejo red onion is best.

Rainfall in both villages is sufficient for farming. It is 2076 and 1535 mm respectively per annum. The average temperature is between 15 to 17 and 20 to 24 degrees Celsius respectively.

Land in the two villages consists of dry land and irrigated land. In Tulungrejo about 60 per cent of its area is dry land, while in Torongrejo dry land is only about 30 per cent, more than 65 per cent of the land in this village is irrigated.

Land tenure status in the two villages are quite different, in Tulungrejo 80 per cent of the land is cultivated by non-owner farmers (fixed rent and share tenant), while in Torongrejo most of the land is cultivated by owner operators.

Most of the population in the two villages are farmers, more than 60 per cent are in agriculture. The average farm sizes in the two villages are similar i.e. 0.750 and 0.650 hectares respectively.

7. Results and Discussion

7.1. Yield and Farm Income

The average yield of farming among categories of tenure were not very different, as seen in Table 3.

Table 3. The average yield of potato and red onion in Tulungrejo and Torongrejo respectively (1985).

Land tenure Category	Potato		Red Onion	
	Yield(q/ha)	Value (Rp)	Yield(q/ha)	Value(q/ha)
Owner Operator	137.8	2,282,706	102.71	3,081,482
Fixed rent	144.3	2,375,305	110.87	3,326,165
Share tenant	138.6	2,213,800	80.43	2,413,168.

The highest average value of yields are for fixed rental operators both for potatoes and red onions, while the lowest yields are for farmers with share tenant status farmer.

The average total cost of production per hectare were also not very different among the three tenure categories as seen in Table 4.

Table 4. The average total cost of production per hectare for Potato and red onion Farms in Tulungrejo and Torongrejo respectively (1985).

Tenure categories	Farm income (Rp)	
	Potato in Tulungrejo	Red onion in Torongrejo
Owner operator	524,541	1,259,721
Fixed rent	534,498	1,416,454
Share tenant	358,073	1,192,258

The figures in Table 4 indicate that either in Tulungrejo or in Torongrejo the farm income in the owner operated system is lower than for the fixed rental tenure system. In Torongrejo the income of owner operator is the lowest among the three tenure categories. This might be due to the differences in economic motivation of the farmers. Owner operators tend to work non-intensively compared with the other two tenure categories, as a subsistence farmer does, because the owner operators have no responsibility to pay either rent or rental share of output. The differences of production level among the three tenure categories will be analysed further in production function analysis.

7.2. Production Function Analysis

In this analysis Cobb-Douglas production functions were employed with five independent variables, i.e. farm size, labour, seed, fertilizer, and pesticides.

To examine the difference among the land tenure categories as well as the conservation level of the farmers, dummy variables were introduced into the production function. The results of the Cobb-Douglas production function estimation are presented in Table 5 and 6.

Table 5. Cobb-Douglas production function estimation for Potato farming in Tulungrejo, Batu (1985).

Variables (in log)	Regression Coef.	Standard Error
Farmsize	- 0.267	0.166
Labour	- 0.508++	0.103
Seed	0.574++	0.181
Fertilizer	0.656++	0.094
Value of Pesticide	0.186+	0.091
Dummy owner operator	- 0.099+	0.055
Dummy Fixed rent	- 0.012	0.057
Dummy Soil conservation	0.044	0.042
Constant	2.049	

F ratio = 38.560++
R square= 0.705

Notes: Dependent variable = the yield of potato (quintal)
++ = sigificant at 1%
+ = significant at 5%
n = 13

Table 6. Cobb-Douglas production function estimation for Red onion in Torongrejo, Batu (1985).

Variables (in log)	Regression Coef.	Standard Error
Farmsize	0.617+	0.413
Labour	0.628+	0.369
Seed	- 0.074	0.260
Fertilizer	- 0.027	0.203
Value of Pesticide	0.085	0.125
Dummy owner operator	- 0.016	0.068
Dummy fixed rent	0.034	0.086
Dummy soil conservation	- 0.048	0.035

Constant	0.795

F Ratio = 31.577++
R square = 0.803

Notes: Dependent variable = yield (quintal)
++ Significant at 1%
+ Significant at 5%
n = 71

Table 4 and 5 showed that the regression models fit quite well, both have F ratios highly significant at 1% level with coefficient of determination (R^2) 71 and 80 per cent respectively. However, from the first order correlation matrix in Appendix 4, we can see that there is close correlation among the independent variables, indicating that there is serious multicollinearity in the model.

To eliminate the multicollinearity effects in this study theproduction function was normalized by dividing all variables by farm size. In other words the analysis was done on a per hectare basis. The results are presented in Table 7 and 8.

Table 7. The Cobb-Douglas production function estimation of Per hectar potato farming in Tulungrejo,Batu in 1985.

Variables (in log)	Regression Coef.	Standard Error
Labour(per hectare)	0.326++	0.108
Seed (per hectare)	0.536++	0.199
Fertilizer (per hectare)	0.982++	0.079
Value of Pesticide (per hectare)	0.237+	0.100
Dummy owner operator	- 0.160	0.061
Dummy fixed rent	- 0.135+	0.060
Dummy soil conservation	0.040	0.764
Constant	0.097	

F Ratio = 74.305++
Coefficient of Determination (R^2) = 0.800

Notes: Dependent variable = per hectare yield of potato (quintal
++ Significant at 1%
+ Significant at 5%
n = 138

Table 8. The Cobb-Douglas production function estimation of Per hectar Red onion in Torongrejo, Batu (1985)

Variables (in log)	Regression Coef.	Standard Error
Labour(per hectare)	0.239+	0.179
Seed (per hectare)	- 0.096	0.282
Fertilizer (per hectare)	- 0.110	0.192
Value of Pesticide (per hectare)	0.064	0.124
Dummy owner operator	0.033	0.055
Dummy fixed rent	0.104+	0.064
Dummy soil conservation	- 0.048	0.035
Constant	4.476	

F Ratio = 2.472+
Coefficient of Determination (R^2) = 0.215

Notes: Dependent variable = per hectar yield of potato (quintal
++ Significant at 1%
+ Significant at 5%
n = 71

Tables 7 and 8 show that there are differences in the significance of their independent variables, in the two villages of 'Kecamatan' (sub District) Batu. The production function of Potato in Tulungrejo have significant coefficients in all independent variables included in the per-hectare model, while red onion in Torongrejo only per - hectare labour has a significant coefficient. This might be because the farmers in Torongrejo did not pay serious attention to seed, fertilizer and pesticides for their red onion farming. The farmers normally used the seed from their own previous crops, so that the quality of their seed did not vary among the farmers.

Fertilizer as well as pesticides are also not familiar to the farmers, particularly in red onion farming; that is why its application is very low, relative to the standard recommendation.

Dummy variable for owner operator have a significant coefficient (at 95%), meaning that there are different intercepts between owner operator and share tenant in potato production function. The coefficient is - 0.165, this means that the production function of share tenant farmers is higher than owner operators. This result runs counter to the theory that owner operators have higher productivity relative to share tenants. This is due to the differences in the share contract systems in the village studied with the common share contract system. In this village share tenant farmers have their own decision in managing their leased land as the fixed rent farmers have. Land owners just lease out their land for potato growing without making any contribution to farming activities. Usually tenant farmers in Tulungrejo are rich farmers, as potato farming required a high level of capital.

Similarly, if we compare fixed rent tenants relative to share tenants. The coefficient of the dummy variable for fixed rent is - 0.135 (significant at 5%), meaning that share tenants have a higher production function. As compared to owner operators, fixed rent tenants have a higher intercept, this means that fixed rent operators have higher per-hectare productivity relative to owner operators. This is understandable, as operators on fixed rents will always exploit the land to compensate for the land rent that they must pay.

In Torongrejo, the dummy variable for owners has a regression coefficient which is not significantly different from zero, meaning that there was not any significant difference in their production function between owner operators and share tenants, however, there were significant differences between fixed rent tenants and share tenants. The former have higher production functions than the latter. While relative to fixed rent, owner operators also have a higher production function. This is might be due to the 'patron client' relationship between land owner and share tenant. Most of the share tenant farmers stated that they are closely related to their land owner.

The impact of the soil conservation effort on the productivity of potato or red onion farming were not significant. The dummy variable for soil conservation in both activities were not significantly different from zero. In other words, the levels of soil conservation effort 'good' and 'not good' were not significantly different on their production functions. This is because it is only recently that soil conservation practices have been introduced to the farmers in the area of study.

The soil conservation practices seem to be obviously different among the three tenure categories. Most of owner operators sample have practiced soil conservation in a 'good' category; 63 of 83 samples (75.9%) have practiced soil conservation efforts in 'good' category. While for fixed rent farmer, only 39 of 90 samples (43%) have practice the soil conservation in 'good' category, and this effort was actually carried out by the landowner before leasing out their land, and the land renter merely maintained it. Many of them did not bother with soil conservation efforts.

Most share tenant farmers in the study area (83%) have practiced a 'good' category of soil conservation effort. The data indicate that share tenant farmers were concerned with soil conservation; this is because of the dependency of the share tenant on the landowner, if they worked well on the land he shared, the owner will give him an extension of the contract.

7.3. Analysis of resource use efficiency

This analysis was directed to an examination of allocative efficiency of the resources used and included in the production function estimated in previous analysis. The efficiency is measured by obtaining the ratio of the value of marginal product of each input to its market price. The value of marginal product of Xi is:

$$YVMPX_i = b_i \cdot \frac{Y}{X_i} \cdot Py$$

Where,

$VMPX_i$ = Value of marginal product of X_i
Y = Geometric means of product (yield)
X_i = Geometric means of the ith input
b_i = product elasticity of the ith input
P_y = Price of per unit product

The price of the input is determined based on its current market price in 1985. The results are presented in Tables 9 and 10.

Table 9. Analysis of resource used efficiency per-hectare Potato farming in Tulungrejo (1985).

Variable	Geometric means	b_i	$VMPX_i$	PX_i (Rp)	$VMPX_i/PX_i$
Potato Yield (quintal)	41.21	-	-	-	-
Labour (man days)	372.39	0.326	595.25	950	0.626
Seed (quintal)	10.91	0.536	33406.16	50000	0.668
Fertilizer (quintal)	28.05	0.982	23804.83	11000	2.164
Pesticide (,000 Rp)	174.18	0.237	925.20	1000	0.925

Notes: The price of potato is Rp.16500 per quintal.

Table 10. Analysis of resource used efficiency per-hectare Red onion farming in Torongrejo (1985).

Variable	Geometric means	b_i	$VMPX_i$	PX_i (Rp)	$VMPX_i/PX_i$
Red onion Yield (quintal)	93.54	-	-	-	-
Labour (man days)	579.43	0.239	1157.48	1000	1.15
Seed (quintal)	447.71	-0.096	- 601.72	40000	-0.01
Fertilizer (quintal)	10.30	-0.110	-29969.12	11000	-2.72
Pesticide (,000 Rp)	0.348	0.064	516082.75	1000	516.08

Note: The price of red onion = Rp.30000 per quintal.

As shown in Table 9 and 10, the resources used in the two villages all are used inefficiently, either for production of potatoes in Tulungrejo or red onions in Torongrejo. The ratio of the value of marginal product of all inputs to their market prices are not all equal to unity.

The use of labour in per-hectare potato farming has a value of marginal product less than its market price so, the ratio is less than unity (0.626), meaning that there is excessive use of labour at the current price level. In red onion farming at Torongrejo, however, the use of labour input per-hectare was close to the optimum level with the ratio of MVP to its market price close to unity (1.15). Thus it is suggested that the labour use in Torongrejo is more efficient relative to its use in Tulungrejo.

Fertilizer was used inefficiently in potato farming at the current price level. It should be increased to improve profits. For red onion farming in Torongrejo, however, an opposite result was obtained. However because of the

non-significant coefficient of fertilizer in the estimated production function, the estimate of its efficiency are questionable.

In Table 9 the ratio of the value of the marginal product of pesticide to its market price is close to unity (0.925), meaning that its use on per-hectare potato farming is close to an optimum level.

The use of resources seems to be affected by the land tenure status. In the analysis of variance almost all of the inputs indicated significant differences among the three tenure categories (see appendix 2).

All the differences are due to the differences in the share contract systems in the two villages. As stated previously, the share contracts for potatoes in Tulungrejo are completely different to the common system usually practiced for other commodities. In this commodity (potato), share tenant farmers are rich farmers or have sufficient money capital and, land owners do not make any contribution to farming activities, as the usually live in the city far from the village.

16 Conclusions

From the observations and analysis the conclusions obtained in this study are as follows :

a. In the Brantas River Basin there are many forms of labour relationships between the farm operator and landowner, such as land leasing in various different ways between one village andanother; share tenancy is also different between one commodity as well as between one village and another.
b. The land tenure systems significantly affect the use of inputs as well as the level of productivity, however, it seems that this conclusion cannot be generalized for all commodities, as each commodity and each village have a different system of land tenure practices. In potato farming in Tulungrejo, share tenant farmers have the highest per-hectare productivity relative to fixed rent or owner operators. However, in Torongrejo owner operators and share tenant farmers in red onion farming have no significant difference in productivity. The only significant difference is between the productivity of fixed rental and share tenant farmers. These differences might be because of the differences in tenure contract systems in the two villages.
c. In relation to soil conservation, it seems that the land tenure system also significantly affects conservation practices. Fixed rent famers seems to be uninterested in soil conservation practices as compared to owner operators and share tenants.

Based on those conclusions it is suggested that each policy on the improvement of productivity should pay attention to land tenure status, each policy should be directed not only to the landowner, but to the land operator as well.

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Appendix 2. One-way ANOVA of per hectare inputs used on Potato and Red onion among tenure categories in Batu, Malang 1985

Group	Means			
	Labour (mandays)	Seed (quintals)	Fertilizer (quintals)	Pesticide (,00 rupiah)
POTATO				
Owner Operator	531.319	12.087	47.041	321.832
Fixed rent	356.450	10.914	41.936	190.133
Share tenant	546.127	11.580	40.936	279.692
RED ONION				
Owner operator	602.[illegible]	4.464	11.085	3.990
Fixed rent	617.021	4.948	10.666	3.850
Share tenant	539.933	4.078	8.460	2.380

Variable: Labour in Potato farming

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
Between	684718.900	2	342355.500	3.579
Within	12914520.000	135	95663.080	
Total	13599240.000	137		

Variable: Labour in Red onion farming

Between	41932.898	2	20966.449	.957
Within	1489722.976	68	21907.691	
Total	1531655.875	70.		

Variable: Seed in Potato farming

SOURCE	SUM OF SQUARE	D.F.	MEAN SQUARE	F RATIO
Between	37.205	2	18.603	1.318
Within	1905.544	135	14.115	
Total	1942.749	137		

Variable: Seed in Red onion farming

Between	57045.466	2	28522.733	3.054
Within	635058.630	68	9339.097	
Total	692104.096	70		

Variable: Fertilizer in potato farming.

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
Between	669.588	2	334.794	0.111
Within	405602.500	135	3004.463	
Total	406272.100	137		

Variable: Fertilizer in Re donion farming.

Between	555432.781	2	2777716.391	4.146
Within	4554924.417	68	66984.183	
Total	5110357.199	70		

Variable: Pesticide in Potato farming.

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
Between	489353.700	2	244676.900	7.269
Within	4544233.000	135	33660.990	
Total	5033587.000	137		

Variable: Pesticide in Red onion farming

Between	0.214	2	0.107	7.250
Within	1.002	68	0.015	
Total	1.216	70		
