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Technical Efficiency of Land Tenure Contracts in West Java Province, Indonesia

Erizal Jamal
Indonesian Center for Agricultural Technology Assessment and Development,
Indonesian Agency for Agricultural Research and Development (IAARD)
Email: erizal_jamal@yahoo.com

Yovita Anggita Dewi
Indonesian Center for Agricultural Technology Assessment and Development,
Indonesian Agency for Agricultural Research and Development (IAARD)
Email: yovi_anggita@yahoo.com

ABSTRACT

Obtaining land tenure contracts for rice farms is a major problem faced by farmer tenants in the province of West Java. This study aimed to analyze the type of land tenure contracts in this region and the levels of technical efficiency of each contract system. Data were collected through a survey, with respondents randomly selected from the Karawang and Subang districts of West Java. The stochastic frontier was used to determine the efficiency of each system.

Results showed that the average area being tilled was higher than land owned due to land tenure arrangements that increased farmers' access to land. Three common land tenure contracts in this region are fixed rental, sharecropping, and mortgage. Sharecropping and mortgage coefficients were found to be less efficient, while fixed rental was more efficient compared to owner-cultivated plots. These results provided evidence to support the view that sharecropping is inefficient for the tenants. However, sharecropping is still a common type of land transaction in West Java. To improve efficiency, the local government can help farmers by enabling them to lease land through fixed rental or other more favorable arrangements.

INTRODUCTION

In the peasant economic model developed by A.V. Chayanov (Pincus 1996), the level of economic activity of family farms varies in direct proportion to the internal demand of the household, as expressed by the ratio of the consumer to the worker. As ratio rises, the household will attempt to either increase the cultivated area, or work in landholdings more intensively. Farmers owning land would increase cultivation efforts, while the landless would strive to gain access to the land. To acquire access to the land, there are alternatives in tenure systems for landless farmers which include fixed rental, sharecropping, and

mortgage. Sumaryanto and Rusastra (2000) classified these three land tenure systems as non-property, rights class based on the socio-economic study of land tenure systems in Indonesia.

Land tenure encompasses all arrangements established among people to determine their rights in the use of land. These rights may be fixed by custom or law and are often explained as a complex or bundle of rights which, together, manage the property, or the right to control an economic good (in this case, land). This bundle of rights is often shared through contracts with others (Kuhnen 1971).

Land tenure is a critical issue in Indonesia, especially in Java, where land fragmentation is increasing and the marketing of land is underdeveloped. The choice of land tenure contract for farmlands is becoming increasingly important because of increasing absentee ownership and a great number of landless farmers. These different tenure systems result in different levels of production efficiency and equity. At the same time, the nature of the tenure market contract is affected by the manner in which markets for labor and capital function and resources are distributed. However, this area has been researched scarcely in Indonesia. Most previous studies explained the differences in land tenure in terms of the land fertility or productivity.

The significance of this study may be seen from both theoretical and practical points of view. From the theoretical view, the study of land tenure systems is a new approach in institutional economics. Understanding the levels of technical efficiency of these land tenure systems is important. By understanding this situation, improving the land tenure system would probably be an appropriate way of enhancing efficiency in farming the land.

PREVIOUS RESEARCH

Contracts have been an important theoretical topic in economics. The view of contracts is typically classified under two theoretical constructs: principal-agent theory (Cheung 1992; Stiglitz 1974) and transactions cost theory (Coase 1961; Williamson 1998). The principal-agent model begins with the assumption that the producer (agent) is risk-averse and the buyer (principal) is risk-neutral. Output depends on the producer's effort and exogenous factors (e.g., weather), and only the producer or agent can shirk outputs (moral hazard). These assumptions generate the well-established outcome of tension between properly aligning incentives and risk avoidance. Specifically, as a risk-averse agent, the producer should be willing to forego some level of income, a risk premium, to shift risk to the buyer of the product.

According to Allen and Lueck (1995), empirical evidence in support of the risk-shifting hypothesis is nil because most studies found little support for risk as a determining factor in contract choice. They suggest that the data support a transaction cost view of the world. Standard principal-agent models assume that contracts, aside from their comprehensiveness, are costless to write.

In contrast, transaction cost theory assumes that writing and fulfilling contracts are costly, thus focusing attention on monitoring, enforcement of costs and post-contractual opportunism, as a result of relation-specific investment (Hudson and Lusk 2004).

Share tenancy is a labor contract that yields higher utility to the principal compared with wage or rental contracts (World Bank 2003). Wage contracts incur moral hazard costs associated with the agent's (worker's) gain

from effort shirking. Rental contracts are said to misallocate risk-bearing, where, the worker bears the risk, even though he or she is likely to be more risk-averse than the landlord. Share tenancy mitigates both problems, although, imperfectly. In comprehensive reviews and analyses of alternative theories to date, Hayami and Otsuka (1993) favored the risk-aversion view, although they interpret that tenant labor has to include management inputs and exclude casual labor.

On the other hand, Schuh and Brandao (1992) concluded that "recent literature on sharecropping is converging on market imperfections for inputs, other than land, as the explanation for variations in contractual arrangements." In this theory, also known as transaction cost theory, risk aversion is omitted, but shirking of more than one input is allowed (Reid 1973). Reid further argued that both the tenant and landlord contribute managerial inputs, and that share tenancy motivates them to provide those inputs in which they have a comparative advantage. According to Roumasset (1978), this "partnership" model, formalized by Eswaran and Kotwal (1985), provides a non-cooperative equilibrium model of contract choice by mischaracterizing landlords as having an absolute and comparative advantage in decision-making.

In Indonesia, the Basic Agrarian Law of 1960 is a first effort to reconcile *adat* (traditional or customary) law with western law and to give small farmers and the landless more equitable access to land (Lucas and Warren 2000). At the turn of the century, one-third of the agrarian population had no land in Java, while at the other extreme, nine percent of the landowners held more than one-third of all lands (Husken and White 1989). The ratio above has not changed substantially over the years. Based on the data from the Indonesian agriculture census of 1983 and 2003, around 63 percent of the farm households in Java owned less than 0.5 hectare of land; on the other hand, around 15 percent owned 52 percent of the total land in the island.

The 1995-99 microsurvey by the Indonesian Center for Agro-Socio Economic Research and Development (ICASERD) indicated an increasing number of landless farmers in Java, particularly those who plant rice. Landless farmers constituted 49 percent, while farmers owning less than 0.5 hectare of land composed 39 percent. Urban residents own lands in the urban fringes, where most lands are used for speculation rather than cultivation. In other cases, lands occupied by affluent people were distributed to the local farmers on different tenure arrangements. As land disputes escalated, land resources were left underused. Cultivation was sub-optimal because of the investors' reluctance to invest over the long term (Como GmbH 2001).

MATERIALS AND METHODS

Research Location

Data used in this study are from the research "Efficiency of Land Tenure Contracts in West Java, Indonesia", funded by the Indonesian Agency for Agricultural Research and Development (IAARD). Four villages were selected from the Karawang and Subang districts of West Java. The two villages in Karawang were chosen based on their proximity to an industrial area, source of income and degree of labor competition between agriculture and industries. The village Wanasari in Teluk Jambe sub-district is near an industrial area, the households' source of income was mainly industrial and labor competition between agriculture and industries was high. The other village (Telasari village, Jatisari sub-district)

was selected based on its distance from the industrial area, source of income was mainly agriculture, and labor competition with industry was still low.

The selection of villages in Subang district followed the same criteria as those in Karawang. One village was in the north and another in the east. Based on Pincus' (1996) study, the percentage of landless farmers in these regions differed, with those in North Subang being around 74 percent compared to 50 percent in East Subang. In North Subang (Mariuk village, Binong sub-district), agriculture was the main source of income, while in the south (Pabuaran village, Pabuaran sub-district), industrial employment was the main source of income.

These differences in the location, with respect to distance to an industrial site, were expected to have a significant impact on contract choice. From each village, one or two hamlets or *kampong* were sampled depending on the number of landowners in each hamlet.

Methods of Collecting Data

Data were collected through personal interviews with the farmer tenants and landowners. Using a pretested questionnaire, the survey collected information on the choice of tenure contract, cropland area cultivated, labor use, input use, quantity and value of output per unit of land, and characteristics of farmers (cropland owned, household labor force, education of household head, characteristics of field, input and output, income, expenditures, and non-agricultural activities). Tenants and landowners were the respondents of the survey,

Secondary data on information about land ownership history and the process of land fragmentation were collected.

There is a total of 241 samples of land tenure arrangements distributed among the following units: landowners - 80; rented out - 34; rented in - 127; fixed-rental arrangements - 39; sharecropping arrangements - 57; and mortgage arrangements - 31.

Methods of Analysis

Descriptive analysis

Descriptive analysis was used to manage large quantities of data in the research study. Descriptive analytical tools were employed to explain the different choices in land tenure contracts. Models were tested separately for different types of land tenure to analyze the collected data.

Statistical analysis

The stochastic frontier was used to obtain the technical efficiency (TE) of land tenure contracts. Developed by Aigner et al. (1977), the stochastic frontier has been used to carry out a wide range of research and reviews. The most prominent approach was by Battese and Coelli (1988, 1992, 1995). The general form of the stochastic frontier can be described as follows:

$$Y_i = f(X_{1i}\beta)\varepsilon^{3i} \quad (1)$$

where: Y_i = output produced by the ith observation

X_{1i} = vector of inputs applied by the ith observation

β = vector parameter coefficient

ε_i = specific error term of the ith observation

$$\varepsilon_i = v_i - u_i \quad (2)$$

The model using production function is described as the composed error model due

to the stochastic frontier function having the specific error term of ε_i. The specific error term consists of two error terms, v_i and u_i, which carried out the different distributions itself. Component v_i is the random output variation due to the external factors that have symmetric and normal distribution while u_i is the error term due to the internal factors. The distribution is asymmetrically distributed and half-normal. The equation is defined as:

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \quad (3)$$

$$\lambda = \sigma_u / \sigma_v \quad (4)$$

A total variation of actual output toward its frontier is based on Battese and Corra (1977) defined as:

$$\gamma = \sigma_v^2 / \sigma \quad (5)$$

Technical efficiency (TE) can also be measured using the equation developed by Jondrow et al. (1982) that can be rewritten as:

$$TE = \exp(-E[u_i/\varepsilon_i]) \quad (6)$$

with

$$E[u_i/\varepsilon_i] = \frac{\sigma_u \sigma_v}{\sigma_t}\left(\frac{f(\varepsilon_i \lambda/\sigma)}{1 - F(\varepsilon_i \lambda/\sigma)} - \frac{\varepsilon_i \lambda}{\sigma}\right) \quad (7)$$

The stochastic production frontier (8) and its inefficiency function (9) were used to determine the technical efficiency of each tenure system. The parameters of the model were estimated using the maximum likelihood estimate (MLE) procedure in the Frontier 4.1 program (Coelli 1996), with TE Effect model. The form of the stochastic production frontier was described as:

$$\ln y = \alpha_0 + \sum_{i=1}^{n} \beta_i \ln X_{ei} + \varepsilon_1 \quad (8)$$

where:
y = output (kg/ha)
x_1= total cropland owned (ha)
x_2 = seed (kg)
x_3 = organic fertilizer (nitrogen) (kg)
x_4= organic fertilizer (non-nitrogen) (kg)
x_5 = pesticide (li)
x_6 = inorganic fertilizer (kg)
x_7 = family labor
x_8 = hired labor

While the inefficiency function was described as:

$$|D_1| = \alpha_0 + \sum_{i}^{n} b_k \ln Z_{ki} + \varepsilon_1 \quad (9)$$

where: z_1 = share of agriculture share income
z_2 = age of household head
z_3 = household labor supply
z_4 = value of asset
z_5 = education (1=illiteracy)
z_6 = proportion of owned land
z_7 = D2 : dummy variable, 1 = fixed rental, and other = 0
z_8 = D3 : dummy variable, 1 = sharecropping, and other = 0
z_9 = D4 : dummy variable, 1 = mortgage, and other = 0

RESULTS AND DISCUSSION

Land Tenure Arrangements in West Java

In the study area, some landowner-farmers leased out a part of their land either to the landless or to other farmers. Most landless farmers leased farmlands from landowners. The average area for cultivation was higher than land owned. This indicates that land tenure arrangements (fixed rental, sharecropping, and mortgage) provide land access to the landless (Table 1).

Table 1. Average cultivated plots of households under different tenure arrangements

Tenure Arrangements	Villages			
	Telasari	Wanasari	Pabuaran	Mariuk
Cropland owned and farmed by farmers (ha)	0.58 (0.785) n=20	0.45 (0.625) n=19	0.65 (0.426) n=19	0.65 (0.601) n=22
Cropland owned by farmers and leased to tenants (ha)				
Fixed rent	0.30 (0.582) n=12	0.12 (0.412) n=9	0.18 (0.305) n=8	0.10 (0.271) n=10
Sharecropping	0.36 (0.582) n=15	0.28 (0.428) n=15	0.48 (0.685) n=14	0.39 (0.562) n=13
Mortgage	0.076 (0.196) n=5	0.079 (0.158) n=10	0.182 (0.381) n=9	0.164 (0.350) n=7
Cropland owned by farmers and leased out to other farmers (ha)	0.111 (0.244) n=17	0.103 (0.215) n=16	0.134 (0.480) n=18	0.432 (1.00) n=19
Total cropland operated* (ha)	1.204 (0.924)	0.826 (1.645)	1.358 (1.34)	0.870 (1.605)

( ) = standard deviation
n = number of respondents
Total cropland operated*: (cropland owned + cropland leased) - cropland leased-out

Fixed rental involves an advanced cash payment to the landowner. In sharecropping, the tenant provides a share of the harvest to the landowner. In mortgage, the land is awarded to the lender in exchange for a lump sum loan, and the land is returned to the owner upon loan repayment.

Land Tenure Contracts

Sharecropping was the dominant tenure arrangement in all villages of the study area. Under this contract system, the landowner and tenant share the harvest 50:50. In cases where the landowner receives one-half of the harvest, he shares in the cost of the inputs, especially for fertilizers and pesticides.

There were differences among the villages on sharing of inputs under the sharecropping arrangement (Table 2). In Mariuk, all landowners prepared the seed, while in Pabuaran, the landowner and tenant prepared the seed together. In both villages, farmers believed that successful harvests depended on the use of good seed. In all the four villages studied, tenants shouldered the cost of land clearing and transplanting, while the payment of the land tax and village fee was shared equally between landowner and tenant.

Most of the sharecropping contracts were not longer than one year in Telasari, Wanasari and Pabuaran. One-year contracts predominated in Wanasari. Farmers in this village had difficulty renting out the land for longer periods

because tenants go from one place to another. However, two- to five-year contracts were more common in Mariuk, with almost a third of the sharecroppers under contracts of more than five years. Most farmers leasing out their land to relatives had contracts of more than two years, and one farmer, Haji Alim, even had a 25-year contract with a family member.

Direct credit linkages between landowners and tenants were relatively rare in the four the villages, with only 16-30 percent of the landowners providing "soft loans" to tenants. The loan covered the costs of inputs and support for the tenant family's basic needs during the lean period prior to harvesting. In a few cases, soft loans were limited to the purchase of inputs.

The landowner and the share tenant were usually unrelated, with only 20-37 percent of them being relatives. In the interviews, some landowners claimed that their relationship with the tenant did not have an effect on the arrangement, and that they implemented the same terms with relatives and non-relatives alike. A more detailed description of the sharecropping contract between the landowners and tenants is shown in Table 2.

Fixed-rent contracts or *sewa* involve cash payments paid in advance to the landowners. The amount ranged from IDR (Indonesian Rupiah) 2,050,000 to 4,500,000/ha/year in all the villages studied (average exhange rate = USD 1: IDR 9,000). The tenant paid for all inputs, reaped all of the benefits (yield), but also took all the risks of production. In this arrangement, the landowner was not related to the tenant. In Mariuk, a landowner intending to rent out land would inform a mediator, who would try to find a person who wanted to rent it. If the transaction succeeded, the mediator would be paid around 5-10 percent of the transaction cost – which is shouldered by the owner.

In Telasari, aside from money, some farmers paid the rent by giving the owner 1,400-2,000 kilograms of rice paddy/hectare per season of

Table 2. Description of contract under sharecropping arrangement

Description of contract	Villages			
	Telasari	Wanasari	Pabuaran	Mariuk
Input share of tenants (%)				
Seed	100.0	100.0	50.0	50.0
Fertilizer	50.0	50.0	50.0	50.0
Pesticide and herbicide	50.0	50.0	50.0	50.0
Land clearing	100.0	100.0	100.0	100.0
Harvesting	50.0	50.0	50.0	50.0
Other costs (land tax, etc)	50.0	50.0	50.0	50.0
Output share	50.0	50.0	50.0	50.0
Duration of contract				
1 year	59.9	53.3	65.7	0.0
2-5 years	27.4	26.6	12.9	69.2
> 5 years	13.3	20.1	21.4	30.8
Percentage of landowners providing soft loans to tenant	20.0	16.7	21.5	30.7
Percentage of landowners related to tenant	37.1	22.9	20.0	28.6

cultivation. Under the fixed- rental arrangement, the owner is responsible for paying the land tax and village fee. Most owners who rented out their land were part-time farmers or lived outside the village. They chose fixed rent to avoid the risks in rice farming.

Mortgage enables landowners to earn large capital without relinquishing their land assets. The mortgage *(gadai)* of rice fields constitutes an important segment of contract market in all villages. There is a written contract between the landowner and the tenant, which contains a description of the land, the duration of contract, the amount of payment, and a clause about the tenant's right to ownership if the landowner is unable to pay back on the due date. The contract was for a minimum of two years, or four seasons of rice production for which the landowner received cash payments of IDR 35,000,000 to 70,000,000 IDR per hectare. During the period covered by the contract, the mortgagee could use the land for rice production, paid for all inputs, reaped all the benefits, but at the same time, shouldered all production risks. The contracting parties in a mortgage are usually not relatives.

The mortgage contract also involved a mediator between the mortgagor (landowner) and the mortgagee (lender). On average, the arrangement is completed in two weeks to one month. For the mediator's services, the fee is approximately 5-10 percent of the value of the contract.

All income from the land during the mortgage period are accruable to the lender. If, on the agreed upon due date, the landowner does not have enough cash for repayment, the mortgagee could find another person to take over the contract arrangement under the same conditions as the original contract.

In all of the contractual arrangements, especially in sharecropping, landowners have criteria in choosing the tenant. These included attitude, honesty, effort to get best results, and maximization of income from the land. The landowners have some degree of control in the use of inputs especially fertilizers and pesticides (of which they shouldered 50% of the expenditures in all four villages). The landowners, likewise, had joint control with the tenant in all harvesting activities. The final sharing was done after deducting all of the tenant's loans.

Technical Efficiency of Land Tenure

The estimated result for the parameter in the stochastic frontier is presented in Table 3. All the coefficients, with the exception of the location specific dummy variables, were interpreted as the elasticity of output with respect to inputs. The elasticity of output with respect to total area cultivated and seed was negative, with values of –0.00043 and –0.00178. This indicated that most of the farmers used their own seed; while the quality of seed is low, the farmers used more seed, then the land would give low returns. The negative sign for the total area indicated that the rice-farming activities were more efficient in consolidate operated plot.

The elasticity of output, with respect to non-nitrogen fertilizer (organic) and pesticide, was positive, and highly significant with values of 0.15535 and 0.00016 respectively. Because of the long-term use of inorganic nitrogen (urea) on rice fields in Java, lower marginal returns were observed with its continued use. Table 3 shows a positive value (although not significant at 1% level) for organic nitrogen fertilizer. In contrast, a highly significant positive value was found for non-nitrogenous organic fertilizer, indicating that higher levels of return resulted from application of organic phosphate fertilizer.

The contribution of pesticide to the level of

Table 3. Maximum likelihood estimates calculated using the stochastic production frontier

Variable	Parameter Estimate	t-ratio
Intercept	7.22639*	21.2770
Total area	-0.00043*	-6.3851
Seed	-0.00178	-0.0568
Organic fertilizer (Nitrogen)	0.00009	0.1790
Organic fertilizer (Non-nitrogen)	0.15535*	3.4038
Pesticide	0.00016*	2.2311
Inorganic fertilizer	0.01349	0.5327
Family labor	0.00004	0.7070
Hired labor	0.04289	1.889
Location dummies		
Telasari (dummy)	0.00009	1.8817
Wanasari (dummy)	0.02460	1.2931
Pabuaran (dummy)	0.00007	1.5809

* significant at 1 percent level

return was highly significant, but the parameter estimate was relatively lower than the other parameters. This indicated that the farmers' use of pesticides may have been sub-optimal or less than the required amount.

Family and hired labor were positively related to the return, although the relationships were not statistically significant at 1 percent level. Nevertheless, family labor was positively related to the return because most farmers used less family labor; therefore, there is a positive relationship. The positive sign of hired labor can be caused by the farmers' predominant use of contract labor (*borongan*, or payment of a fixed amount for a specific task). On the other hand, in all study areas, the wage workers dominated, worked on most activities more than needed, thus, having negative relationship.

Location in the same agroecological zone is insignificant with respect to the intercept of production frontier. The coefficients on three location dummies were positively and insignificantly different from zero. This finding also supported the hypothesis that no significant variation occurred among the study areas.

Efficiency Effect of Land Tenure Contracts

The factors influencing technical inefficiency are presented in Table 4. Of these factors, only the coefficients of fixed rental and sharecropping were statistically significant (at 1% level) and different from zero (cultivating own land). The coefficient for sharecropping was positive which means that this tenure arrangement was less efficient compared to owner-cultivated plots. On the other hand, the coefficient for fixed rental was negative which means that this tenure arrangement was more efficient than the owner-cultivated plots. Mortgage also had a positive value, although not statistically significant at the same level.

The share of agricultural income was negatively related to technical efficiency, whereas, the increasing of share income from agricultural activities would increase the technical efficiency of the plots. In particular, all land tenure arrangements generated identical outcomes in the output and input used, due to the absence of alternative employment opportunities for the tenant. A minimum subsistence income

Table 4. Maximum likelihood estimates of the parameter of technical inefficiency model

Variable	Parameter Estimate	t-ratio
Intercept	2.99249	1.1040
Agriculture share income	-0.39022	-1.2679
Age of household head	-0.00054	-1.1890
Household labor supply	-0.02103	-1.0686
Asset	0.00081	1.5600
Education of household head(1=illiteracy)	0.07701	1.3516
Proportion of owned land (to total area cultivated)	0.00086	1.5755
Fixed rental	-0.49871*	-2.7482
Sharecropping	0.23543*	2.6083
Mortgage	0.33667	0.1352
Sigma-Square	0.945	2.4907
Gamma	0.82421	10.7259
Log likelihood function	83.180	

*significant at 1 percent level

must be provided to the tenant as a participation constraint. This result was also cited by Shaban (1985), wherein different characteristics can be observed between lands under different tenure arrangements, depending on the presence of opportunities available to the tenants.

The relative degree of restrictions and interaction of labor and input markets can explain the different levels of inefficiency in land tenure systems. Fixed-rent plots had the least restrictions, with respect to the rights of the tenant, and did not involve labor or input sharing (with the owner) since the fixed-rent tenant paid for all inputs and reaped all benefits (or losses) of cropping activities. With the least restrictions on input-output decisions, fixed rent contracts were not associated with significant inefficiency. The renter was the residual claimant to output, and fixed rental tenancy results in resource allocation and technical efficiency that were more efficient than owner-cultivated plots.

Sharecropping, on the other hand, involves the commitment of both contracting parties to share the costs of inputs, and benefits of outputs. The arrangement, however, puts restrictions on the sharecropper. Moreover, the tenant is expected to provide labor input to the landowner, in cases of substantial delays during critical farm operations and sub-optimal use of labor on tenant's fields. Therefore, despite the contribution of the landowner in inputs, the lack of autonomy of tenant in this partnership explains the inefficiency of sharecropping.

Despite its relative inefficiency, however, sharecropping is still a common type of land transaction in West Java. One explanation for this is the growing landlessness in rural areas due to population pressure and limited alternative livelihood opportunities. This might give landowners an undue advantage in negotiating land contracts. Sharecropping might be driven largely by the tenant's inability to pay fixed rent in advance (before planting or harvesting),

given the absence of a credit market. This view is supported by Ananish and Maitra (2000) who used cost-sharing, resource constraint, and outside employment opportunity to evidence that sharecropping was also considered an inefficient form of land tenure in rural India.

Other Variables

Several socioeconomic and resource factors had a significant influence on technical inefficiency.

Age. The negative coefficient of age (although not significant at 1% in this study) indicated that technical efficiency appeared to be higher among older farmers. Age captures farming experience, which might accumulate over time because of learning-by-doing. Thus, an older farmer might become more proficient with his technology as he accumulated relevant knowledge and skills (Feder et al. 1985).

Household assets. Technical efficiency decreased with the increase in assets owned by the household. Clearly, households with more assets are better able to pay for land preparation and other farming activities on time.

Educational level. Compared to heads of households with formal education, illiterate farmers were more inefficient. However, farmers who were at least able to read and write with no formal education were more efficient than those with formal education. The ability to read and write might be sufficient in the context of improving technical efficiency of farming. This result was consistent with the theory of adoption of innovation as education enhanced technology uptake and perhaps the returns to adoption.

Proportion of owned land to total area cultivated. Relatively smaller proportion of owned land (to total area cultivated) reduced inefficiency, as indicated by the positive value of this variable. This might be due to low levels of resources and technology needed for efficient operations. This inverse farm size-farm efficiency relationship is consistent with literature. Unobserved aspects of land quality were lower for households with more land, especially where land redistribution had tried to balance land quality and availability to the households. The relationship might also be due to unmeasured inputs, such as quality of labor and management effort.

CONCLUSION AND RECOMMENDATIONS

Land tenure arrangements in West Java increase landless farmers' access to land through fixed rental, sharecropping, or mortgage. According to statistical analysis, sharecropping and mortgage coefficients are positive, or these tenure systems are less efficient compared to owner-cultivated plots. Fixed-rental arrangement is negative, or, this tenure system is more efficient compared to owner-cultivated plots. Despite its relative inefficiency, however, sharecropping is still commonly practiced in West Java.

This study looked into two main problems: the first was tenant access to the land, and the second were reasons behind the efficiency of different contract choices. The difference in efficiency are lower in cases where there are no alternative employment opportunities for the tenants. Therefore, the improvement of land markets in the rural area faces a paradox, because most of the tenants are part-time farmers and share of agricultural income is low.

Lastly, an important factor to improve land market and efficiency in farm activities are developing regulations that governs access to the land. This study suggests that government should improve the tenants' ability to lease land through fixed rental or other arrangements,

to increase the tenants' technical efficiency. Furthermore, efforts could be made to improve the regulation of the minimum total area requirement for tenant rice farming activities, thereby, allowing the tenant to gain sufficient income from the farm for their family and their activities.

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