Land rental markets in India: efficiency and equity considerations

Shaheen Akter[*], *John Farrington*[**], *Priya Deshingkar*[***], *Pramod Sharma*[****] *and Laxman Rao*[****] [1]

* Research Associate, Overseas Development Institute, London.
** Research Fellow, Overseas Development Institute, London.
*** Research Fellow, Overseas Development association, based in Hyderabad, India.
**** Research Officer, Overseas Development Institute.

Correspondence address:

Shaheen Akter, ODI, 111 Westminster Bridge Road, London SE1 7JD.
Phone: +44(0)1908550650 Mobile: +44(0)7875285176.
(Email: shaheenakter@yahoo.com)

Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

[1] The authors acknowledge the financial support of the UK Department for International Development. The usual disclaimer applies.

Land rental markets in India: efficiency and equity considerations

Abstract

Despite the fact that land rental is restricted to varying degrees in India, the participation in this market is widespread and it is observed to operate relatively efficiently in 12 villages studied in Andhra Pradesh and Madhya Pradesh. The estimated probit models predicted that the rental market transferred land to those with relatively smaller holdings, but greater ability to make productive use of land, more assets to invest, more adults available for labour and fewer off-farm opportunities. Also land is rented out predominantly to younger farmers and to farmers not involved in off-farm jobs. Renting in is predicted to be relatively higher in the villages which are remote and weakly integrated into mainstream infrastructure and institutions. Land rental markets make an important contribution towards land use redistribution in the villages where land rental is high and where land distribution without land rental is relatively more unequal. The study recommends that existing policies restricting land rental should be eased, and investment towards infrastructure development and off-farm employment generating projects expanded.

KEYWORDS: land rental markets, economic efficiency, equity, India
JEL classification: Q12, Q15, Q24, C21

1. Introduction

Land rental market is a critical issue in many developing countries in terms of differential impacts on efficiency and equity. In particular, fear of its efficiency reducing outcomes has led a number of countries including India to impose restrictions on rental markets.

There is wide literature arguing share tenancy causes inefficient resource allocation because the share tenant receives as marginal revenue only a fraction of his marginal product of labour, thus reducing the tenant's incentive to supply labour or other inputs (Otsuka, Chuma and Hayami 1992). The counter argument of the New School is that resource allocation can be equally efficient in both with and without rental arrangements under the costless enforceable efforts to tenants' work by the landlord (Cheung 1969). A more recent set of arguments is that rental markets transfer land to 'poor but efficient' producers due to the presence of household agricultural ability and imperfections in the labour and capital markets (Deininger and Jin 2002)[2]. Households having a limited number of family labour and/or have fewer assets are

[2] There are alternative land tenure contract arrangements. Sharecropping is a rental arrangement in which the crop and costs of inputs are shared. Leasing on the other hand is a rental arrangement for cash. This analysis combines both.

likely to rent out land, given the limited coverage that their labour force can achieve. On the other hand, those having higher assets and having higher numbers of adults tend to rent in, to spread their assets over a larger area.

There is a broad consensus that the main causes of rural poverty lie in low rates of agricultural growth and factor productivity (Fan, Hazell and Thorat 1998). The evidence also suggests that countries with more equal land distribution experience higher rates of economic growth (Deininger and Squire 1996), and that the key to raising productivity in agriculture lies largely in the deregulation of the policy environment together with measures to broaden access to land and complementary inputs (Mearns 1999). More equitable distribution of operational land holdings would create more equitable patterns of demand, which in turn would enhance growth in the rural non-farm sector and remove some of the biases in the credit market arising from the unequal distribution of assets and power.

The government of India and a number of State governments have placed restrictions on land leasing/share cropping transaction to ensure efficient use of land resources. Despite government regulation, these are widely practised transactions. The disparity between regulation and practice merits some investigation if regulatory changes incorporating desired combinations of equity and efficiency are to be designed.

Given that the demand for the most risk-free and the most secure investment in land under limited supply is rising day by day causing a gradual rise in price, the poor often cannot buy land but acquire the right to use it through the rental market.

Based on this background, this paper looks for answers to the following questions.

- First, do land rental markets transfer land to efficient producers?
- Second, are land rental markets conducive to equal distribution?

The paper is organised as follows. Section 2 describes the methodology and data. Section 3 estimates the determinants of land rental participation using probit analysis. Section 4 examines the impact of land rental on equity. Production function analysis is presented in the appendix. The paper concludes at section 5.

2. Methodology and data

Analytical framework

The first question on land transfer to efficient producers is examined by probit models for rental market participation with maintained hypotheses following the

conceptual framework developed by Deininger and Jin (2002). Theoretically, by solving a farm household maximisation problem it is derived that the amount of rented in land is strictly increasing in agricultural production ability and strictly decreasing in their land endowment, which implies that rental markets transfer land to poor but efficient producers. In order to test this hypothesis empirically, a rental market participation model in the reduced form should include agricultural production ability as an independent variable, which is an unobserved variable. Deininger and Jin used deterministic production function analysis to estimate agricultural ability. Instead, farm level technical or economic efficiency to represent agricultural ability can be obtained using many different methods developed over the past half of a century (Coelli, Rao and Battese 1998). This study uses one of the principal methods, the stochastic frontier production function analysis to estimate farm-specific economic efficiency to represent agricultural production ability to use as an independent variable in the rental market participation model.

Thus the following rental market participation model and modified Cobb-Douglas production function model are specified:

$$R_i \text{ (=0 for non participants, =1 for participants)} = a_0 + a_1 A_i + \Sigma a_j Z_{ij} + e_i \quad (1)$$

$$\ln (Y_i) = b_0 + \Sigma b_k \ln (X_{ik}) + \Sigma d_p D_j + v_i - u_i \quad (2)$$

$$A_i = \exp (- u_i) \quad (3)$$

where the subscripts i, j, k and p refer to the i-th farmer, the jth, the kth and the pth parameter or variable respectively (i = 1….n, j = 2…J, k = 1….K, p = 1….P); ln represents the natural logarithm; R is a dummy variable for renting in/out, Y is the vector of output variable, Xs are input variables, A is the agricultural ability/efficiency, Zs are determinant variables of rental market and Ds are village specific/other dummy variables affect production efficiency.

The α_0, α_j, β_0, β_k, and δ_p are unknown parameters to be estimated; the ε_i and v_i are assumed to be independently and identically distributed random errors; the u_i is a vector of non-negative inefficiency effects independently distributed and arise by truncation at zero of the normal distribution $N(\mu_i, \sigma_u^2)$.

The equity question was examined by comparing the distribution of own land available for crop production and actual operated land. The rental market would promote equity if the distribution of the latter variable is more equitable than the former. Actual land operated equals own land available for production plus rented in

land minus rented out land. The inequality was measured by the Gini index to evaluate the impact of rental market participation on equity.

Data and Descriptive analysis

The data used for this analysis are drawn from the Livelihood Options Project of Overseas Development Institute conducted in 2001-2002 in two States of India, Andhra Pradesh (AP) and Madhya Pradesh (MP). The project carried out several rounds of survey and collected household characteristics and asset information using village census comprising 4,647 households in AP and from 1,297 households in MP. Cropping and other detailed data were collected from a sample of 662 farms 360 from AP and 302 from MP. We have used census and sample survey information of 662 farms covered in the sample survey. For equity analysis we have used land utilisation data for all 5944 households.

In the survey heterogeneous regions and villages were chosen purposively from AP and MP. The regions for AP were Telangana, Rayalseema and Coastal Andhra, and for MP were Malwa, Bundelkhand and Mahokoshal (Farrington et al. 2005). From each region two contrasting villages from a particular district were chosen for data collection based on a number of different criteria including proximity to urban areas, roads and markets; social and economic indicators of development; absence of factionalism and extremism; coverage by pro-poor programmes etc. The villages have differential access to rental markets. The participation rate in the census varies from 1 percent in the village Lotya Junarda (LJ) to as high as 52 percent in the village Partala (PT)[3]. In the sample of 662 households the participation rate varies from no participation in the village Piplya Ragho (PR) in MP to 21 percent in Kamalapuram (KA) in AP. Only one large farm in LJ rented out 2 acres of land and a marginal farm rented in 1 acre of land. Rental market is thus virtually absent in two (PR and LJ) of the six villages in MP.

The rate of participation in the rental market is shown in table 1. The participation rate is higher in AP than in MP. The sample mean of operated land greater than own land in both States indicate the presence of absentee owners and/or the presence of some out-village owners. About 23 percent of the landless households acquired land through leasing/sharing in. About 9 percent of the landless households in MP also acquired land through leasing/sharing in.

[3] This includes both renting in and renting out households.

3. Determinants of land rental market

The variables included in the market participation model (1) are described in Box 1. We would expect the likely coefficient of A, Z2, Z3 and Z8 be positive and negative respectively for rented in and rented out models and that of Z1, Z4, Z5, Z7, Z9 be negative and positive respectively for rented in and rented out models, holding other factors constant. In absence of competitive land buying and selling markets, rental markets would transfer land to producers with higher agricultural ability and so the higher the ability the more will be the rented in and less will be the rented out land. Rental market would also transfer land to those with higher levels of asset endowment, labour endowment and experience in farming. The variables Z2, Z3 and Z8 represent these three characteristics respectively. Rental market would transfer land to those with lower levels of land endowment (Z1). We would also expect rental market to transfer land to those with lower off-farm opportunities. The variables Z4, Z7 and Z9 represent the off-farm opportunities. Younger farmers may have more labour endowments than older farmers and therefore we would expect the coefficient of Z5 to be negative for rented in model and positive for rented out model. The coefficients of dummy for female headed household, caste dummies and village dummies are not clearly predictable. Due to gender and caste discrimination, female head, caste categories considered lower socially may have less access to off-farm opportunities and we would expect the sign of the coefficient of the dummy variables to represent them be positive for rented in and negative for rented out[4]. However, female headed households may have lower labour endowments and due to this reason the sign of the coefficient of this variable may be negative for rented in and positive for rented out model. Finally, rental market would likely to transfer land to those with higher diversity of income sources. This is because according to assets-based view on causes of diversification, diversity of income portfolio reflects the amount of diversity in the assets (Davies 1996). Access to more assets would lead to rent in more and rent out less.

The descriptive statistics of the variables are provided in table 2. On an average, households which supply land in the rental market possess higher level of holding, assets and education. Households, which demand land possess more adults

[4] Four broad categories are recognised in the Constitution of India: Scheduled Tribes, Scheduled Castes (including former untouchables), Other Backward Castes, and General Category including priestly and other high castes (Farrington et al. 2005). The base is the general category.

with younger head and have greater access to migration. Farming is the primary occupation of higher proportion of renter heads and they have proportionately less access to off-farm employment.

The rented in and out regressions were estimated by iterative method using probit analysis (SPSS package). The rented in model is better fit than the rented out model shown by the Chi square statistic. We also report Effron's measure of R^2 (Maddala 2001), which shows the explanatory power of the model. This is equivalent to Ordinary Least Squares R^2. The first two columns in tables 3 and 4 report the probit estimates of the models without agricultural ability variable and the last two columns with agricultural ability variable. The sample size differs as because operated land was not observed for all households. The models predicted the sign for most of the variables as expected except for education, migration and diversification index in the rented in model, however they are not significant at the 10 percent level (table 3). In the rented out model all variables exhibit sign as expected (table 4). Thus although not all coefficients turn out to be significant, they are consistent in terms of sign in both models. Land ownership contributes most to any decision to rent out. The contribution of total assets, adult members and age of head of the family is equally important in both rent in and rent out decisions. Off-farm job of the household head appears an important determinant of rental market participation, from both demand and supply sides.

The coefficient of agricultural ability tells us that a 10 percent increase in ability results in a likely increase in the probability of having rented in land by more than 4 percent and a likely decrease in the probability of rented out land by more than 3 percent. The coefficient is significant in both models. The economic efficiency vector estimated by equations (2) and (3) is used as explanatory variable in the rental models. The estimated production function (model 2) is explained in the appendix.

From the econometric point of view, it is important that a measure of agricultural ability should be included in the land market participation models, otherwise the coefficient of the included variables such as land, adults in household, age of farmer are likely to be biased as they are related with agricultural ability/efficiency. This is clearly noticeable when we compare the full sample model with the sub sample model that includes the agricultural ability variable.

Caste dummies are not significant in the rented in model except for backward caste in the full sample. In the rented out model they are all significant in the full

sample but not in the sub sample except for scheduled caste[5]. The large difference between the samples in the rented out model may be due to the low sample size of participants under each caste. The coefficients of the caste variables may be more representative in the full sample model than the sub sample model.

Most of the village dummies significantly determine participation in the rented in market. Rented out market is less dependent on village specific characteristics as indicated by statistical significance as well as the size of the coefficients of village dummies. So it is important to point out probable village specific characteristics, which influence leasing in/sharing in decision. In general participation in rented in market is higher in the villages more remote from townships, except for MD. In the "near township" villages where rented-in participation is lower, village specific landlessness is higher with more livelihood diversity and more unequal distribution of land[6]. This indicates that the lower level of village specific livelihood diversity may be a determinant of leasing in land, the variable diversity index appears insignificant in the rented in model but significant with expected sign in the rented out model. In most cases, in the villages which are weakly integrated into mainstream infrastructure and institution such as KA, PT and MB, rented in participation is higher than the strongly integrated villages in the same region/district. This suggests that, in "near-township" villages the opportunities for landless or near-landless households to earn a livelihood from activities other than farming are strong, and possibly more favourable than farming, whereas the absence of these alternatives in more remote villages makes it imperative for poorer households to rent in if they are to have sufficient land to make a large contribution to their livelihood from farming.

The analysis supports the proposition that rental markets transfer land to those with higher agricultural ability and lower land endowments. The average economic efficiency estimated using stochastic frontier production function analysis was quite high having an average of 92 percent ranging from a minimum of 67 percent to a maximum of 98 percent. The difference in the average efficiency level among tenure groups is very low (Table 5). Statistically, the economic efficiency of the owner/rent

[5] The schedule caste remains in the lower of the Hindu hierarchy including the so-called 'untouchables' who had to do 'unclean' jobs such as skinning carcasses and cleaning out latrines and drains. Although the practice of untouchability was abolished in 1955, discrimination still continues.

[6] There are exceptions. For example, land distribution is more equal in SM (near) than MB (as in table 6).

out farms is significantly lower than the tenant farm. The economic efficiency of the owner farm and rent out farm is statistically the same.

4. Does land leasing/share cropping promote equity?

Comparing the Gini index of the distribution of own land available for crop production and actual operated land, we arrive at the conclusion that land rental contributes to equity.

Land distribution is highly unequal in the villages of both States (AP and MP). The inequality is much higher in KO and GU. Participation was higher in villages such as KO and KA of Coastal Andhra in AP and the villages in MP except PR and LJ. Out of these six villages, the rental market significantly improved the land use distribution in four villages (KO, KA, GG and PT). Thus, land rental markets play an important role towards land use redistribution in the villages where land rental is high and land distribution without land rental is relatively more unequal[7].

Due to off-farm employment opportunities and lack of working capital, 20 percent of the land owners, most of them were marginal farmers, leased out their total land in KO instead of selling in the market. This indicates that rental markets may lead to efficiency enhancing outcomes in non-farm sector. On the other hand, 22 percent of the landless in KO and 26 percent of the landless in KA were leasing in land. Thus, land leasing is providing the opportunity to the landless to use land and to utilise their family resources.

On an average, land distribution is more equal in MP than in the AP villages, livelihood diversity is also higher in MP than in AP. Usually, inequality is higher in villages closer to urban centres, except for Tikamgarh district in MP, where the village SM is near but land distribution is more unequal in the far village MB.

5. Conclusions and implications

Despite the fact that land rental is restricted to varying degrees in India, the participation in this market is widespread. Out of 12 villages in Andhra Pradesh and Madhya Pradesh studied here, 6 had participation rates more than 25 percent in land rental and sharecropping markets. The estimated probit models predicted that the rental market transferred land to those having less land available for use, more ability to use land, more assets to invest, a higher adult workforce and fewer off-farm

[7] About 30% and 32% of the households are participants respectively in KO and KA. The participation rate was 32%, 52%, 26% and 27% in GG, PT, SM and MB respectively. GG and PT are tribal dominated villages.

opportunities. Also the propensity to rent in is associated with younger than average age of household head. This implies that rental market is operating relatively efficiently and so restriction on land leasing may be limiting private investment as well as the scope for consolidation into more efficient operational holdings.

Village specific characteristics greatly influence the decision to participate in the land rental market. Renting in is observed to be relatively higher in the villages which are remote and weakly integrated into mainstream infrastructure and institutions, compared with their "near-township" counterpart in the same region or district. This indicates that the opportunities for landless or near-landless households to earn a livelihood from activities other than farming are strong, and possibly more favourable than farming, whereas the absence of these alternatives in more remote villages makes it imperative for poorer households to rent in if they are to have sufficient land to make a large contribution to their livelihood from farming.

The probability of one head to get an off-farm job decreases the probability of renting land in by more than fifty percent and increases the probability of renting land out by at least 50 percent. Thus investment towards off-farm employment generating projects may correct rental market. There is a possibility that land rental compensates for the lack of other non-farm opportunities. However the evidence suggests the latter are perhaps better options in terms of livelihood earnings for the poor.

Land rental market plays an important role towards land use redistribution in the villages where distribution without land rental is relatively more unequal. Thus land rental contributes to equity. This implies that banning of land leasing is likely to be unjustified on equity considerations.

Economic efficiency estimated by stochastic frontier production function suggests that tenant farms are more efficient than owner-operated farms, on an average, but a further examination of the average total factor productivity (measured by the ratio of the total value of output to total value of the input) showed that the owner farm was more productive than the tenant farm. This result is contradictory. Instead of comparing the averages by tenure group, multivariate analysis on factors determining economic efficiency may give clearer picture of the relationship between tenancy and economic efficiency. This lies outside the immediate scope of this paper, but may provide fertile ground for further study.

References:

Cheung S.N.S. 1969. *The theory of share tenancy*. Chicago, IL: University of Chicago Press.

Coelli T. 1996. *FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation*, Department of Econometrics, University of New England, Armidale, NSW, 33pp.

Coelli T, Rao D.S.P. and Battese G.E. 1998. *An Introduction to Efficiency and Productivity Analysis* Kluwer Academic Publishers, Boston, 289pp.

Davies S. 1996. *Adaptable livelihoods:coping with food insecurity in Malian Sahel*, London, Macmillan.

Deininger K. and Squire L. 1996. Economic growth and inequality: re-examining the links. *World Bank Economic Review* 10: 565-91 pp.

Deininger K. and Jin S. 2002. Land rental markets as an alternative to reallocation: equity and efficiency considerations for the China land tenure system., mimeo. The World Bank, Washington D.C. 44 pp.

Fan S., Hazell P. and Thorat S. 1998. Government Spending, Growth and Poverty: an analysis of interlinkages in rural India. Mimeo, IFPRI

Farrington J., Deshingkar P., Johnson C. and Start D. (ed) 2005. Policy Windows and Livelihood Futures: Prospects for Poverty Reduction in Rural India, Oxford and New Delhi, OUP.

Maddala G.S. 2001. Econometric Methods, Third Edition, John Wiley and Sons, New York, 636 pp.

Mearns R. 1999. Access to land in rural India. *Policy Research Working Paper* 2123. The World Bank, South Asia Region, Rural Development Sector Unit: 56 pp.

Otsuka K., Chuma, H., and Hayami, Y. 1992. Land and labour contracts in agrarian economies: Theories and facts. *Journal of Economic Literature* 30 (Dec.): 1965-2018 pp.

Sadoulet, E., Fukui, S. and de Janvry, A. 1994. Efficient share tenancy contracts under risk: The case of two rice-growing villages in Thailand. *Journal of Development Economics* 45: 225-243 pp.

Box 1. Definitions of variables used for rental market participation model 1.

Variables	Definition
R	Dummy variable for market participation; 1 for participants (rented in/out is yes) and 0 for non-participants (rented in/out is no).
A	Agricultural ability measured by farm-specific economic efficiency estimated using stochastic production function in the modified Cobb-Douglas form. The details are reported in the appendix.
Z1	Land owned in acres (natural log)
Z2	Value of household total assets in Rupees except land (natural log). In this group three different types of assets distinguished: livestock (bullock, cow, buffalo, goat, sheep, pig, poultry, duck), agricultural (tractor, thresher, oil/electric motor, bullock cart, country plough), and non-agricultural (TV, radio, vehicle, phone, cooking gas)
Z3	Number of adults in household (natural log)
Z4	Years of schooling in household (natural log)
Z5	Age of household head (natural log)
Z6	Dummy variable for female headed household: 1 for female head
Z7	Dummy variable for household member has migration experience: 1 for yes
Z8	Dummy variable for primary occupation of head is farming: 1 for yes
Z9	Dummy variable for head has off farm job: 1 for yes
Z10	Dummy variable for scheduled tribe (ST): 1 for ST, 0 otherwise
Z11	Dummy variable for scheduled caste (SC): 1 for SC, 0 otherwise
Z12	Dummy variable for backward caste (BC): 1 for BC, 0 otherwise
Z13-Z21	Village dummies: Z13=1 for VP, Z14=1 for KO, Z15=1 for KA, Z16=1 for GU, Z17=1 for MD, Z18=1 for GG, Z19=1 for PT, Z20=1 for SM, Z21=1 for MB
Z22	Livelihood diversification index measured for 6 classes of activities using inverse Herfindahl-Hirchman diversity index. The value of this index ranges from 1 to number of activities (6 in this case). The higher the value of the index the greater the diversification.

Table 1 Rental market participation in selected villages in AP and MP, India, 2001-2002

	AP(Andhra Pradesh)	MP(Madhya Pradesh)	Total
N (Number of households)	360	302	662
Land own (acre/household)	2.14(0.367)	3.20(0.371)	2.62(0.261)
Land operated (acre/household)	2.27(0.368)	3.24(0.369)	2.72(0.261)
% household landless	38.9	26.4	34.1
% household not operated land	34.7	24.2	32.3
% household leased/shared in	23.0	12.3	20.4
% household leased/shared out	12.5	8.6	10.7
Land leased/shared in (acre/household)	0.41(0.083)	0.19(0.036)	0.31(0.048)
Land leased/shared out (acre/household)	0.27(0.081)	0.18(0.049)	0.23(0.049)

Figures in parentheses are standard errors.
Data source: Survey data, Livelihood Options Project, ODI, 2001-02.

Table 2. Descriptive statistics of the variables used in rental market participation models.

Variables	**All households**		**Rented in**		**Rented out**	
	Mean	**Std**	**Mean**	**Std**	**Mean**	**Std**
Z1 Land own (acres)	2.62	6.74	2.03	3.21	4.74	5.75
Z2 Assets (Rs))	20284	63408	26642	60650	16668	47331
Z3 No of adults	3.40	1.67	3.63	1.61	3.12	1.63
Z4 Household schooling (years)	18.38	17.29	22.75	17.05	21.31	19.97
Z5 Age of head (years)	44.65	13.92	44.18	13.83	48.66	14.50
Z6 Female head	0.07	0.25	0.03	0.18	0.09	0.29
Z7 Member migration	0.32	0.47	0.30	0.46	0.22	0.42
Z8 Primary job of head is farming	0.40	0.49	0.53	0.50	0.45	0.50
Z9 Head in Off-farm job	0.22	0.42	0.12	0.33	0.34	0.48
Z10 Schedule tribe	0.07	0.25	0.08	0.27	0.07	0.26
Z11 Schedule caste	0.18	0.39	0.18	0.39	0.03	0.17
Z12 Backward caste	0.57	0.50	0.51	0.50	0.51	0.50
Z13 Voolapadu (VP)	0.09	0.29	0.10	0.30	0.15	0.36
Z14 Kosuru (KO)	0.12	0.33	0.23	0.42	0.13	0.34
Z15 Kamalapuram (KA)	0.09	0.29	0.27	0.45	0.09	0.29
Z16 Gummadidala (GU)	0.12	0.33	0.08	0.27	0.10	0.31
Z17 Madhwar (MD)	0.06	0.24	0.02	0.14	0.06	0.24
Z18 Ghugra (GG)	0.06	0.24	0.05	0.21	0.01	0.12
Z19 Partala (PT)	0.06	0.24	0.11	0.31	0.09	0.29
Z20 Samarra (SM)	0.12	0.32	0.05	0.21	0.19	0.40
Z21 Mohangar Bhata (MB)	0.06	0.24	0.05	0.21	0.07	0.26
Z22 Diversity index	1.52	0.61	1.59	0.64	1.46	0.56
N	661		147		67	

Data source: Survey data, Livelihood Options Project, ODI, 2001-02.

Table 3. Determinants of renting land in (lease in/ share in)

	Probit estimates (full sample)		Probit estimates (sub-sample with cropping data)	
Variables	**Co-efficient**	**t statistic**	**Co-efficient**	**t statistic**
(Constant)	-1.35	-1.46	-1.48	-1.28
A Agricultural ability			0.41**	2.03
Z1 Land own (ln)	-0.07	-1.28	-0.29***	-4.02
Z2 Assets (ln)	0.08***	3.54	0.07**	2.43
Z3 No of adults (ln)	0.50***	2.76	0.70***	3.20
Z4 Total schooling (ln)	0.01	0.16	0.01	0.17
Z5 Age of head (ln)	-0.62***	-2.58	-0.62**	-2.02
Z6 Female head	-0.28	-0.88	-0.27	-0.66
Z7 Member migration	0.07	0.37	-0.04	-0.21
Z8 Primary job of head is farming	0.40**	2.54	0.10	0.57
Z9 Head in off-farm job	-0.61***	-3.31	-0.53**	-2.11
Z10 Schedule tribe	0.36	1.02	0.52	1.20
Z11 Schedule caste	0.39	1.61	0.25	0.78
Z12 Backward caste	0.34*	1.77	0.06	0.25
Z13 Voolapadu (VP)	1.36***	4.74	1.14***	3.56
Z14 Kosuru (KO)	1.98***	7.00	2.44***	6.63
Z15 Kamalapuram (KA)	2.50***	8.51	2.33***	6.74
Z16 Gummadidala (GU)	1.00***	3.43	0.96***	2.81
Z17 Madhwar (MD)	0.45	1.18	0.10	0.23
Z18 Ghugra (GG)	1.44***	4.07	0.95**	2.02
Z19 Partala (PT)	1.78***	4.73	1.66***	3.76
Z20 Samarra (SM)	0.58*	1.88	0.54	1.62
Z21 Mohangar Bhata (MB)	0.66*	1.90	0.31	0.80
Z22 Diversity index	0.11	0.88	-0.07	-0.52
N	661		429	
Chi Square	705.42		476.40	
R^2	0.28		0.41	

*** significant at 1%; ** significant at 5%; * significant at 10%

Data source: Survey data, Livelihood Options Project, ODI, 2001-02.

Table 5. Economic efficiency by tenure group

Tenure group	N	Average Economic efficiency
1. Owner operator farm	310	0.92
2. Rent out greater than rent in	38	0.91
3. Rent in greater than Rent out	81	0.93
Total farms	429	0.92
1 Vs 2 t-ratio (probability level)		0.74 (.465)
1 Vs 3 t-ratio (probability level)		1.95 (.053)
2 Vs 3 t-ratio (probability level)		1.91 (.059)

Data source: Survey data, Livelihood Options Project, ODI, 2001-02.

Table 4. Determinants of renting land out (lease out/ share out)

	Probit estimates (full sample)		Probit estimates (sub-sample with cropping data)	
Variables	**Co-efficient**	**t statistic**	**Co-efficient**	**t statistic**
(Constant)	-1.80*	-1.56	-1.69	-1.13
A Agricultural ability			-0.32***	-2.72
Z1 Land own (ln)	0.48***	6.61	0.51***	5.01
Z2 Assets (ln)	-0.06***	-2.75	-0.10***	-3.44
Z3 No of adults (ln)	-0.50***	-2.33	-0.59**	-2.23
Z4 Total schooling (ln)	0.02	0.25	0.04	0.43
Z5 Age of head (ln)	0.47*	1.70	0.64*	1.83
Z6 Female head	0.10	0.29	0.43	0.97
Z7 Member migration	0.04	0.19	0.03	0.12
Z8 Primary job is farming	-0.22	-1.12	-0.19	-0.84
Z9 Head in off-farm job	0.58***	2.76	0.88***	3.32
Z10 Schedule tribe	-0.71*	-1.68	-0.12	-0.23
Z11 Schedule caste	-1.05***	-2.72	-1.09**	-2.00
Z12 Other backward caste	-0.67***	-3.13	-0.34	-1.27
Z13 Voolapadu (VP)	0.92***	2.91	1.11***	2.65
Z14 Kosuru (KO)	0.61*	1.76	1.10**	2.30
Z15 Kamalapuram (KA)	0.38	1.09	0.93**	2.13
Z16 Gummadidala (GU)	0.31	0.94	0.78*	1.77
Z17 Madhwar (MD)	0.51	1.32	0.26	0.50
Z18 Ghugra (GG)	-0.21	-0.37	0.21	0.29
Z19 Partala (PT)	0.61	1.44	0.54	0.95
Z20 Samarra (SM)	0.49	1.56	0.57	1.37
Z21 Mohangar Bhata (MB)	1.11***	2.84	1.46***	3.03
Z22 Diversity index	-0.31**	-2.01	-0.37*	-1.92
N	661		429	
Chi Square	679.02		465.39	
R^2	0.18		0.29	

*** significant at 1%; ** significant at 5%; * significant at 10%

Data source: Survey data, Livelihood Options Project, ODI, 2001-02.

Table 6. Gini indices showing land distribution in AP and MP villages.

Villages in AP	**Own land**	**Operated land**	**Villages in MP**	**Own land**	**Operated land**
OP	0.66	0.66	**PR**	0.72	0.72
VP	0.65	0.64	**LJ**	0.54	0.54
KO	0.85	0.80	**GG**	0.67	0.59
KA	0.72	0.65	**PT**	0.56	0.51
GU	0.87	0.88	**SM**	0.54	0.53
MD	0.67	0.67	**MB**	0.66	0.64
Total	0.80	0.79	**Total**	0.66	0.64

Data source: Census Survey data (4,647 households in AP and 1297 in MP)
Livelihood Options Project, ODI, 2001-02.

Appendix

Production function analysis

Methodology and data:

In order to estimate production function (2) and to estimate equation (3) we use a double log model (linear transformation of Cobb-Douglas function) because the coefficients are elasticities and straight forward to interpret. The empirical model includes some dummy variables in addition to output and inputs.

The data used for this analysis comprise 429 farms 215 from Andhra Pradesh (AP) and 214 from Madhya Pradesh (MP). These farms were selected from the 2002 seasonal survey samples discarding those households which had zero or near zero agricultural activities and others for which input-output data were incomplete. The definition of each variable is given in Table A1.

Table A1. Variables included in the production function regression.

y	Aggregate crop production in 000'Rs: the value of output of all crops grown in a particular year. More than 47 crops produced in Kharif, Rabi and Summer seasons were aggregated.
X1	Land input in acres: area under crop and so it includes cropping intensity.
X2	Family labour in person days
X3	Hired labour in person days
X4	Fertilizer in 000'Rs
X5	Other inputs in 000'Rs: mainly include irrigation cost.
X6	Bullock units: proxy to represent animal traction in absence of data. Alternatives were examined, the best was chosen.
X7	Capital asset value in 000'Rs: proxy to represent machinery and other fixed assets such as pump motors, tractor and thresher. Alternatives were examined, the best was chosen.
D1	Dummy variable for commercial crop=1
D2	Dummy variable for tractor/thresher owner=1
D3	Dummy variable for irrigation access to Bore Well/canal = 1
D4	Dummy variable for irrigation access to tank/open well/lift =1
D5	Dummy variable for farmers with lease out greater than lease in land = 1
D6	Dummy variable for farmers with lease in greater than lease out land in tribal villages=1
D7	Dummy variable for farmers with lease out greater than lease in land in tribal villages=1
D8	Dummy variable for farmers with lease in greater than lease out land in tribal villages=1
V1-V7	Village dummies: V1=1 for OP, V2=1 for KO, V3=1 for KA, V4=1 for GU, V5=1 for LJ, V6=1 for SM, V7=1 for GG & PT (Tribal villages Partala and Ghughra). The village VP is taken as base. The dummy variables for the remaining villages were insignificant with very small coefficients. They were deleted from the regression and so in the base.

According to production theory we expect the signs of input variables to be positive. We expect positive coefficients for the dummy variables D1 to D4 as they imply modernity in agriculture. Other dummy variables can be of either sign. As for the rental farms (D5-D8), there is adequate literature on both arguments in favour and against of tenancy causes inefficient resource allocation (Cheung 1969, Otsuka, Chuma and Hayami 1992). Village dummies (V's) pick up village specific factors that are not included in the model and not random. The data are from two distinct states of India, which differ with respect to many socio-economic factors. Cropping is more intensive in AP than in MP but farming may be becoming less productive in AP because of drought conditions. A dummy variable to test the difference in the production function AP and MP was insignificant. Instead, some villages in AP were found statistically equally productive to some villages in MP. Also we observed that some distant villages were statistically equally productive to near villages. A dummy variable to represent far-near classification was not useful. So we have used village specific dummies.

Production function results

Statistical performance of the model is satisfactory with quite high explanatory power and most of the factors are significant. One common problem arises in cross-section data to use for regression analysis is the violation of constant variance property of the ordinary least

squares method (OLS). Both Breusch-Pagan and likelihood ratio test rejected constant variance property of OLS in our data. So, the co-efficients estimated by the Maximum Likelihood (ML) method are more reliable in this case in statistical term and therefore we explain the coefficients estimated by the ML method using the software Frontier 4.1 (Coelli 1996). The use of Frontier 4.1 allows us the estimate stochastic frontier production model to estimate farm-specific economic efficiency parameter to use as an independent variable in our market participation model.

All inputs have positive elasticities. All inputs except a proxy representing animal power are statistically highly significant. The performance of the input variables appears plausible. A dummy for tractor/thresher produced significant (at 10%, not at 5%) negative coefficient. May be owning a tractor do not necessarily mean more hours are used in own land; may be hiring price is higher than its marginal productivity in own operated land and so tractor owners use less hours in own land and produce less. Tenure is not a significant determinant of production technology. Production function for commercial crop growers is significantly above the others as shown coefficient of the dummy variable D1. Commercial crops include sugarcane, mulberry, groundnut and cotton.

Production function analysis identifies OP, KO, KA, GU and LJ are more productive than other villages. The least productive village is SM.

The estimated mean economic efficiency was 92% (median was 93% and standard deviation was 6%).

Table A2: Production function (pooled model for AP and MP)

	OLS estimates		**ML estimates**	
Variables	**Co-efficient**	**t statistic**	**Co-efficient**	**t statistic**
(Constant)	1.963	97.768	2.049	112.168
Land (lnx1)	0.059	8.260	0.066	9.448
Family Labour (lnx2)	0.016	4.576	0.014	4.652
Hired labour(lnx3)	0.015	4.865	0.015	5.354
Fertilizer(lnx4)	0.016	2.468	0.014	2.156
Other inputs (lnx5)	0.029	5.296	0.018	3.381
Cattle unit (lnx6)	0.004	0.631	0.008	1.281
Capital asset value (lnx7)	0.002	1.343	0.002	1.851
D1 (commercial crop=1)	0.033	2.285	0.022	1.677
D2 (tractor/thresher owner=1)	-0.026	-1.238	-0.030	-1.521
D3 (Irrigation access to Bore Well/canal = 1)	0.015	1.300	0.019	1.870
D4 (Irrigation access to tank/open well/lift =1)	0.005	0.362	0.010	0.746
D5 (farmers with lease out>lease in land = 1)	0.006	0.295	0.004	0.267
D6 (farmers with lease out <lease in land = 1)	-0.014	-1.132	-0.025	-2.179
D7 (farmers with lease out > lease in land in tribal villages = 1)	-0.043	-1.101	-0.025	-0.774
D8 (farmers with lease out < lease in land in tribal villages=1)	0.029	1.034	0.027	1.090
V1 (OP = 1)	0.049	2.237	0.062	2.919
V2 (KO = 1)	0.036	1.667	0.038	2.018
V3 (KA = 1)	0.055	2.568	0.058	3.126
V4 (GU = 1)	0.064	3.195	0.096	4.641
V5 (LJ = 1)	0.093	5.350	0.083	5.343
V6 (SM = 1	-0.071	-4.696	-0.063	-4.572
V7 (Tribal villages (GG & PT) = 1)	0.022	1.109	0.008	0.458
Log likelihood function	466.57		483.06	

N = 429, OLS Adjusted R^2 =0.807, F statistic=78.17, Variance(= σ^2)= 0. 013***(8.72) ; $\sigma^2_u / \sigma^2 = \gamma =$ 0.861***(19.00), LR test, χ^2 = 329.72 *** with number of restriction=1

*** Significant at 1 percent level.