# Is Sharecropping associated with lower yields?

Naman Garg[1], Nakul R Heroor[1], Monika Yadav[2]

## Abstract

*We conducted a survey of farming households in West-Champaran district of Bihar, to check for difference in the input and output intensities across owned and leased-in plots. No significant difference is found. We show that this absence of Marshallian distortion can arise if farmers operate at a level of zero, or suddenly falling marginal product. This can happen if there is excess supply in the labour market or the production function exhibits sudden drop in the marginal product. Social norms might also be at play by violating the 'infinite supervision costs' assumption of Marshallian framework. This absence of Marshallian inefficiency suggests that the tenancy reforms increase productivity, mainly through indirect general equilibrium effects rather than any direct increase in efficiency on tenant farms. However our sample size is small and this aspect needs further investigation with better data.*

# 1. Introduction

The agriculture sector of Bihar exhibits poor performance even though rainfall is abundant and the land is mostly fertile. While the high productivity of states like Punjab and Haryana can be attributed to green revolution, the productivity gap with states such as West Bengal needs an explanation. A major rise in productivity of West Bengal happened due to the Operation Barga[3], which brought in tenancy reforms by ensuring security of tenure for the tenants engaged in sharecropping. While some of this increase can be attributed to other programs, the literature suggests that Operation Barga reforms explain a major part of this productivity increase.[4]

While estimates vary, it is believed that approximately 35% of land in Bihar is under sharecropping (Bandyopadhyay, 2009). Thus the lack of tenancy reforms in Bihar is a plausible explanation for low productivity on Bihar. The Bihar land reforms commission (2008) asserts that "there is a structural bottleneck in Bihar agriculture due to very queer pattern of land ownership and very extortionate system of tenancy-at-will which are causing great impediment to accelerated rate of agricultural growth" and recommends tenancy reforms ensuring security of tenure. Thus the role of sharecropping in low agricultural productivity of Bihar needs

[1] M.A (F) Economics
[2] M.A (F) Sociology
[3] Banerjee et al 2002; Deininger et al. 2013; Bardhan and Mookherjee 2011
[4] Although Bardhan and Mookherjee, 2011 find greater effect of kits delivery program, they acknowledge that their farm level analysis misses the general equilibrium effects.

investigation. The aim of our study is to investigate to what extent can the low productivity in Bihar be explained by high incidence of sharecropping in the state.

The paper is organised as follows. The next section (section-2) discusses the theoretical reasons for expecting lower productivity in sharecropped land and the empirical evidence present on related issues. Ssection-3 describes our study and presents the data and main findings. We do not find any relative inefficiency in sharecropped land as compared to owned land. In section-4 we discuss some plausible explanations for this observations and its implications on the mechanism of the impact of tenancy reforms. Section-5 concludes the article.

# 2. Sharecropping inefficiency : Theory and Evidence

In this section we briefly discuss the theory of why sharecropping is associated with inefficiencies and the relevant evidence for the same.

## 2.1 Theory

Yields in sharecropped land are expected to be less due to Marshallian Inefficiency. The tenant applies less than optimal effort since he equates the marginal cost of his effort only to a proportion of its marginal benefit. Sharecropping is understood to persist despite this inefficiency as it provides a way to balance the trade-off between providing perfect incentives in a fixed rent contract, where the entire marginal benefit of extra effort accrues to the tenant versus optimum risk allocation in a fixed wage contract where the landlord with greater risk bearing capacity takes all the risk (Stiglitz 1974; Stiglitz 1986).

Lack of tenure security can also decrease the incentive to invest on technology. Braverman and Stiglitz (1986) show that “landlords may wish to - and can - resist innovations which unambiguously increase production whenever sharecropping contracts are employed”. In addition to removing this Marshallian inefficiency and providing adequate incentives to invest in technology, tenancy reforms can further have general equilibrium effects that increase productivity (Bardhan and Mookherjee 2011)

## 2.2 Evidence

Shaban (1987) is one of the major studies analysing the impact of sharecropping on yields. Controlling for family-related characteristics by considering mixed families i.e. those which own some land as well as sharecrops other land. Both output and input intensities are found to be higher in owned land compared to sharecropped land. The successful implementation of tenancy reforms in West-Bengal provided a rare opportunity to researchers for evaluating effect of such reforms. Banerjee et.al (2002) estimate that Operation Barga can explain around 28% of agricultural productivity growth in West-Bengal. Deininger et.al (2013) show that there are strong disincentives to invest in soil fertility and irrigation on sharecropped lands. Bardhan and Mookherjee (2011) also find reduction in Marshallian inefficiency due to Operation Barga.

# 3. Data

Our empirical analysis draws upon the primary plot level survey conducted by us in West Champaram district in north-west Bihar. We collected plot-level data from Nawalpur and Dhadhawa gram panchayats in Jogapatti Block and Lagunaha Chautarwa gram panchayat in Bagaha-I block of W. Champaran district. A total of 108 plots, 53 of them owner-cultivated and 55 sharecropped were surveyed. The survey was designed to provide detailed plot-level land characteristics (like plot-size, irrigation, cropping intensity etc), farming inputs (like seeds, fertilisers and pesticides, labour, capital inputs like tractors) and yield. The data was collected for two major agriculture seasons – Aghani (Kharif) and Rabi season and 3 important crops – Paddy (Kharif Crop), Wheat (Rabi crop) and Sugarcane.

## 3.1 Context

The fertile Gangetic alluvial soil, with abundant water resources, particularly ground water resources, forms the basis of agriculture in Bihar. This topographical feature is the main reason behind high proportion of land area put to agricultural use, as compared to other states. Net sown area in Bihar is 57% of total geographical area of the state which is much higher than the national average of 41%. In addition to this, agriculture in Bihar is very much tilted towards subsistence farming, with majority of them being small and marginal farmers and a sizable chunk being landless tenants. “Marginal and small farmers … constituted 96.5% of the total landowning community owned 66% of land. Medium and large farmers who constituted only 3.5% of the total landowning community owned 33% of the land” ( Bandopadhaya, 2009). This reflects incomplete and inadequate land reforms undertaken by various state governments of Bihar.

This unequal distribution of land is the prime reason for high proportion of land under various forms of tenancy. “By a conservative estimate, 35% of land in Bihar is under *Bataidari* (sharecropping) system”. In addition to “Bataidari”, other forms of tenancy like “Hunda” – fixed rent - also co-exist. (We also encountered a peculiar form of tenancy in which tenant provided landlord with laundry services in return for land for cultivation). Our primary focus in this study was “bataidari” form of tenancy.

### *3.1.1 West Champaran District*

Agriculture is the mainstay of people in West Champaran. Being the north-westernmost district of Bihar bordering Nepal, it receives 1201mm of rainfall in a normal year, 84.6% of which is in the period of June to September (S-W Monsoons). 59% of total geographic are of the district is under cultivation with a cropping intensity of 145%. 50.6% of total cultivated area is under irrigation, which is much higher than the national average, with bore-well irrigation being the most common type covering 60% of total irrigated area. Paddy, wheat and sugarcane are the three most important crops in the region, in terms of area under cultivation. West-Champaran is frequently prone to flooding as river Gandhak swells every monsoon and covers adjacent areas in knee-deep water, affecting agriculture produce and productivity.

There is incidence of high inequality of land distribution in West Champaran district, which is reflected by the fact that 86.3% of land-holders are small and marginal owning less than a hectare of land, with the proportion of landless and marginal holdings being highest among Scheduled Castes and Tribes, which is 92% and 95% respectively (Praxis 2009). Hence most of the marginal and landless farmers work as tenants in farms of land-owning castes.

## 3.2 Sampling Methodology

Three gram panchayats (GP), Nawalpur and Dhadhawa from Jogapatti block and Laghunaha-Chautarwa from Bagaha-I block were selected for the survey because of high incidence of sharecropping in villages under these GPs (Praxis 2009). The households in these gram panchayats are organised into "tolas", largely based on the caste. Our sampling methodology was a priori purposive to be representative of different castes engaged in *bataidari*. 6 to 7 tolas were selected in each GP for the survey in a manner representing different castes. Each of the selected tolas were visited for a pre-survey to make a non-exhaustive list of names of bataidars who are willing to participate in the survey. Out of this list, 4 names were selected randomly.

All of the sampled households operate on multiple-plots and cultivate Paddy in Kharif and Wheat in Rabi or sugarcane which is a two-season crop in addition to other crops. Data was collected for only plots with these three crops.

## 3.3 Sample Characteristics

It was found from our survey that all the tenants involved in sharecropping, in consonance with the traditional practice, divide the output equally between the landlord and the tenant themselves. (50% of output was given to the owner in exchange for the land). This was regardless of the caste of the tenant and the land owner, bargaining power, years of association etc. All the cost of inputs including labour were borne by the tenant and this is also in accordance with the traditional practice across this region.

Table-1 shows the details of the sample size. 108 plots cultivated by 57 households were surveyed. Sugarcane was grown on 45 of these plots, 20 and 25 for owned and sharecropped respectively. Sugarcane is more popular among the farmers because it is less vulnerable to frequently occurring floods in the region as compared to wheat or paddy. This reason was explicitly cited by some farmers to us during the survey. Number of paddy and wheat plots in sample are 31 and 32 respectively, with approximately equal number of owned and sharecropped plots (see Table-1). To be able to attribute the difference in yields, if any, to sharecropping inefficiency it is important to have mixed households who own as well as sharecrop land, as it allows a way to control for household level characteristics (Shaban 1987). We have 24 such households in our sample. However these do not necessarily cultivate the same crop in owned and leased-in land. There are 10 such households in our sample who cultivate sugarcane in an owned plot.

Table 1: *Sample Details (Size)*

| | | |
|---|---|---|
| Households | | 57 |
| Sugarcane plots | Owned | 20 |
| | Sharecropped | 25 |
| Paddy plots | Owned | 17 |
| | Sharecropped | 14 |
| Wheat plots | Owned | 16 |
| | Sharecropped | 16 |
| Total plots | | 108 |
| Mixed households (Owner-cultivators *and* sharecropper) | | 24 |
| Mixed households for sugarcane only (Owner-cultivators *and* sharecropper of sugarcane) | | 10 |

Table-2 shows further details of the sample characteristics. The average household size is 8.4 and the average age of the respondent is 47.8. The average plot sizes for sugarcane are 18.0 and 10.8 *kathas* [5] for owned and leased-in plots respectively. Similarly the averages for plot sizes for wheat and paddy are in the range of 7-10 *kathas* (Table-2). Our sample didn't encounter any household with large plots. This reflects the ground reality of small landholdings in Bihar.

Interestingly, we also found two female sharecroppers in our survey who cultivated the land on their own and there were two instances of sharecropping arrangement where the tenant and the landowner were related through kinship links.

Table 2: *Sample Characteristics*

| | | | |
|---|---|---|---|
| Number of Households | | | 57 |
| Average household size | | | 8.4 |
| Average Age *(years)* | | | 47.8 |
| Average Plot Size *(Kathas)* | Sugarcane | Owned | 18.0 |
| | | Sharecropped | 10.8 |
| | Wheat | Owned | 8.0 |
| | | Sharecropped | 8.2 |
| | Paddy | Owned | 9.4 |
| | | Sharecropped | 7.6 |
| Caste Data | Landowner | General | 74.3% |
| | | OBC | 23.0% |
| | | SC | 0% |
| | | ST | 0% |
| | | Muslim | 2.5% |
| | Tenant | General | 2.5% |
| | | OBC | 35.9% |
| | | SC | 46.1% |
| | | ST | 0% |
| | | Muslim | 15.3% |

[5] *Katha* is a local unit of area. 13 katha = 1 Acre

## 3.4 Input and Output Intensities

Table-3 shows the average Input and Output intensities for various crops for different plot types. Note that our data of yield and inputs are based on recall by the respondents. Since agriculture is a major and in most cases the only source of income for the respondents, the recall is expected to be reliable. However, there are some concerns about the respondents' ability to correctly recall the minor differences in effort or inputs. This is especially so if such discrimination among owned and sharecropped land is not active and happens subconsciously. We proceed onto analysis of our survey data, before further discussing the impact of these concerns on our findings.

Table 3: *Input and Output Intensities*

| | **Sugarcane** | | **Wheat** | | **Paddy** | |
|---|---|---|---|---|---|---|
| | *Owned* | *Share-cropped* | *Owned* | *Share-cropped* | *Owned* | *Share-cropped* |
| **Urea** | 69.8 | 66.8 | 35.8 | 57.6 | 47.0 | 52.7 |
| **Potash** | 40.0 | 30.6 | 37.1 | 51.7 | 25.7 | 33.3 |
| **DAP** | 139.1 | 168.8 | 97.1 | 123.2 | 92.9 | 132.6 |
| **Total fertilisers** | 258.8 | 298.9 | 266.3 | 245.8 | 242.6 | 220.3 |
| **Total pesticides** | 47.2 | 46.7 | 33.1 | 30.0 | 36.4 | 28.3 |
| **Average yield** *(kg/katha)* | 1300 | 1235.0 | 77.5 | 63.8 | 74.7 | 95.90 |

The average input intensities are reported in *Rupees/Katha*

For sugarcane, the average money spent (*per katha*) of Urea, Potash and Pesticides is lower on sharecropped plots but more money is spent on DAP in sharecropped plots. However the difference in magnitudes for Urea, Potash and Pesticides is not much. The p-values for the t-test are very high, and thus, none of the differences is statistically significant (Table-4)

Table 4: *Significance Test (Sugarcane)*

| | ***Owned*** | ***Share-cropped*** | ***p value*** |
|---|---|---|---|
| **Urea** | 69.8 | 66.8 | 0.8084 |
| **Potash** | 40.0 | 30.6 | 0.2584 |
| **DAP** | 139.1 | 168.8 | 0.4019 |
| **Total fertilisers** | 258.8 | 298.9 | 0.4295 |
| **Total pesticides** | 47.2 | 46.7 | 0.9682 |
| **Average yield** *(kg/katha)* | 1300 | 1235.0 | 0.8224 |

The p-values reported are for the null hypothesis that there is no difference in intensities

For wheat, the money spent on Urea, Potash and DAP is higher in sharecropped plots compared to owned plots, and the money spent on pesticides is slightly lower. The yield on sharecropped plots is lower. Almost all the differences are statistically insignificant except urea, which is higher in Sharecropped plots (Table-5)

Table 5: *Significance Test (Wheat)*

| | ***Owned*** | ***Share-cropped*** | ***p value*** |
|---|---|---|---|
| **Urea** | 35.8 | 57.6 | 0.0751 |
| **Potash** | 37.1 | 51.7 | 0.3218 |
| **DAP** | 97.1 | 123.2 | 0.1889 |
| **Total fertilisers** | 266.3 | 245.8 | 0.7777 |
| **Total pesticides** | 33.1 | 30.0 | 0.7641 |
| **Average yield** *(kg/katha)* | 77.5 | 63.8 | 0.2199 |

The p-values reported are for the null hypothesis that there is no difference in intensities

For paddy, the money spent on Urea, Potash and DAP is higher in sharecropped plots compared to owned plots, and the money spent on pesticides is slightly lower. The yield on sharecropped plots is higher. But none of these differences are statistically significant (Table-6)

Table 6: *Significance Test (Paddy)*

| | ***Owned*** | ***Share-cropped*** | ***p value*** |
|---|---|---|---|
| **Urea** | 47.0 | 52.7 | 0.7104 |
| **Potash** | 25.7 | 33.3 | 0.3869 |
| **DAP** | 92.9 | 132.6 | 0.1452 |
| **Total fertilisers** | 242.6 | 220.3 | 0.7503 |
| **Total pesticides** | 36.4 | 28.3 | 0.4493 |
| **Average yield** *(kg/katha)* | 74.7 | 95.90 | 0.3481 |

The p-values reported are for the null hypothesis that there is no difference in intensities

Thus we see that there is no general pattern in the input and output intensities of various crops across owned and sharecropped plots. This could be due to the suspect quality of responses by farmers, which are based on memory recall. However, we don't think that is the case.

It is also possible that the differences are statistically insignificant due to small sample size of this study. Even if that is the case the mean values tend to be higher on sharecropped plots, which runs contrary to theory of Marshallian inefficiency.

Thus, our major finding is that there are no differences in input and output intensities of owned and sharecropped plots. But these results are only suggestive due to the above mentioned issues of possibly imperfect recall and small sample size and further detailed studies would need to be done to verify the findings more conclusively.

In the next section we discuss and present some explanations for our findings.

# 4. Discussion

During the survey we found that the respondents did not differentiate much, in terms of the inputs applied, between their owned land versus the sharecropped land. There is no evidence in our sample of farmers treating the two types of land differently in any respect. In fact, some of the respondents seemed perplexed about the need to tell all the details of the inputs applied separately for the owned land and the sharecropped land, since they saw no rationale for them to be different. We found that the amount of fertilisers and pesticides used were according to the prevailing standards in the surrounding region, and the farmers did not think of discriminating among owned and sharecropped land in this respect. Notably, the amount of fertiliser used is same even across different crops for a given farmer. This further indicates that the prevalent standards play an important role in determining farming practices in this region.

This observation about no relative inefficiency of sharecropped land vis-à-vis owned land is contrary to theory and evidence in the literature, and thus needs an explanation. We offer some plausible explanations below.

One possibility is that the results are driven not by high yields of sharecropped land, but by low yields of owned land. In other words, the relative non-difference in the input and output intensities across owned and sharecropped land is not because the farming intensity of sharecropped land is as high as that of owned land, but because it is as low in owned land as in sharecropped land. This is plausible as the farmers do not seem to be experimenting at their own ends to increase the yield and the farming practices are mostly determined by prevalent standards and norms of the region. Several factors can be attributed to this inactivity. Many farmers mentioned the uncertainty of climate and rainfall in the region which deter innovation and use of other technology, for instance the use of HYV seeds in an unpredictable environment, which are comparatively way more expensive than the ordinary seeds. One of the farmers remarks:

> *"HYV seeds would not work in this area, what's the use of spending money? The precarious climate wreaks havoc on our crops, dhoop mein jal jata hai, baarish mein gal jata hai (while the crop gets burnt in scorching heat, floods result into rotting)"*

Another possibility is the role of social norms and other such social dynamics. The farmer is not an independent entity, he lives within the structure of a community. The social-cultural and economic environment of the community determines to a great extent the technology and other methods employed by the farmer. For example: during the course of discussion however, some respondents spoke about the need to render more efforts in the sharecropped land citing social pressure in a close-knit community. One of the farmers quotes:

> *"If we do not put in more efforts in the batai (sharecropped) land, the landowner will think of us as lazy people and irresponsible towards his land which harms our repute in the village. Later in the future, he can also take away the land and give it to somebody else"*

Thus, it is possible that the social structure allows costless supervision of sharecroppers which violates a critical assumption of the Marshallian inefficiency framework, which assumes infinite supervision costs.

Apart from such sociological factors, the observation of no difference can be also explained in the same framework as that of Marshallian inefficiency.

## 4.1 Critique of Marshallian Inefficiency

In Figures 1-4, OA represents the costs of labour. OB is the production function. OC is the effective return to the sharecropper. Thus the curve OC is just a proportion of the curve OB.

Figure-1 shows the basic Marshallian paradigm and the consequent inefficiency in sharecropping. L* is the level of input that maximises the total social surplus. At this level the slope of production function is same as that of labour cost. But in the sharecropping arrangement the farmer only maximises his own effective return equating the slope of only his effective return to the labour costs. This results in L' level of inputs. L' is less than L* due to the concavity of the production function.

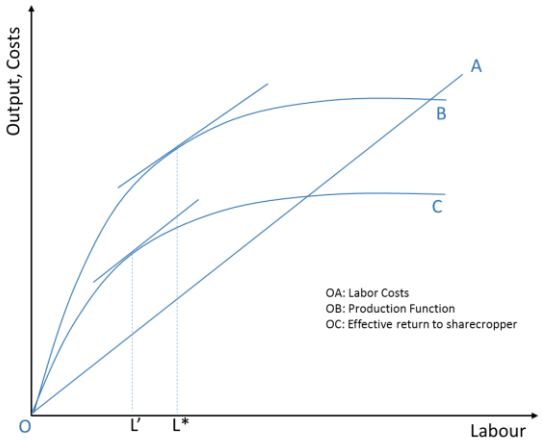


Figure-1: *Marshallian Inefficiency*

In this framework, we propose that the inputs levels will be same if they are such that any extra input will not increase the output significantly i.e. the slope of production is zero or reduces rapidly.

Figure-2 shows the case where the input levels are such that the marginal product is zero. This happens when the cost of labour is very low, as reflected by the horizontal labour cost curve. The labour cost curve reflects the opportunity cost of labour which includes the benefit forgone from working for wage and/or the value that farmer may put on leisure. But in the situation of surplus labour, this opportunity cost can be taken as zero, when farmer does not have employment opportunities the benefit forgone of which will be reflected in opportunity cost of labour. This justifies a horizontal labour cost curve. The farmer equates the slope of the labour

cost curve to the production function (OB) on owned plots and to effective return (OC) on sharecropped plots. Now since the slope of labour cost is zero and the slopes of production function (OB) and effective return (OC, which is a constant proportion of curve OB) will always become zero at same level of input, the inputs applied on owned and sharecropped land are same i.e. L' = L*

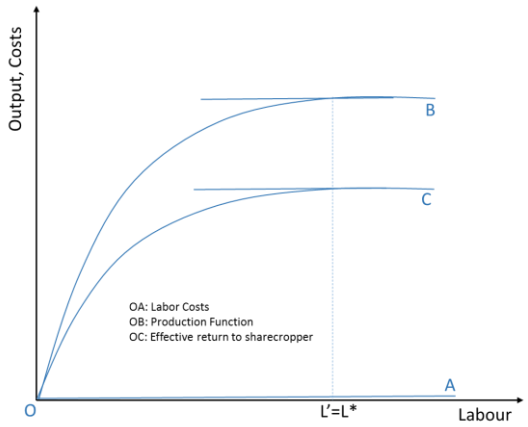


Figure 2: *No Marshallian inefficiency due to zero labour cost*

Figure-3 shows the case when the marginal product suddenly drops to zero (at point D). In such a situation also the amount of input applied will be same in owned and sharecropped land if the maximum marginal effective return at point E is greater than the opportunity cost of labour. For expositional purposes the marginal product is made to be discontinuous at point D in Figure-3.

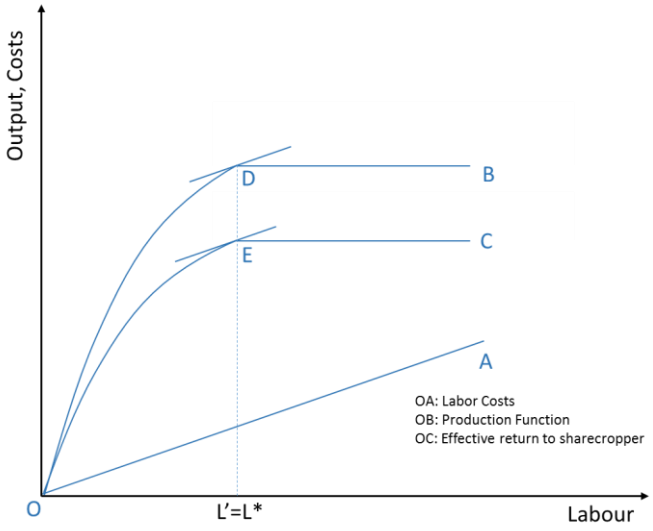


Figure 3: *No Marshallian inefficiency due to sudden decrease in marginal product*

Figure-4 makes the curve smooth but retains the sudden drop in marginal product. It can be seen that the inputs applied will approximately be same. Note that for this situation to occur it is not needed that the *actual* marginal product drop suddenly. It is sufficient for the farmers to *believe* that the marginal product drops suddenly to use similar levels of inputs in owned and sharecropped land.

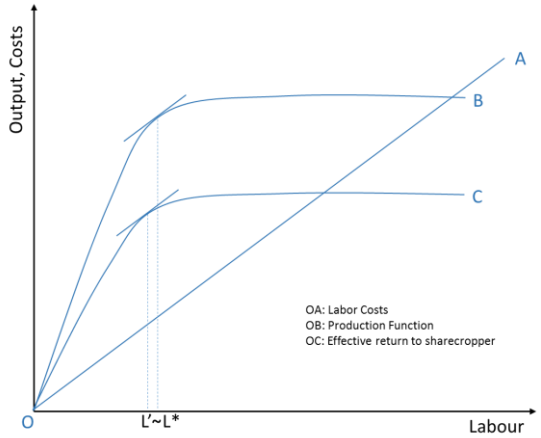


Figure 4: *Introducing smoothness in Fig-3*

## 4.2 Implications

We have presented plausible theoretical explanations for our observations. But how does it square with other empirical evidence. Shaban (1987) find significant difference in yields of owned and sharecropped land. Banerjee et al. (2002) find that major increase in yields can be attributed to the Operation Barga reforms. This is an important policy issue and understanding about mechanisms of such outcomes will have implications for policy recommendations.

The analysis in Banerjee et al. (2002) uses district level data and thus represents aggregate effects of the Operation reforms. Bardhan and Mookherjee (2011) use farm level data and find much less impact of Operation Barga, which means that security of tenure doesn't directly increase the yields of sharecropped land. This, they propose, indicates that Operation Barga had much of its effect through indirect channels such as "general equilibrium effects on the distribution of land, resulting from possible induced effects on entry or exit, or the size distribution of farms", rather than by reducing Marshallian inefficiency. "It is possible that Operation Barga reduced the profitability of leasing out land, inducing large landowning families to subdivide, sell off part of their lands, or switch to self-cultivation. The resulting changes in the composition of farms could alter aggregate yields even if they did not affect the productivity within any type of farm distinguished by ownership status or size" (Bardhan and Mokherjee 2011).

Our results, by showing the absence of Marshallian inefficiency, provide further evidence in favour of this explanation. In a review of evidence on land reforms in India, Ghatak and Roy (2007) point out the need to disentangle the direct and indirect effect of land reforms. Our study

finds evidence that most of the impact of tenancy reforms may be driven by indirect effects. We reiterate the importance of this as an important area of further research with better data.

# 5. Conclusion

We find that there is not much difference between the input and output intensities of owned and sharecropped land. The respondents in our sample, treat both types of land similarly. But this observation goes contrary to the theory of Marshallian inefficiency. We offer 2 possible explanation for this.

Firstly, it is possible that the framework of rational self-interested agents working to maximise the their own utility is not appropriate to analyse the situation. The perplexity of respondents on being asked to tell the details of the owned and sharecropped plots separately shows that their mind do not work, at least consciously, in a framework of analysing marginal benefits and marginal costs. In fact, some respondents clearly stated that they ought to put more efforts in sharecropped land because of the social pressure so as not to be perceived as irresponsible and indolent by the land owner. This highlights the role social norms can play in explaining economic realities

On the other hand, the observation can also be explained within the same framework as that of Marshallian inefficiency. We have shown that the inputs applied can be same for owned and sharecropped land if farmers operate at a point where any extra input will not significantly increase the output. This can happen due to very low opportunity cost of labour in a situation of excess supply. Alternatively the farmer's belief, irrespective of actual reality, that extra input will not increase output much can them to apply same effort on owned and sharecropped land.

This finding throws further light on the mechanism of increase in productivity due to tenancy reforms. It suggests that much of the effect is through indirect channels, due to general equilibrium effects. We reiterate the emphasis by Ghatak and Roy, 2007 on the need for further investigation to disentangle direct and indirect effects of tenancy reforms with better micro-level data.

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