WP. No. : SAUFE-WP-2015-001

Revisiting the Tenancy-Inefficiency Question with an Inter-temporal Optimisation Framework: Insights from the Agrarian Set-up of Assam Plains in Eastern India

Binoy Goswami
Assistant Professor,
Faculty of Economics, South Asian University
Akbar Bhawan, Chanakyapuri
New Delhi 110021, INDIA
Email: binoygoswami@sau.ac.in

M. P. Bezbaruah
Professor, Department of Economics
Gauhati University
Guwahati 781014, INDIA
Email: bezbaruah.mp@gmail.com

Working Paper Number: SAUFE-WP-2015-001

http://www.sau.int/fe-wp/wp001.pdf

FACULTY OF ECONOMICS
SOUTH ASIAN UNIVERSITY
NEW DELHI
October, 2015

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Binoy Goswami
Assistant Professor, Faculty of Economics
South Asian University
Akbar Bhawan, Chanakyapuri
New Delhi 110021, INDIA
Email: binoygoswami@sau.ac.in

AND

M. P. Bezbaruah
Professor, Department of Economics
Gauhati University
Guwahati 781014, INDIA
Email: bezbaruah.mp@gmail.com

Abstract

Traditionally the tenancy-inefficiency debate is centred on the incentive problem of sharecroppers that induce them to under-supply inputs and effort in cultivation. The fixed rent tenants are supposed to be free from this problem as the rents they pay are in the nature of fixed costs and hence do not enter marginal calculations. The present paper argues that even the fixed rent tenants can have an incentive problem, albeit of the opposite type, if an inter-temporal optimisation framework is adopted. They may be inclined to use production enhancing inputs like chemical fertilisers excessively so as to maximise returns from the land during their tenure, disregarding the implication of their action for long term soil health. For empirical verification of the argument, the authors analyse survey data from Assam Plains, where land holders of all size class actively participate in the land lease market. While the sharecroppers have been expectedly found to use land less intensively than the owner operators, the fixed rent tenants are seen using land much more intensively which can impair soil health in the longer run. Suitable reforms of the prevailing agrarian institutions have been called for to address the incentive problems of both sharecroppers and fixed rent tenants.

Key Words: Tenancy, Sharecropper, Fixed rent tenant, Owner operator, Efficiency/Inefficiency

JEL Classification: Q 15

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Abstract

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1. INTRODUCTION

The background

When agricultural land and labour are not owned equally, tenancy arrangements is expected to bring about a better allocation of these resources across rural households. In practice tenancy contracts take various different forms and the effect of these different forms on agricultural development has been extensively discussed in economic literature. The relation between tenancy contracts and efficiency of land use is an old yet inconclusive issue in the literature on tenancy relation.

The Marshallian school of thought, which started the debate, views sharecropping as inefficient compared to fixed rent tenancy contract (Marshall, 1920). The Marshallian theory considers sharecropping to be less efficient as sharecroppers may lack incentives to supply sufficient efforts in crop production. Since the sharecroppers usually need to share half of their output with the landlords, at the equilibrium they may equate half of the marginal product of their effort to their marginal cost. Thus, the sharecroppers stop supplying efforts at a point when marginal product is still higher than marginal costs and hence at the equilibrium economic surplus is not maximised. On the other hand, fixed rent being a fixed cost, it does not influence the marginal decision of the tenants and consequently the fixed rent tenants are expected to

supply sufficient efforts to maximise the economic surplus. The Marshallian inefficiency argument against sharecropping was, however, challenged by another approach referred to as "monitoring approach" pioneered by Johnson (1950). Johnson asserted that the landlord might be able to enforce the desired intensity of cultivation by applying three techniques: 1) specifying what the tenant must have to do before offering the contract, 2) sharing a part of the cost of production and 3) granting only short-term contract.

These two contesting theoretical propositions have already been empirically verified by many researchers across regions over time. However, like the theoretical debate, the empirical evidence is also not decisive. In the Indian context, while Bell (1977), Bharadwaj and Das (1975), Pant (1983), Dobbs and Foster (1972), Tripathy (1985), Islam and Benerjee (1985), Bhaumik (1993), Shaban (1987), Sharma et al (1995), have found evidence in support of the Marshallian school, the studies by Dwivedi and Rudra (1973), Chattopadhyay and Sarkar (1997), Junakar (1976), Rao (1971), Chattopadhyay and Sengupta (2001), Chakravarty and Rudra (1973) have confirmed the result of the Monitoring school. On the other hand, the studies by Chattopadhyay (1979) and Vyas (1970) could not draw any decisive result.

Richness of the debate notwithstanding, the analytical frameworks therein are usually static. Though a static framework may be adequate for discussing the sharecropper's disincentive for going all the way to maximise the total economic surplus from cultivation, it implicitly assumes the fixed rent tenant to be on the same plank as the owner operator and hence free from any such incentive problem. Adoption of an inter-temporal framework for comparing optimisations by farmers under different tenure status in a dynamic context can show that even the fixed rent tenants may have an incentive problem albeit of the opposite type. A fixed rent tenant farmer, rationally motivated to maximise the return from the land over his/her tenure, may exploit the land too intensively. Thus, while the sharecropper is characterised by under exploitation of land, the fixed rent tenant may over exploit the land, both the outcomes being not optimal.

The Theoretical Framework

Theoretically the argument presented in the preceding para can be captured in the following simple two period optimisation model. The current period is denoted by 0 and the future period is denoted by 1. Leasing is limited to only current period, i.e. the tenant farmer's optimisation horizon is a single period[1]. For simplicity land quality is assumed to be uniform. Current output per hectare Q_0 depends on current input per hectare (input intensity) X_0, Q_0 =

$Q_0(X_0)$; $dQ_0/dX_0 > 0$ and the second derivative may be negative to accommodate diminishing returns.

Future output $Q_1=Q_1(X_1, X_0)$; $\delta Q_1/\delta X_1>0$ but $\delta Q_1/\delta X_0<0$, because higher X_0 may adversely affect soil health and impair future natural soil productivity.

A share cropper maximises $\alpha Q_0(X_0) - C_0(X_0)$ with respect to X_0. α is the share of output the tenant farmer retains and $C_0(X_0)$ is the cost function. For simplicity $C_0(X_0)$ may be assumed to be linear implying a constant marginal cost of inputs per hectare. Optimal solution for the sharecropper is given by

$d[\alpha Q_0(X_0)]/dX_0 - d[C_0(X_0)]/dX_0 = 0$ or $\alpha d[Q_0(X_0)]/dX_0 = d[C_0(X_0)]/dX_0$ …….. (1), where $\alpha d[Q_0(X_0)]/dX_0$ and $d[C_0(X_0)]/dX_0$ are marginal product and marginal cost respectively.

The fixed rent tenant maximises $Q_0(X_0) - C_0(X_0) - F$ with respect to X_0. F is the rent per hectare which is a constant. His/her optimal solution is given by

$d[Q_0(X_0)]/dX_0 - d[C_0(X_0)]/dX_0 - dF/dX_0 = 0$ or $d[Q_0(X_0)]/dX_0 = d[C_0(X_0)]/dX_0$…..... (2), where $d[Q_0(X_0)]/dX_0$ is the marginal product and as mentioned before $d[C_0(X_0)]/dX_0$ is the marginal cost.

The owner operator's optimisation horizon includes both current and future period. The owner operator will receive a stream of income over a period of time. Hence he/she would like to maximise not only the current use value but also the asset value of land. So he/she maximises the sum of present discounted values of output net of cost of the present and the future periods, which is, $[Q_0(X_0) - C_0(X_0)] + [Q_1(X_1,X_0) - C_1(X_1)]/(1+r)$, where r is the rate of discount. The first order condition for maximisation with respect to X_0 gives

$$\{d[Q_0(X_0)]/dX_0 - d[C_0(X_0)]/dX_0\} + 1/(1+r)\,[\delta Q_1(X_1,X_0)/\delta X_0 - \delta C_1(X_1)/\delta X_0]$$

Or $\{d[Q_0(X_0)]/dX_0 - d[C_0(X_0)]/dX_0\} + [\delta Q_1(X_1,X_0)/\delta X_0]/(1+r) = 0$ …… (3)

Where $d[Q_0(X_0)]/dX_0$ and $d[C_0(X_0)]/dX_0$ are marginal product and marginal cost in period 0 and $[\delta Q_1(X_1,X_0)/\delta X_0]/(1+r)$ is the present discounted value of marginal impact of X_0 on future output Q_1. Thus manipulating (3) gives equation (4)

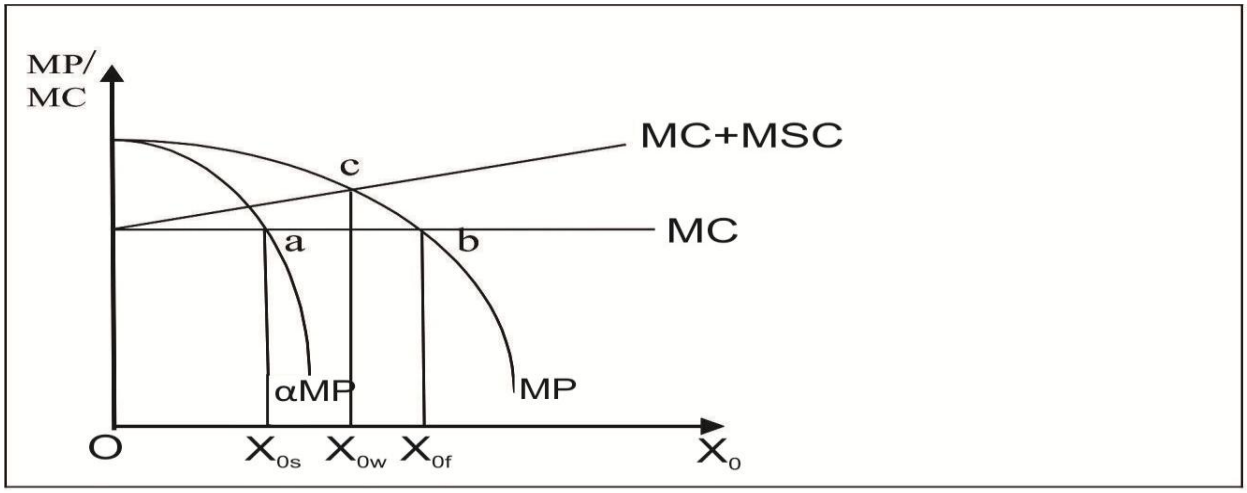
$$d[Q_0(X_0)]/dX_0 = d[C_0(X_0)]/dX_0 - [\delta Q_1(X_1,X_0)/\delta X_0]/(1+r) \text{ ……..... (4)}$$

For reason stated above $\delta Q_1/\delta X_0<0$. Hence the term $[\delta Q_1(X_1, X_0)/ \delta X_0]/(1+r)$ is also negative. The right hand side of (4) is now marginal cost of production in the current period plus the marginal spill over cost of present production in the form of reduction of future output.

From comparison of equations (1), (2) and (3) or (4), it is clear that X_0 chosen by the fixed rent tenant will be the largest. For the share cropper and the owner operator, the values of optimal X_0 will depend on the size of α and the magnitude of $[\delta Q_1(X_1, X_0)/ \delta X_0]/(1+r)$. With plausible values for these two terms, it is arguable that the sharecropper's optimal X_0 will be the least and that of the owner-operator will be somewhere between the share cropper's and the fixed rent tenant's.

The argument is further illustrated in fig 1.

Fig.1: Supply of input (X_0) by sharecroppers, fixed rent tenants and the owner operators at the equilibrium



Note: MP: marginal product, MC: marginal cost, MSC: marginal spill over cost of present production in the form of reduction of future output, αMP: marginal product of sharecroppers, MP: marginal product of fixed rent tenants and owner operators

In figure 1, supply of input (X_0) is represented on the horizontal axis whereas the vertical axis represents marginal product (MP) and marginal cost (MC). The horizontal line represented by MC is the constant marginal cost faced by the sharecroppers and the fixed rent tenants. The marginal cost curve for the owner operators is given by (MC+MSC) which is above the marginal cost curve faced by the sharecroppers and the fixed rent tenants. On the other hand, the curve given by MP is the marginal product curve faced by the owner operators and the fixed rent tenants. Given MC and MP, the fixed rent tenant is at equilibrium at point b where he supplies X_{0f} amount of input. But for a sharecropper, he/she will attain equilibrium at a. Since, he/she retains only a share of his/her marginal product given by α; the MP curve is shifted downward

by the amount of marginal product that he/she sacrifices. Thus αMP, the marginal product curve of the sharecropper intersects the marginal cost curve at point a corresponding to which the sharecropper supplies only X_{0s} amount of input. On the other hand, point c is the equilibrium point for the owner operators at which he/she supplies X_{0w} amount of input. Clearly $X_{0s} < X_{0w} < X_{0f}$.

Thus, in the inter-temporal context, the owner operator's current input intensity is arguably efficient as the choice is made by taking into account not only current output but also the trade-off between current input intensity and future land productivity. In other words, the owner operators while optimizing the returns from land desire to maintain a balance between the use value and the asset value of land. This trade-off does not figure in the fixed rent tenant's optimization. The fixed rent tenant's optimization horizon being only the current period, he/she tries to maximize only the use value of land and the result is the excessive application of inputs as compared to the owner operator. On the other hand, sharecroppers do not even have incentive to supply adequate effort to maximise current production.

Objective, Scope and Organisation of the Paper

Given this theoretical framework, the core research question framed for the empirical investigation is whether share croppers apply too little and fixed rent tenants apply too much input to optimally harness productivity of cultivable land. Besides labour intensity, extent of use of chemical fertiliser, extent of multiple cropping (indicated by cropping intensity) and proportion of area under high yielding varieties (HYV) in total rice acreage have also been included for analysis as indicators of using cultivable land intensively. For empirical verification of the question under consideration, a regression analysis has been adopted in which the above mentioned indicators have been regressed on two forms of tenancy contracts (i.e. sharecropping and fixed rent) besides certain control variables identified from existing literature which may influence the dependent variables.

For operational focus, the study uses data from a primary sample survey of 240 farmers from four locations of Assam Plains which are characterised by preponderance of small and marginal farmers who actively lease in and lease out cultivable land. The issue under consideration assumes importance in the context of Assam for mainly two reasons. First, Assam, the largest state in Northeast India, continues to remain as a predominantly agriculture based economy in terms of both agriculture's contribution to the State Domestic Product and share in employment[2]. Second, agricultural production in the state is largely dominated by paddy; and

tenancy, more specifically sharecropping, is widespread in the organization of the paddy production in the state (Bezbaruah, 1994; Kuri, 2003; Gautam, 1995; Land Reform Unit of the Lal Bahadur Shastri National Academy of Administration, 1994)[3]. While the existing studies have gone into issues related to tenancy in Assam's agriculture, none of these have, however, specifically focused on the issue of relative efficiency/inefficiency (i.e. the issue of optimal extraction of land productivity) of tenancy contracts. The present paper is an attempt to fill this gap in the literature. In view of the evidence regarding widespread incidence of tenancy in Assam, the findings of the study can have significant implications for reconstructing of agrarian relations in the state.

The paper has been organized into five sections. Section 2 elaborates on the materials and methods used in the study. Section 3 presents a profile of the sample highlighting the land holding pattern, tenure status of the sample farmers and the cropping patterns across sample farms with different tenure status. Section 4 presents the results of the empirical analysis. Section 5 summarizes the findings of the study and discusses their policy implications.

2. THE MATERIAS AND THE METHODS

2.1. Sampling Procedure

As mentioned above, the study is based on primary data collected from the plains of Assam during January-June, 2011. Physiologically Assam is comprised of the Brahmaputra Valley, the Barak Valley and the hill region separating the two valleys. While the Brahmaputra Valley and the Barak Valley comprise about 72 percent and 9 percent of the total geographical area of the state respectively, the hills constitute the remaining 19 percent of the area. Both system and institution wise agriculture in the hills stands in a different footing from that in the plains. The traditional practice of shifting cultivation is still widely prevalent in the hills. Besides, though the traditional community ownership of land has been giving way to individual ownership, in the absence of cadastral survey, transition to individual ownership of land has remained incomplete. In contrast, the farming systems and agrarian institutions in the two plains have fair amount of similarity. Hence, the present study is limited to the plains which together constitute 81 percent of the state of Assam.

To make a relatively small sample fairly representative of the geographical scope of the study, a multi-stage sampling design has been followed. In order to represent the agro-climatic variations within the plains, four dispersed districts were selected in the first stage of the sampling. The selected districts are Dibrugarh in Upper Brahmaputra Valley, Morigaon Central

Brahmaputra Valley, Nalbari in Lower Brahmaputra Valley and Cachar in Barak Valley. In the second stage, in consultation with the district agriculture officers of the selected districts and keeping in view the representativeness of the district in terms of cropping pattern and socio-economic background, one development block from each of the districts had been selected. Then, from each block, three villages (thus a total of 12 villages) had been selected at random. Finally, from each selected village 10 percent of households owning and/or operating on agricultural land were selected at random. A total of 240 households thus selected formed the final sample size covered in the survey.

2.2. Line of Analysis

The question that present paper pursues has been answered at two levels. First, the average values of labour intensity and other indicators of production enhancing practices (cropping intensity, proportion of area under HYVs in rice acreage and fertiliser use) of the farmers under different tenure status have been compared graphically. Such an exercise gives an impression about the probable association of nature of tenancy contracts with the concerned variables. In the next stage, a multiple regression analysis has been carried out in order to examine the effects of tenure status on labour intensity and production enhancing practices more rigorously by controlling for interferences of other factors. The details of the regression models framed, their estimation procedures and results obtained thereof have been elaborated in section 4.

3. LANDHOLDING AND TENURE PROFILE OF SAMPLE FARMS

3.1. Patterns of Ownership and Operational Holding

Table 1: Percentage Distribution of Sample Households and Areas under Different Size Classes of Ownership Holding

Ownership Holdings Size (Hectare)	Sample Households (%)	Area in Size Class (%)
Nil	15.0	-
0-1	37.5	15.75
1-2	27.5	32.44
2-3	9.2	16.82
3-4	5.0	13.72
4-5	5.0	17.67
5-6	0.8	3.60
Total	100	100

As shown in Table 1, sample households are found to be concentrated in the size classes of 0-1 (37.5 percent) and 1-2 (27.5 percent) hectare of ownership holdings. **The largest size class of**

ownership holding is 5-6 hectare and only 0.8 percent of households are found to be in this size class. In terms of area, while the largest share (32.44 percent) is still that of the small class of 1-2 hectare of ownership holding, areas in the size classes of 3-4 (13. 72 percent) and 4-5 (17.67 percent) hectare are also not insignificant. On the other hand, **15 percent of households in the sample are landless**. Thus, 65 percent of households (37.5 percent + 27.5 percent) in the size classes of 0-1 and 1-2 hectares own 48.19 percent (15.75 percent + 32.44 percent) of total area and 10 percent (5 percent in each) of sample households in the size classes of 3-4 and 4-5 hectare own 31.39 percent (13.72 percent + 17.67 percent) of sample area. **These findings speak for the existence of inequality in land holding.**

Table 2: Percentage Distribution of Sample Households and Areas under Different Size Classes of Operational Holding

Operational Holdings (in Hectare)	Sample Households (%)	Area in Size Class (%)
Nil	7.90*	-
0-1	35.00	16.59
1-2	35.40	36.27
2-3	15.00	26.78
3-4	3.30	8.64
4-5	2.50	8.48
5-6	.80	3.24
Total	100.00	100.00

Note: *These are pure lessors and hence their operation holding size is zero

In terms of number of operational holding (Table 2), while 35 percent of the sample households are in the size class of 0-1 hectare, 35.40 percent and 15 percent are in the next higher classes of 1-2 and 2-3 hectares respectively. Sample farmers in these three categories account for 16.59 per cent, 36.27 per cent and 26.78 per cent respectively of the area operated by all sample households. **These numbers imply that most of the sample households operate on marginal and small farms[4]. The highest size class of operational holding is 5-6 hectare which contains only 0.80 percent of the entire sample farmers operating on 3.24 per cent of total area.**

3.2. Patterns of Tenancy Contracts

Almost half of the farmers in the sample covering four different agro-climatic zones of Assam are fully or partially tenant farmers and around 1/3rd of the sample area is under lease.

Table 3: Percentage of the Sample Tenant Holdings and Area Lease in by Terms of Lease

Type of Tenancy Contracts		Holdings (%)	Area Leased in
Fixed Rent	In cash	11.5	15.12
	In kind	27.34	23.47
	Total	**38.85**	**38.59**
Sharecropping	Cost Sharing	22.30	24.73
	Without Cost Sharing	27.34	28.34
	Total	**49.64**	**53.07**
Mortgage		**11.51**	**8.35**

Note: i) Figures in the third and fourth columns have been expressed as a percentage of the total tenant holdings and total leased in area respectively.

Sharecropping and fixed rent are the major forms of tenancy contract prevailing in Assam. Between fixed rent and sharecropping, sharecropping is predominant in terms of number of holdings and area under this contract. While 49.64 percent of the tenant farmers are sharecroppers, 38.85 percent tenants have leased in under fixed rent. In terms of area, 53.07 percent of the leased in area is under sharecropping and 38.59 percent is under fixed rent (Table 3). Under sharecropping, the landlord and the tenant in certain cases have cost sharing arrangement where the landlord provides the seed to the tenant which he saves from his share of last year's harvest. However, this component of total costs is very negligible. In so far as the sharing of output is concerned, the sharecropper can retain only half of the produce irrespective of whether costs is shared or not whereas there is some degree of variations in rent when the tenancy contracts are fixed rent. All the tenancy contracts are informal reflecting the fact that concealed tenancy is rampant in Assam. There is little evidence of reverse tenancy. **It has been found that majority of the tenancy contracts are for short duration. 64.8 percent fixed rent contracts have been agreed upon for less than three years. In case of sharecropping, 60.8 percent contracts are for less than 3 years. The lessors do not want to lease out the land to the same tenant for more two years even when the contracts are informal because of a stringent provision in the existing tenancy law. As per the law a tenant may become the occupancy tenant and subsequently the owner of the land if he continues to hold the land for three years[5]. Hence at the end of the second year of lease the existing tenant is replaced by a new one.**

3.3 Tenure Status wise Cropping Pattern

Table 4: Tenure Status Wise Cropping Pattern

Tenure Statuses	Winter Paddy	Summer Paddy	Winter Vegetable	Rape & Mustard	Potato	Jute
Owner Operator	58.35	21.67	9.15	7.72	2.21	0.90
Sharecropping	88.37	9.40	-	1.31	0.48	0.44
Fixed rent	22.12	39.36	21.54	16.20	0.39	0.39
Overall	58.18	22.09	9.37	7.78	1.74	0.84

As shown in Table 4, while the sharecroppers and owner operators grow mainly winter paddy, the fixed rent tenants grow summer paddy, winter vegetables, winter paddy and to some extent rape and mustard also. Summer paddy, winter vegetables, rape and mustard are the fertilizer intensive crops.

4. INTENSITIES OF INPUT AND PRODUCTION ENHANCING PRACTICES ACROSS LAND TENURE STATUS

This section of the paper investigates into the issue of how the tenure status of a farmer impacts his supply of labour and adoption of production enhancing practices. Three production enhancing practices namely cropping intensity, extent of the use of high yielding varieties of rice and fertilise consumption besides labour intensity have been considered. The definitions and measurement of the labour intensity and production enhancing practices have been given in Table 5.

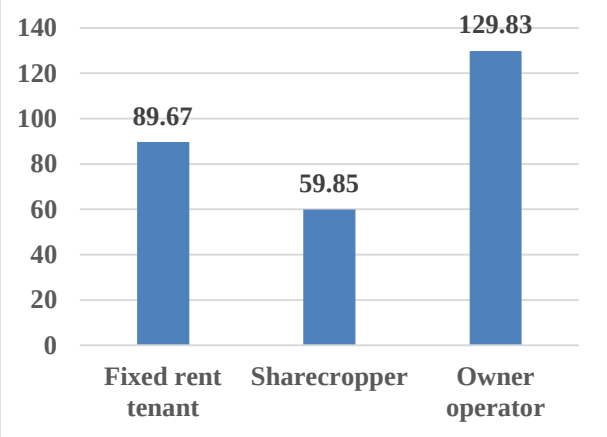
TABLE 5: DEFINITIONS AND MEASUREMENT OF LABOUR INTENSITY AND PRODUCTION ENHANCING PRACTICES

Labour intensity and production enhancing practices	Definitions and measurement
Labour intensity (LI)	Total amount of money spent on labour by a household has been divided by the gross cropped area. Total monetary value of labour = number of man days * wage paid. Total monetary value of labour also includes the imputed value of family labour.
Cropping intensity (CI)	(Gross Cropped Area/Net Sown Area)*100.
Extent of use of high yielding varieties rice (EHYV)	Area under HYV rice as a percentage of total rice acreages
Fertilizer consumption (NPK)	NPK (in Kg) per hectare of gross cropped area

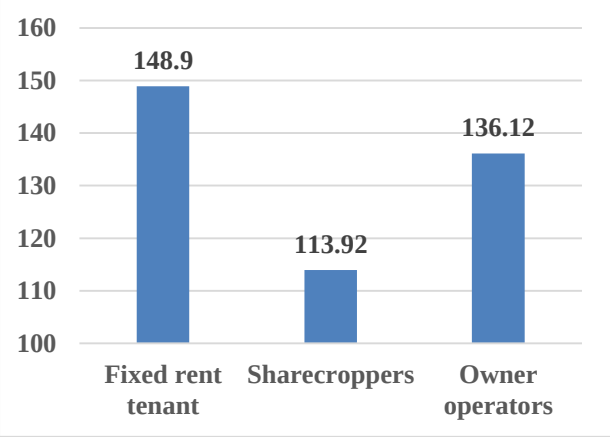
4. 1. Average Levels of LI, CI, EHYV and NPK across Farm Households under different Tenant Status

A comparison of the average values of labour intensity, cropping intensity, extent of use of HYVs rice and NPK across farm households under different tenure status has been made in figures 2.a through 2.d. Since an owner operator should be free from the disincentive to apply inputs adequately and also the perverse incentive of excessively extracting land productivity without caring for longer term soil health, he/she would internalise the conflicting goals of maximizing output in one round of cultivation and conserving long term soil health. Thus the observed factor intensities and extent of use of other production enhancing practices in the owner operated farms can be assumed to be economically optimal. Given this, the labour intensity and extents of use of the other production enhancing practices of share croppers and fixed rent tenants can be compared with those of the owner operators to see if labour intensity and other practices under consideration are used sub-optimally by share cropper and excessively by fixed rent tenants.

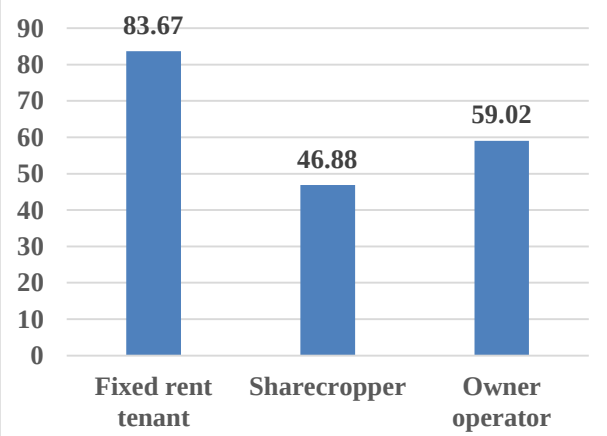
2.a: Expenditure on Labour (in Rupee hundred /hectare) across Sample Farmers by Tenure Status



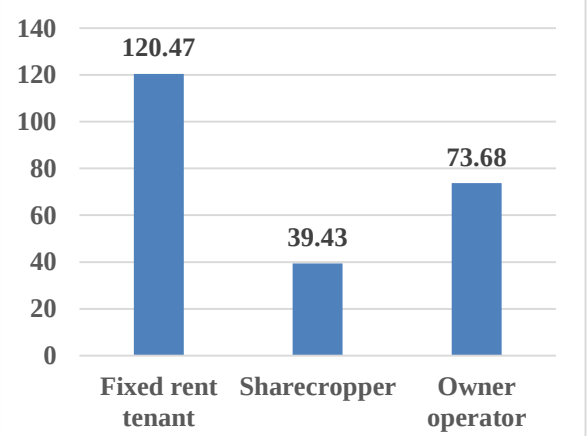
2.b: Cropping Intensity across Sample Farmers by Tenure Status



2.c: Area under HYV Rice as a Percentage of Total Rice Acreages across Sample Farmers by Tenure Status



2.d: Application of NPK (kg/hectare) across Sample Farmers by Tenure Status



It is clear from figures 2.a through 2.d that the share croppers, as would be predicted by Marshallian inefficiency argument, use labour and production increasing input and practices the least intensively. However what is striking is that fixed rent tenants apply relatively more chemical fertilisers, devote larger share of rice acreage to growing HYVs and have cropping intensity larger than even the owner operators[6]. Only in case of labour intensity, the value for the owner operators is the highest.

That the fixed rent tenants are inclined to exploit land productivity excessively without consideration for soil health is further borne out by the numbers in Table 6. The table presents a comparison of the recommended level with the actual level of NPK applied by the owner operators and the fixed rent tenants in case of two most fertiliser intensive crops namely summer paddy and cabbage[7]. The table show that both the categories of farmers apply NPK at higher rates than the recommended dose. But while the applications by the owner operators exceed the recommended doses only marginally, the applications by fixed rent tenants are grossly excessive[8].

Table 6: Comparison of recommended level of NPK with the actual level applied by owner operators and fixed rent tenants[9]

Ingredients of fertiliser	Summer Paddy (Kg /hectare)			Cabbage (Kg /hectare)		
	Recommended	Owner operator	Fixed rent tenant	Recommended	Owner operator	Fixed rent tenant
N	40	55	98	120	107	216
P	20	28	32	60	101	105
K	20	9	10	60	46	54
NPK	80	93	140	240	254	374

Notes: i) the source for recommended level of NPK is Assam Agricultural University and Department of Agriculture, Government of Assam, 2009; ii) the source for owner operator and fixed rent tenant is field survey data

While the graphical representations in figures 2.a through 2.d, and the numbers in table 6 are very instructive, they may not be conclusive enough to firmly establish our hypothesis. To be able to draw inference more rigorously, it is necessary to examine the relation of labour intensity, cropping intensity, extent of use of high yielding varieties and fertiliser use with the nature of tenancy contracts while controlling for other factors that are also expected to influence the intensities of labour use and the production enhancing practices. This is sought to be achieved through multiple regression analysis, details of which are laid out in the next sub-section.

4. 2. The Framework for Econometric Analysis

In the regression analysis, labour intensity and the three production enhancing practices are the dependent variables. The independent variables include two different forms of tenancy contracts such as i) POHSC: Proportion of Operational Holding under Sharecropping and ii) POHFR: Proportion of Operational Holding under Fixed Rent[10].

Table 7 shows the notations and the definitions of the control variables included in the regression models. The control variables which are expected to influence the dependent variables have been identified from the existing literature.

TABLE 7: CONTROL VARIABLES INCLUDED IN THE REGRESSION MODELS

Control Variables	Definitions	Expected signs of the control variables in different regression equations			
		LI	CI	EHYV	NPK
Farm Size (FS)[11]	size of operational holding in hectares		+	+/-	+/-
Family Labour (FL)	Imputed value of family labour per hectare of operational holding	+	+		
Extent of Irrigation (IR)	proportion of irrigated area in the operational holding	+	+	+	+
Area under High Yielding Varieties (PHYV)	percentage of area under HYV rice as a percentage of total rice acreage		+/-		
Area under Fertilizer Intensive Crops (AFIC)	Proportion of Operational Holding under Fertilizer Intensive Crops	+			+
Access to Extension (EXT)	D = 1 if the i-th farmer has received any direct benefits from the government's extension service network; D = 0, otherwise.		+	+	+/-
Access to Finance (FIN)	D = 1, if the i-th farmer has access to institutional credit and otherwise D= 0.		+	+	+
Location Characteristics[12] (LC)	L_1 = 1 for Morigaon, 0 otherwise; L_2 = 1 for Nalbari, 0 otherwise; and L_3 = 1 for Cachar, 0 otherwise. Dibrugarh is the reference category	+/-	+/-	+/-	+/-

Specification of the functional forms of the regression models

a) Labour Intensity

Since the dependent variable LI can take only positive values, the exponential specification is considered to be more appropriate than the simple linear formulation[13]. The exponential formulation which is non-linear in nature has been made linear by taking logarithm in both sides for the ease of estimation. Thus the final form of the model to be estimated is:

$$\text{Ln } LI_i = \beta_0 + \beta_1 POHSC_i + \beta_2 POHFR_i + \beta_3 FL_i + \beta_4 IR_i + \beta_5 AFIC_i + \beta_6 L_{1i} + \beta_7 L_{2i} + \beta_8 L_{3i} + U_i \ldots\ldots\ldots\ldots (1)$$

U_i is the usual random disturbance term.

b) Cropping Intensity (CI)

The value of the dependent variable is bounded at the lower end by the value 100 and it has been observed that there is a cluster of 98 observations at 100 in the data set. In such a situation, a linear regression is not appropriate; rather a left censored Tobit model is more appropriate.

The Tobit model is formulated with the help of latent variable CI^*_i in the following manner.

$$CI^*_i = \beta_0 + \beta_1 POHSC_i + \beta_2 POHFR_i + \beta_3 FS_i + \beta_4 FL_i + \beta_5 IR_i + \beta_6 PHYV_i + \beta_7 EXT_i + \beta_8 FIN_i + \beta_9 L_{1i} + \beta_{10} L_{2i} + \beta_{11} L_{3i} + U_i \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Where, U_i are the random disturbances.

The observed dependent variable CI_i is linked to the latent variable CI^*_i as per the following formulation:

$$CI_i = 100 \text{ for } CI^*_i < 100$$

$$= CI^*_i \text{ for } CI^*_i \geq 100$$

c) Extent of Use of High Yielding Varieties (EHYV)

The value of the dependent variable, i.e. EHYV, is bounded between 0 and 100 which makes a linear regression model inappropriate. Again, clusters of observations could be observed at both the ends (44 observations at the lower end and 82 observations at the upper end) in which the dependent variable takes the values 0 and 100 respectively. Hence, a both side censored Tobit model has been formulated.

The Tobit model is formulated with the help of latent variable $EHYV^*_i$ in the following manner.

$$EHYV^*_i = \beta_0 + \beta_1 POHSC_i + \beta_2 POHFR_i + \beta_3 FS_i + \beta_4 IR_i + \beta_5 EXT_i + \beta_6 FIN_i + \beta_7 L_{1i} + \beta_8 L_{2i} + \beta_9 L_{3i} + U_i \quad \ldots\ldots\ldots\ldots (3)$$

Where, U_i are the random disturbances.

The observed dependent variable $EHYV_i$ is linked to the latent variable $EHYV^*_i$ as per the following formulation:

$$EHYV_i = 0 \text{ for } EHYV^*_i < 0$$

$$= EHYV^*_i \text{ for } 0 \leq EHYV^*_i \leq 100$$

$$= 100 \text{ for } EHYV^*_i > 100$$

d) Fertilizer Consumption (NPK)

The value of the dependent variable as expressed in terms of NPK per hectare is either 0 or any value greater than 0. For the farmers who do not apply chemical fertilizers at all, the value of the dependent variable is 0. This implies that the lower end of the value of the dependent variable is 0 with no limit for the upper end. In the data set, there are 43 farmers for whom the value of the dependent variable is 0. Thus, there is a cluster of observations at 0. Since in such a situation a linear regression is not appropriate, a left censored Tobit model has been formulated.

The Tobit model is formulated with the help of the latent variable NPK^*_i which may take any probable value but is not always observable. Thus, in the context of the regression model, NPK^*_i have been formulated in the following manner.

$$NPK^*_i = \beta_0 + \beta_1 POHSC_i + \beta_2 POHFR_i + \beta_3 FS_i + \beta_4 IR_i + \beta_5 AFIC_i + \beta_6 EXT_i + \beta_7 FIN_i + \beta_8 L_{1i} + \beta_9 L_{2i} + \beta_{10} L_{3i} + U_i \quad \text{..……. (4)}$$

Where, U_i are the random disturbances.

The observed dependent variable NPK_i is linked to the latent variable NPK^*_i as per the following formulation:

$$NPK_i = 0 \text{ for } NPK_i < 0$$

$$= NPK^*_i \text{ for } NPK^*_i \geq 0$$

4.3 Results and Discussion

Since the data used in the present exercise come from a cross–section sample, before estimating the model, the Breusch-Pagan test has been applied to check for the presence of heteroskedasticity in the data. If the test showed the presence of heteroskedasticity, subsequently the problem has been corrected by estimating heteroskedasticity consistent robust standard

errors (Gujarati, 2004). This exercise has been repeated in case of all the regression models included in the paper.

TABLE 7: RESULTS OF THE REGRESSION ANALYSIS

Type of Regression	**Semi - log Linear**	**Left Censored Tobit**	**Both sides Censored Tobit**	**Left Censored Tobit**
Dependent Variables →	**Labour Intensity**	**Cropping Intensity**	**Proportion of HYV in Rice Acreage**	**NPK per hectare**
Test of → Heteroskedasticity	BP test $Chi^2[11] = 1.10$ Prob. = 0.294	BP test $Chi^2[11] = 27.77$ Prob. = 0.002	BP test Chi^2 [9] = 26.49 Prob. = 0.002	BP test Chi^2 [10] = 78.04 Prob. = 0.000
Variables	Estimates of coefficients/values			
%OH under SC	-0.001* {0.0008}	- 0.002* (0.001)	-0.014 (0.119)	– 0.002 (0.002)
%OH under FR	-0.001 {0.001}	-0.002 (0.002)	.38** (0.174)	0.006** (0.003)
Farm Size	-	-0.012 (0.049)	0.066 (4.216)	0.224*** (0.05)
Family Labour	0.0001*** {0.00001}	0.007 (0.035)	-	-
Extent of Irrigation	0.005*** {0.0008}	0.005*** (0.001)	0. 318** (0.15)	0.005*** (0.002)
Area under High Yielding Varieties	0.001 {0.001}	-0 .002 (0.002)	-	
Area under Fertilizer Intensive Crops	-	-	-	0.012*** (0.002)
Access to Extension	-	-0.215 (0.233)	61.37** (24.72)	–0.105 (0.288)
Access to Finance	-	0.134 (0.105)	21.5* (12.36)	0.234* (0.134)
L_1	0.203** {0.093}	0.543*** (0.158)	113.30*** (16.96)	-0.252 (0.273)
L_2	-0.108 {0.093}	0.424** (0.165)	115.82*** (13.91)	-0.363 (0.245)
L_3	0.246*** {0.077}	0.642*** (0.132)	65.08*** (12.25)	0.448** (0.186)
Constant	8.57*** {0.077}	0.667*** (0.185)	-27.34** (12.95)	-0.649*** (0.161)
R^2/Pseudo R^2	0.4342	0.1917	0.1316	0.1948
F	20.05*** [8, 209]	9.00*** [11, 209]	14.25*** [9, 206]	11.49*** [10, 208]

Figures within { }, ( ) and [ ] are standard error, heteroskedasticity consistent robust standard error and degrees of freedom respectively. ***, ** and * indicate significant at 1, 5 and 10 percent respectively.

The results of regression analysis presented in table 7 show that sharecropping has negative and significant impact on labour intensity and cropping intensity. The result confirms that the sharecroppers supply relatively less labour and cultivate the land less intensively. On the other hand, the fixed rent tenants devote a comparatively higher proportion of rice acreage to high yielding varieties and use more chemical fertilisers. In fact the fixed rent tenants apply

substantially higher amount of chemical fertilisers than even the owner operators as is evident from figure 2.d and Table 6. Thus the results of regression analysis confirm our theoretical proposition presented in section 1. While the sharecroppers don't have incentive to supply adequate effort and lag behind in adopting production enhancing practices, fixed rent tenants on the other hand, suffer from the perverse incentive of utilising the land more intensively than even the owner operators by applying liberal doses of chemical fertiliser.

Among the control variables, family labour and extent of irrigation have positive and significant impact on labour intensity. In fact extent of irrigation has positive and significant impact on all the three production enhancing practices considered in the paper. Results of regression analysis reveals that access to extension services induce the farmers to adopt HYVs of rice. Further, access to credit has positive and significant impact on adoption of HYVs of rice and application of fertilisers, the reason for which is obvious. Among the locational dummies, the dummy for Morigaon is significant with a positive sign in the regression equations for labour intensity, cropping intensity and extent of use of HYVs of rice. On the other hand, the dummy for Nalbari is significant with a positive sign in the regression equations for cropping intensity and extent of use of HYVs of rice whereas the dummy for Cachar is significant bearing a positive sign in all the four regression equations.

5. CONCLUSION WITH THE IMPLICATIONS FOR POLICY

The present study investigates if labour intensity and other practices under consideration are used sub-optimally by share croppers and excessively by fixed rent tenants. As hypothesized, the sharecroppers have been found to have undersupplied labour. In terms of the production enhancing practices, it has been found that sharecropping has negative and significant impact on cropping intensity. On the other hand, it has been found that, the fixed rent tenants have the tendency to devote larger part of their rice acreages to growing HYV and also to use relatively more chemical fertilizers.

Thus the findings of the study imply that while the sharecroppers lack the incentive to supply adequate labour efforts and to adopt production enhancing practices, the fixed rent tenants have the perverse incentive for using chemical fertiliser excessively which may have adverse implication for long term health of the soil. Both these practices are equally undesirable. Given the fact that either type of tenancy contracts do not create suitable conditions for optimal extraction of land productivity, one may therefore tend to suggest that tenancy should be prohibited or at least regulated. However one has to understand that tenancy contracts are the pragmatic outcome of mismatch in the endowments of land and labour across rural households (Ray, 1998). Hence it may not be desirable to abolish tenancy. The practical alternative is to

suitably modify agrarian institution so that the inclination of both categories of tenant farmers to use land in improper combinations with other factors is corrected.

The problems of sharecroppers not optimally utilizing land productivity and the tendency among the fixed rent tenants to apply liberal doses of chemical fertilizers can be traced to a stringent provision in the existing tenancy law. The prevailing tenancy law has the provision of a tenant becoming an occupancy tenant and subsequently the owner of the land if he/she holds the land continuously for three years. The lessors in fear of losing the ownership rights therefore do not want the tenancy contracts to be recorded and to lease out land for a long period. Tenancy contracts being oral, the sharecroppers cannot realise the benefit of the tenancy law and continue to pay half of the produce. Higher rent paid by the sharecroppers reduces their incentive to supply adequate efforts and to adopt production enhancing practices. The fixed rent tenants on the other hand, knowing that the lease is going to be for a short period, have the perverse incentive of over exploiting land by excessive use of various production enhancing inputs and practices during their tenure.

Since the root of undersupply of inputs by the sharecroppers and excessive use of inputs like chemical fertilisers by the fixed rent tenants lie in the informal and short-duration lease contract arising from the stringent provision in the tenancy act, it is high time to have a fresh look into the tenancy law. In this context, the present paper intends to suggest that leasing in and out should be made hassle free by removing this stringent provision in the tenancy law. Scrapping off this provision from the prevailing law will allow the lessors to lease out land for a long period without the fear of losing the ownership right[14]. In that case, the lessors may not resist recording the tenancy contracts. Recording of tenancy contracts would allow the sharecroppers to protect themselves from paying higher rents which will ultimately improve their incentive for optimal extraction of land productivity. On the other hand, if land can be leased in for a long period of time, the fixed rent tenants may have the incentives to make investment for the development of the land and also to apply inputs like chemical fertilizers judiciously. Since the land will be under the possession of the tenant for a long period, he/she will in all probability balance the use value against the asset value of land.

NOTES

1 Land may in practice be available for more than one period under lease. In the context of the present study, though more than 60 percent of the tenancy contracts are for short duration, most of them are however for more than one year. This however does not make our assumption of leasing being limited to only one period invalid since the incentive problem that the tenant farmer suffers from will arise in the last period of the contract. In fact, if the duration of the tenancy contract is short, the incentive problem may be present from the first period of the contract. Besides, as has been discussed in section 3.2, since

at the end of the second year of lease the existing tenant is replaced by a new one instead of the resumption of land for self - cultivation by the owner, the problem persists.

[2]Agriculture contributes 24.44 percent of the GSDP of Assam in 2009-10 and more than half of the workforce in the state is engaged in agriculture (Government of Assam, 2012).

[3] More than 75 percent of the gross cropped area is under paddy (Goswami, 2012)

[4] Farmers with operational holding less than one hectare are marginal farmers and those who cultivate 1-2 hectares are considered as small farmers.

[5]An occupancy tenant is the one who holds land continuously for three years and has a permanent heritable and transferable right of use and occupancy in the land.

[6]Though higher than that of the owner operators, the apparent observation from the figure for cropping intensity of the fixed rent tenants is that there is still scope for improvement. However, while interpreting the cropping intensity of the fixed rent tenants, one should keep the fact in mind that the crops that the fixed rent tenants grow are basically rabi crops and hence can be cultivated only in one half of the year. Those of the tenants who grow either of the following combinations of crops, viz., winter vegetable and rape and mustard or summer paddy and rape and mustard, can only cultivate at least some part of the land more than once even during one half of the year since rape and mustard in particular is a short duration crop. Thus, a cropping intensity of 148.9 may still be sufficiently higher as far as the fixed rent tenants are concerned. The explanation of as to why the fixed rent tenants grow only these crops is provided in Goswami and Bezbaruah (2013). Since, the fixed rent tenants grow the crops basically for commercial purpose, they choose those crops which can be grown during that half of the year when the weather risk is minimum. The fact that these crops involve little weather risk induces the farmers to apply costly inputs like HYV seeds (It is therefore not surpassing that these tenants devote a very high proportion of rice acreages to HYVs), irrigation, chemical fertilizers and pesticides which results in higher production and yield and fetches higher return.

[7]In the present context, the recommended level of NPK refers to the minimum dose of NPK that maximizes the return/yield in a round of cultivation. However, it is not necessary that the recommended level of NPK is also the optimal level for soil health. Nevertheless, it is instructive to compare the recommended level with the actual level of NPK for inferring the fertiliser utilisation pattern of the farmers and understanding its implications for soil health. A very high level of NPK as compared to the recommended level is very likely to have adverse implication for soil health.

[8] It can also be observed from Table 6 that neither owner operators nor the fixed rent tenants apply NPK in the recommended proportion. The application of NPK in an imbalanced proportion may be a fall out of the price distortions that stems from subsidy given to the farmers especially for urea.

[9]The overall application of NPK as shown in figure 2.d (for all crops together) is lower as compared to the use of NPK in summer paddy and cabbage as the other crops that the farmers grow are not very fertiliser intensive crops. For example, chemical fertiliser is rarely used in the cultivation of winter paddy to which the farmers devote a substantial portion of cropped area.

[10]Operational holdings of farm households are divided into three parts not necessarily all parts occurring in each observation. These are the part under sharecropping, the part under fixed rent tenancy and the part owner operated. In the regression analysis it is neither possible nor necessary to include these three parts as separate independent variables. If all the three parts are included, they add up to 100 percent in each observation resulting in perfect multi-collinearity situation. In view of the focus of the paper, the two independent variables included are percentage of operational holding under sharecropping and

percentage of operational holding under fixed rent tenancy. Indeed given other control variables the effect on the dependent variable of owner operated part of the operational holding is captured by the constant term in the respective regression equations.

[11] Available literature suggests that the impact of farm size on the supply of labour or more specifically the labour intensity of farm households gets materialised through the channel of family labour (Sen, 1962). Hence, farm size as an explanatory variable has not been incorporated in the regression of labour intensity; instead availability of family labour has been incorporated as an explanatory variable in order to capture the more direct association of labour intensity with family labour. On the other hand, farm size exerts its impact on the production enhancing practices considered in the paper directly rather than it getting manifested indirectly through other channels. For example, small farms are expected to cultivate their land more intensively and hence to have higher level of cropping intensity.

[12] Each of the four broad locations of field study belongs to different agro-climatic zones. These locations vary in terms of cropping pattern depending on the agro-climatic conditions which may ultimately have impact on the choice of input intensity by the farmers and adoption of production enhancing practices. Hence, three locational dummies have been incorporated in the regression model so as to control for the impact of agro-climatic variation

[13]The predicted values of the dependent variable from the linear regression model fall within the range of $-\infty$ to ∞. In the present context, since the dependent variable takes only positive value, a linear regression is therefore not the appropriate tool.

[14]Given the characteristics of the lessors in which the prevailing tenancy legislation was formulated, the provisions of the law might have been justified. But the characteristics of the lessors of the present time have changed and they are also small and marginal or at best medium land holders. In the sample of farmers considered for the paper, there is not a single lessor who owns more than 6 hectares of farm land. Hence, protecting the interests of the lessors is as important as safeguarding the interests of the lessees. Taking away land from the lessors to transfer it to the lessees will merely create another class of landless people (Goswami and Bezbaruah, 2013).

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