Interspatial Total Factor Productivity Analysis of Alternative Land Lease Arrangements in Bundelkhand Region of Uttar Pradesh

Maya Kant Awasthi[*]

The Bundelkhand region of India is a semi-arid plateau, which consists of twelve districts of northern Madhya Pradesh and five districts of southern Uttar Pradesh. It is located between fertile Gangetic plain stretching across northern Uttar Pradesh and the highlands of central Madhya Pradesh. The region suffers from severe ecological degradation induced primarily by the factors such as soil degradation and deforestation. The hilly landscape, high winds and the poor quality of the soils further aggravate the problem of soil erosion and degradation. As a result of this, the region is economically one of the most backward regions of the country. Subsistence rainfed, single crop agriculture and small-scale livestock production is the mainstay of livelihood of majority of the people of this region. In the rural areas, growing demographic pressure has resulted in fragmentation of land holdings and poor productivity of land. Therefore, farmers often rear animals to support their agricultural income. Under cumulative impact of these factors, combined with limited rainfall and absence of substantial industrial activities many farm families are finding it very difficult to meet their subsistence needs. Hence temporary and long-term migration of villagers from the rural areas of the region in search of alternative sources of livelihood has become increasingly common. This situation has created a vast market for the short term land lease market in the region. Those people who are migrating from villages and farmers with uneconomical land holding find it profitable to lease out their land on short term annual land lease contracts. Similarly for farmers who do not possess land but have the human resource and capital or have very small land holding find further acquiring of land very lucrative through annual land lease contract mechanism to bring in economies of scale in their operation. Among the lessee, landless, marginal and small farmers from upper cast Hindu families are prominent groups. These groups of farmers take land on lease because due to prevalence of very rigid social caste system these farmers find it very difficult to work on the fields of other farmers as a casual agricultural worker to support their family income. For these farmers taking land on annual lease is an option, which is socially acceptable and economically feasible.

Review of literature on this topic shows that most of the policy debates related to farm tenancy are centered around the assumption that farmlands held under informal land lease contracts are less productive than the owner cultivated farms and types of

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[*] Assistant Professor, Agriculture Management Centre, Indian Institute of Management, Lucknow – 226 013 (Uttar Pradesh).

land lease arrangement affect the production efficiency. The logic for this belief is that short term land lease contracts discourage long-term investment in land improvements because the individual lessee farmer may not be able to recover his investments on land improvements. Therefore, informal contractual land lease arrangements may fail to promote investments required for maintaining and improving productivity of land. Confirmation of this hypothesis will indicate the need for tenancy reforms to improve production efficiency. From a public policy point of view, better information on the relative efficiency of farm lands under different land lease contracts would provide a better indication of how land lease systems affect resource use and thereby the overall productivity of farming operations. If we can measure the relative production efficiency of alternative land lease contracts then we would be in a position to determine the productivity gains possible through land reforms. If land tenure arrangements are the major sources of productivity differences, then efforts to develop technologies will be secondary to land reform policies. Although the question of relative production efficiency of various land lease contracts is central in any debate and discussion on land reform, there is relatively little rigorous empirical research has been carried out on this topic. The paper therefore, attempts to test the hypothesis that land cultivated under various land lease arrangements achieves different level of production efficiency.

DATA AND METHODOLOGY

Multistage stratified random sampling technique has been used to collect primary data for this study. In the first phase, out of five districts of Bundelkhand region of Uttar Pradesh, Jalaun district has been selected randomly. In the second stage, a sample of 12 villages (Bhadwan, Sahav, Sekhpura, Hadrukh, Hirapur, Patrahi, Jeepura, Madori, Bhadekh, Ata, Saidnagar and Akodi) have been drawn from various regions of the district selected in the first stage. Finally a sample of 10 land lessee farmers have been drawn on simple random basis from each village selected in the earlier stage. A matching sample of owner operated farms was also drawn from each of these selected villages. Primary· and secondary data for the study were collected during April, 2002 to March, 2003.

The Conceptual Framework

Conventionally majority of the productivity studies are based on partial productivity parameters such as yield per hectare or output per person. However, in case of market imperfections, these productivity indicators are often misleading specially in cases when substantial input substitution takes place. These partial productivity indicators fail to reflect the observed productivity differentials. Total factor productivity (TFP) is therefore, a conceptually superior way to estimate productivity - and therefore production efficiency. Total factor productivity can be defined as the ratio of aggregate output to aggregate inputs used. There are two basic approaches to the measurement of total factor productivity. The first approach is a

growth accounting approach, which is based on index numbers, and the second approach is a parametric approach, which is based on an econometric estimation of production, cost and profit functions. For the present study we have used the index number approach for its superiority over parametric approach because this approach is free from problem of degrees of freedom and statistical reliability in working with small samples.

In the present study for total factor productivity analysis, Divisia index approach (Gavian and Ehui, 1999) has been used. Surprisingly despite its soundness there have been relatively very few applications of this approach in farming system analysis. To elaborate this method let us assume that the agricultural process in land held under land lease contract system i at time t can be represented by the production function:

$$Q_{it} = F(X_{it}, T_{it}, D_i) \qquad \qquad \ldots(1)$$

where Q_{it} is the output level, X_{it} is a vector of factor inputs, T_{it} is an index of technology, and D_i is a vector of dummy variables for every tenure system other than the reference base system T_{it} and D_i denote also intertemporal and interspatial efficiency difference indicators. Equation 1 assumes that the production function in each tenure system has common elements as well as differences resulting from the tenure arrangement, which are maintained by the additional argument D.

Constant returns to scale and perfect competition in input and output markets imply that $(\partial \ln F/\partial \ln X_k) = s_k$, where the term s_k represents the cost share for the k-th input. Using these assumptions, we can rewrite equation as

$$\Delta \ln Q = \frac{1}{2}\sum_k \left[s_{kts} + s_{kot} \right] \qquad \left[\ln X_{kis} - \ln X_{kot} \right] + Q_{io} + \mu_{st} \qquad \ldots(2)$$

From Equation 2 the output differential across tenure systems and time periods may be broken down into an input effect, a tenure system effect and an intertemporal effect. And the difference in land productivity can be decomposed into three effects: (i) a factor intensity effect ρ_{io}; (ii) a tenure system effect (θ_{io}), and (iii) an intertemporal effect (μ_{st}).

In the case of multiple outputs, the Tornqvist–Theil quantity index can also be used to aggregate different outputs.

$$\left[\ln\left(\frac{Q}{A}\right)_i - \ln\left(\frac{Q}{A}\right)_o \right] = \frac{1}{2}\sum_j \left[r_{ji} + r_{jo} \right] \qquad \left[\ln\left(\frac{Q_j}{A_i}\right)_i - \ln\left(\frac{Q_j}{A_j}\right)_o \right] \qquad \ldots(3)$$

where r_{ij} and r_{jo} denote the j-th output revenue share in systems i and o, respectively. Q_j denotes the j-th output level.

There are two components that contribute to any observed differences in total factor productivity (TFP). First, in the level of land productivity and second is factor intensities. Increases in TFP arise when land productivity increase proportionally more than increases in factor intensity levels. However, land productivity will increase if a farmer applies more purchased inputs. Unless there are improvements in the use of these inputs this will be explained as a change in factor intensity and not TFP.

RESULTS AND DISCUSSION

Description of Land Contracts in the Survey Region

In the Bundelkhand region of Uttar Pradesh various types of short term land lease arrangements under which farmers gain access to crop lands are prevalent (Table 1). The findings of the study revealed that 50 per cent of the lessees belong to landless and marginal farmers category, whereas, about 40 per cent of the lessees belong to the small and medium farm category. Only 7 per cent large farmers took land on lease. The results of the study also reflect that the poor landless, marginal and small farmers form a major lessee group.

TABLE 1. COMPOSITION AND NATURE OF LAND CONTRACTS
IN BUNDELKHAND REGION OF UTTAR PRADESH

Sl. No.	Lessee category	Per cent in total lessee	Types of land lease category (per cent of total)		
			Cash rented (payment at the time of finalising lease contract)	Cash rented (payment due at the time of harvesting)	On yield sharing Basis
(1)	(2)	(3)	(4)	(5)	(6)
1	Landless	22	9	18	73
2	Marginal	28	13	26	61
3	Small	29	22	16	62
4	Medium	14	27	42	31
5	Large	07	64	21	15
	Overall	100	20	23	57

The analysis of land lease pattern show that the landless and marginal farmers preferred crop yield sharing arrangement whereas the medium and large farmers preferred cash rent lease contract. In case of cash rent system of land lease the tenant pays for all inputs and takes all the benefits and bears all losses of farming. The average cost for renting the land in the study area was Rs. 4,357.00 and Rs. 2,308.00 per acre for irrigated and non-irrigated area respectively. As land lease cash contract payable at the time of harvesting involve risk of crop failure and fairly large waiting period for cash payment, land rent rate on such types of arrangements are typically 13 to 17 per cent higher than the cash rent lease arrangement payable upfront at the time of contract. In case of sharecropped land lease contract both the partners share the costs of the inputs and the benefits of the outputs. Sharecropped land lease system is prevalent in those cases where landowner has trust in the lessee. Usually this system is prevalent when both the parties belong to same caste, band or part of the extended family.

Transforming the Production Data

For the purpose of this analysis, pair-wise comparisons between those lands cultivated by the owner and land being cultivated under an informal farmer-to-farmer arrangement, i.e., rented on spot cash basis, rented on harvesting time payment basis

or sharecropped land lease arrangements have been carried out. To have an adequate number of observations in each land lease category, the analysis has been restricted to three crop categories, wheat, pea and legume plots. These three crop categories together constitute 84 per cent of the gross cropped area. All by-products were also grouped together for the purpose of analysis. For inputs, four broad categories, i.e., human labour, farm energy (bullock and tractor), chemicals (fertiliser and pesticides) and seed have been formed.

Implicit output indices of wheat, pea and legumes were calculated by dividing the total value of all output by the price index obtained by weighing the individual output prices by the revenue share of each crop. A corresponding input quantity index for labour, farm energy, chemicals and seed was computed as the ratio of total expenditures in each input category to the weighted price index of that input. This was computed considering all prices of individual input prices weighed by the cost share of each input.

All the input and output calculations were carried out on per acre basis. For calculation purpose land was included as a numeraire. This method was followed as it allowed the output and input components to be interpreted as land productivity and factor intensity, respectively. The price data used in this study was obtained from a number of primary and secondary sources. Output and seed prices were drawn from a bi-monthly survey of retail prices in Jalaun and Madhogarh "Mandis" which are two major agricultural markets in the area. Based on the observation that most of the farmers market their crops within three months following harvest, the price average for this period was used to represent output prices. The average of the market seed prices during sowing season has been used to obtain the value of seed. Prices for purchased inputs such as fertilisers, pesticides, and hiring rate of tractor power were derived from data collected directly from the respondent farmers.

Productivity Estimates

The findings of the study indicate that statistically there is no significant change in the average crop yield of various crops across the land lease contract systems (Table 2).

TABLE 2. COMPARISONS OF CROP PRODUCTIVITY ON DIFFERENT LAND LEASE
CONTRACT SYSTEMS

Sl. No.	Crop	Yield on owner cultivated land (acre /acre)	Land lease category (Yield quintal per acre)		
			Cash rented (payment at the time of finalising lease contract)	Cash rented (payment due at the time of harvesting)	On yield sharing basis
(1)	(2)	(3)	(4)	(5)	(6)
1.	Wheat	15.60	15.65	15.45	15.59
2.	Black gram	9.82	10.00	9.86	9.79
3.	Peas	10.55	10.62	10.50	10.60
4.	Lentil	7.10	7.03	7.00	7.16
5.	Mustard	6.15	6.17	6.12	6.13

However, the average total productivity levels was observed to be lower for each of the three informal land lease contracts (rented on spot cash basis, rented on harvesting time cash payment basis and sharecropped contract basis) in comparison to owner cultivated land (Table 3).

TABLE 3. COMPARISONS OF TOTAL FACTOR PRODUCTIVITY, LAND PRODUCTIVITY AND FACTOR INTENSITIES.

(1)	On owner cultivated land	Land lease category		
		Cash rented (payment at the time of finalising lease contract)	Cash rented (payment due at the time of harvesting)	On yield sharing basis
	(2)	(3)	(4)	(5)
Total Factor Productivity	1.00	0.92	0.90	0.87
Land productivity	1.00	0.94	0.92	0.93
Wheat	1.00	1.12	1.16	1.09
Peas	1.00	0.96	0.95	0.93
Lentil	1.00	0.94	0.94	0.96
Mustard	1.00	0.86	0.85	0.85
By-products	1.00	1.01	1.01	0.99
Factor Intensity	1.00	1.04	1.06	1.07
Labour	1.00	1.00	0.99	0.99
Farm energy	1.00	1.01	1.00	0.99
Chemicals	1.00	1.05	1.03	1.06
Capital	1.00	1.00	0.99	0.98
Seed	1.00	1.02	1.02	1.02

Land under share cropped leased system has the lowest TFP levels producing 17 per cent less output than the owner cultivated lands using the same mix of various inputs. The cash rented land was found to be 8 to 10 per cent less efficient than the owner cultivated land depending on the types of cash payment method being adopted.

The productivity analysis results suggest that overall land productivity levels for various land lease arrangements are lower than the owner cultivated fields. However, the land productivity gap is relatively less than the gap in TFP levels due to the relatively high levels of factor intensity on informally-contracted fields. The higher level use of labour, farm energy, capital. chemicals and seeds applied to informally-contracted fields increases the level of land productivity but not the level of TFP (Table 4). For example, the factor intensity level on share cropped lease arrangement is 7 per cent higher than the owner cultivated lands but the TFP level is 13 per cent lower.

The results of the study reflect that the differences in input use intensity between the informally-contracted lands and the owner cultivated lands were positive, whereas differences in land productivity were negative. This has yielded a negative change in TFP levels for all lands under informal land lease contracts. Chemical and seeds were the major contributor to higher levels of inputs for all the informal contracts. The presence of relatively high input intensities coupled with low TFP, suggest that the capacity of land under cash rent and share cropped land lease contract is not being affected due to under-investment in variable inputs.

TABLE 4. SOURCES OF TOTAL FACTOR PRODUCTIVITY DIFFERENCES

Sl. No.	Crop	Land lease category		
		Cash rented (payment at the time of finalising lease contract)	Cash rented (payment due at the time of harvesting)	On yield sharing basis
(1)	(2)	(3)	(4)	(5)
1.	Difference in TFP (per cent)	8	10	13
2.	Total factor intensity	-4	-6	-7
3.	Land productivity(Output)	6	8	7
4.	Labour	0	1	1
5.	Farm energy	-1	0	1
6.	Capital	0	1	2
7.	Chemicals	-5	-3	-6
8.	Seed	-2	-2	-2
9.	Difference in TFP as share of difference in land productivity (per cent)	200	166	186
10.	Total factor intensity	150	133	100
11.	Labour	0	16.6	14
12.	Farm energy	25	0	14
13.	Capital	0	16	28.5
14.	Seed	50	33	28.5

CONCLUSIONS

The results of study indicate that though various land lease arrangements have different production efficiency levels, the differences in productivities across land lease arrangements are relatively small. It is not possible to relate lower input use as a consequence of land lease arrangement. However the findings of the study suggest that various land lease contracts are relatively less productive than the owner cultivated land. Decomposition of the factor intensity levels in the study identified chemical and seed inputs as the major source of differences. The study therefore, indicates that land lease pattern does not constrain productivity at the current level of development in Bundelkhand region of Uttar Pradesh.

REFERENCE

Sarah, Gavian and Simeon Ehui (1999), "Measuring the Production Efficiency of Alternative Land. Tenure Contracts in a Mixed Crop-Livestock System in Ethiopia," *Agriculture Economics;* Vol. 20, No.1, pp. 37 – 49.