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Regional Disparities in Profitability of Rice Production: Where Small Farmers Stand?

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ABSTRACT

Economic liberalisation policies introduced since the early 1990s helped in accelerating growth of the economy, but it also increased farmers' distress especially among marginal and small farmers in the backward states. The accelerated farm mechanisation, increased share of purchased inputs, fluctuation in prices and higher wage rates increased the vulnerability of small farmers than large farmers. In this context, historical inverse relationship between farm size and productivity has changed into positive one, with larger farms getting the advantage of large scale mechanisation and technology. The paper revisits the farm size and productivity debate at the state level by using unit level data of cost of cultivation for rice crop. The paper has found that, there is convergence of yield of rice across states mainly helped by convergence in fertiliser, irrigation and farm machinery use. However, there was widening gap between bottom 25 per cent and top 25 per cent (based on farm size) of the farmers in terms of yields, gross returns, profitability. The condition of tenant-small farmers was more precarious due to high land rents (50 per cent of total cost). The share of loss making farms is 17 per cent among bottom 25 per cent of the farmers compared to only 3 per cent among top 25 per cent of the farmers. The distress of small farms is aggravated by higher risk in profitability. Most of the farmers in states like Punjab, Haryana, Andhra Pradesh, Tamil Nadu and Gujarat are getting reasonable profits, while farmers of Maharashtra, Jharkhand, Assam, Bihar and Orissa are earning meagre profits. Use of modern inputs (farm machinery use and fertiliser use) helped in increasing profitability, while use of traditional inputs (animal labour and manure) are associated with losses. There was a convergence in the use of modern inputs across states, which have the potential to reduce inter-state disparities in profits and yields. The regression results show that there was a positive relation between farm size and profitability after controlling for state structural variables and input use.

Keywords: Economic liberalisation, Farmer's distress.

JEL: Q11, Q12, Q16

INTRODUCTION

With the liberalisation of the economy and reduced support to the social sectors especially agriculture, there is a doubt about inclusiveness of agricultural growth. There is evidence of severe distress among small and marginal farmers resulting in distress out-migration from agriculture to work as casual/contract labourer in the non-agricultural sector (mostly into construction, manufacturing, mining activities) in urban areas which are also in distress condition with lack of basic amenities to live (Breman, 2010). The agricultural distress is more severe in backward states with rainfed agriculture which are not able to seize the opportunities emerging from the free markets. Some studies indicate that there is absolute divergence in agricultural income levels across states, however, after controlling for structural characteristics of

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states there is a strong tendency of convergence in post-liberalisation period (Birthal *et al*., 2011). Bhalla and Singh (2012) also reported convergence of agriculture across the districts and states. But the absolute disparities across the states remain extremely high. Farmer distress is more severe among marginal farmers in rainfed areas who invest more on failed bore wells mainly to irrigate crops like cotton and paddy in states like Telangana and Maharashtra (Kennedy and King, 2014).Many researchers covered the distress among small farmers by using micro-level data with emphasis on cash crops like cotton and sugarcane.

The growing distress among small and marginal farms across India as evidenced from the news media, by the growing number of farmer suicides, arises the another important question of economic viability of small farms. There is no empirical evidence on this count in recent years. The high incidence of farmer suicides among small farmers thus raise doubts about the historical inverse relationship between farm size and productivity. There were many studies which postulated the inverse relationship between farm size and productivity in the early period of green revolution (Carter (1984); Feder (1985); Barrett (1996); Heltberg (1998); Dorward (1999); Assuncao and Ghatak (2003); Srinivasan (1972); Bhattacharya and Saini (1972). Given that more than 80 per cent of holdings are with less than one hectare, it is important to revisit the farm size and productivity relationship given the rapid mechanisation and labour saving technologies. There is no research on the recent trends in the relationship between farm size and distress, profitability and productivity. There are some indications that the inverse farm size-productivity relationship has changed with large scale adoption of farm machinery and other labour saving technologies in the changed high-wage scenario.

OBJECTIVES AND METHODOLOGY

With this background and to bridge the research gap mentioned above, the paper examines the regional disparities in farm size and profitability by taking rice crop as a case study across all the states by using plot level data of cost of cultivation scheme for the period 2000 to 2002 (Triennium Ending 2002) and 2008 to 2010 (TE 2010). Rice crop is selected because of its importance for large number of small and marginal farmers in many states. The sample size for the first three years was 11794 and for the later three years was 12385. The costs were calculated based on both cost A2 and cost C2 basis. Cost A2 include attached labour, casual labour, hired and owned animal labour, seed cost, insecticides, manure, fertiliser, land revenue, depreciation, irrigation (own plus hired), machine(own and hired charges) and rent paid for leased in land. The cost C2 was cost A2 + interest on fixed capital + imputed rent on owned land- land revenue+ imputed value of family labour. The plot level data was reclassified based on the plot size. In the whole paper plot size and farm size were used interchangeably. The specific objectives of the study are (i) how cost structure and farm profitability was changed across the states and farm size groups

between 2002 and 2010, (ii) is there is any convergence of farm profitability and input use over the period across the states, (iii) is there is any change in the farm size and profitability relationship, (iv) what determine farm profitability.

RESULTS

The Figure 1 depicts the state level productivity in 1996-97 and growth in productivity from 1996-97 to 2012-13. The average productivity of rice is 1800 kg/ha in 1996-97 with the annual growth rate of about 4 per cent per annum between 1996-97 and 2012-13. During this period, there was convergence of rice productivity across the states. The growth in productivity was much higher in less productive states (Rajasthan, Bihar, Assam, Orissa, Himachal Pradesh and Madhya Pradesh) in the past decade. The growth in high productive states (Punjab, Tamil Nadu, Karnataka, Andhra Pradesh and Kerala) was less. This might be due to the diffusion of technology (higher fertiliser use) and spread of irrigation to low productive states and also policy and programme interventions to reduce the yield gap among states like special emphasis on backward districts and eastern India. However, there was a need to examine the plot (farm) level data to understand whether the distributional benefits of productivity growth is equal among small and large farmers, tenants and unirrigated farmers. What are the factors contributing to productivity and profit growth?

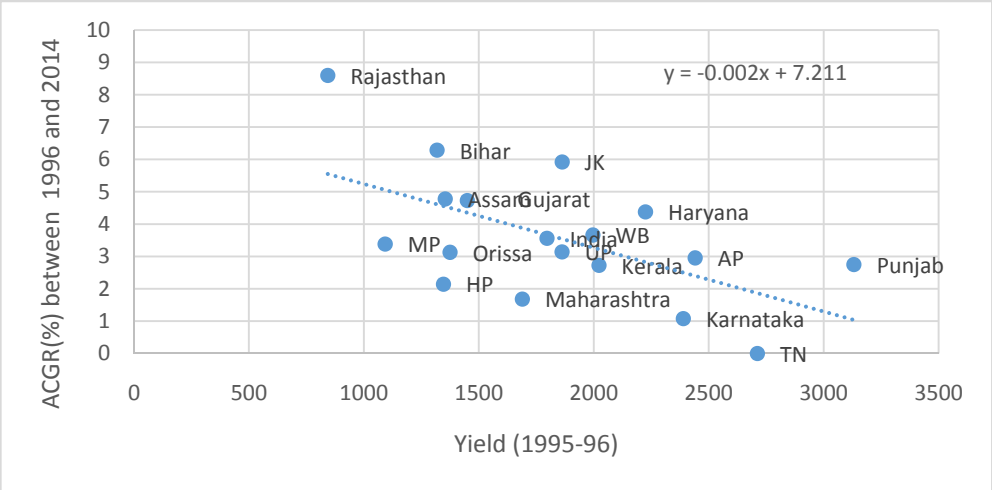

Figure 1. Convergence of Paddy Yields between 1996 and 2014.

Plot Size and Profitability Relationship

Table 1 depicts the sample structure of rice farmers (plots) of the cost of cultivation scheme in India. All the plots were grouped into four categories based on

plot size, less than 1 ha plots are 9921(80.1 per cent), 1-2 ha plots are 1825 (14.7 per cent), 2-4 ha plots are 515 (4.8 per cent) and more than 4 ha plots are 124 (1.0 per cent) in TE 2010. This indicates that predominantly (more than 80 per cent of all the farms) farm size was less than 1 hectare which is very small compared to world standards. On an average plot size increased from 0.733 to 0.758 ha. The per hectare yield was the highest among large plots (56.9 quintal/ha) compared to small (40.4q/ha) and marginal (35.3q/ha) plots. The gross returns per hectare was Rs.38.8 thousand in the TE 2010, with marginal farmers only getting Rs.36.6 thousand and large farmers getting Rs.63.1 thousand per hectare. There was a clear positive relationship between plot size and gross returns per hectare. There is no much difference in cost A2 across the farm size groups, but cost C2 (which include imputed family labour) is much higher among marginal farmers. With higher gross returns and less costs the large farmers (>4 ha) are getting higher net profits (Rs.40.2 thousand per ha) compared to only Rs.16.3 thousand per ha among marginal farmers (based on

TABLE 1.SAMPLE STRUCTURE OF THE PADDY FARMERS

			Rs.1000/ha							
Plot size (1)	Sample (2)	Area (ha) (3)	Gross returns (4)	Cost A2 (5)	Cost C2 (6)	Profit A2 (7)	Profit C2 (8)	Yield (q/ha) (9)	Machine (hours/ha) (10)	Labour (days/ha) (11)
TE 2002										
<1 ha	9570	0.462	18.5	12.3	28.7	6.2	-10.3	32.7	6.1	128
1-2 ha	1622	1.432	20.3	10.8	21.9	9.5	-1.6	35.3	9.2	98
2-4 ha	505	2.738	23.9	11.3	22.1	12.6	1.8	40.9	12.3	81
> 4 ha	97	5.236	29.5	13.2	24.0	16.3	5.4	49.7	22.0	72
Total	11794	0.733	19.0	12.0	27.5	7.0	-8.4	33.6	6.9	122
TE 2010										
<1 ha	9921	0.470	36.6	20.3	52.8	16.3	-16.3	35.3	8.8	121
1-2 ha	1825	1.436	44.4	19.6	41.8	24.8	2.7	40.4	11.3	85
2-4 ha	515	2.778	57.2	22.7	46.5	34.5	10.6	50.6	14.3	73
> 4 ha	124	5.444	63.1	22.9	46.5	40.2	16.6	56.9	15.5	64
Total	12385	0.758	38.8	20.3	50.9	18.5	-12.0	36.9	9.5	113
Plot size quartile groups										
TE 2002										
Bottom 25 per cent	2766	0.183	19.3	14.7	38.2	4.6	-18.9	33.4	6.4	142
Middle 25 to 50 per cent	3140	0.395	18.7	12.0	27.6	6.6	-8.9	33.1	5.9	130
Middle 50 to 75 per cent	3230	0.695	17.9	10.9	22.9	7.0	-5.0	32.2	6.0	118
Top 25 per cent	2658	1.749	20.5	10.7	21.6	9.8	-1.1	35.8	9.7	95
Total	11794	0.733	19.0	12.0	27.5	7.0	-8.4	33.6	6.9	122
TE 2010										
Bottom 25 per cent	2636	0.184	37.1	23.9	73.8	13.2	-36.8	35.4	9.5	139
Middle 25 to 50 per cent	3525	0.398	36.3	19.7	49.4	16.6	-13.1	35.2	8.3	125
Middle 50 to 75 per cent	3332	0.703	36.8	18.6	42.1	18.2	-5.3	35.6	8.9	108
Top 25 per cent	2892	1.783	45.9	19.7	41.8	26.2	4.1	41.8	11.5	83
Total	12385	0.758	38.8	20.3	50.9	18.5	-12.0	36.9	9.5	113

cost A2). If we consider cost C2, the average profits are negative (-12 thousand/ha) and only farms with more than 2 ha are getting positive profits on an average. There was clear and strong positive relationship between plot size and net profits. Labour days per hectare were much higher among marginal plots (121 days/ha) compared to large plots (64 days/ha). The machine use is higher among large plots (15.5 hours/ha) compared to marginal plots (only 8.8 days/ha).

Given that the usual classification of farm size grouping may not be directly applicable for plot size grouping (as most of the farmers operate on many pieces of plots and crops scattered in many places in the village), we have categorised the sample into quartile groups based on plot size with four categories to understand the bottom and top 25 per cent of farmers cost structure along with two middle groups (25-50 per cent and 50 to 75 per cent). The bottom 25 per cent of the farmers average plot size is 0.183 ha, the 25-50 per cent of the farmers is 0.395 ha, the 50-75 per cent group of farmers are with average farm size of 0.695 ha and the top 25 per cent farmers are having plot size of 1.749 ha. The results are similar as that of the earlier grouping with yield of top 25 per cent of the farmers was 41.8 q/ha, where as the remaining the 75 per cent of the farmers getting only about 35 q/ha yield. It is to be noted that the except top 25 per cent farmers, the remaining farmers average acreage under rice is less than 1 ha and hence fall in the category of less than 1 ha plot size group. The profitability was positive only for top 25 per cent of the farmers if we consider cost C2. The bottom 25 per cent of the farmers were getting a loss of Rs.36.8 thousand/ha, middle 25-50 per cent were getting a loss of 13.1 thousand/ha and upper middle (50-75 per cent) were getting aloss of 5.3 thousand/ha. The use of machine labour was low (6.4 hours/ha) and the human labour (142 days/ha) was higher among bottom 25 per cent. The results clearly shows that the small farmers (bottom 75 per cent) were in severe distress and not able to cover full costs. On the other hand the top 25 per cent of the farmers were able to cover full costs with some profits.

Inputs Use and Plot Size

Some more indicators on input use by different quartile groups based on plot size were given in Table 2. As expected labour productivity (Rs./ha) has increased from Rs.297/ha on bottom 25 per cent to Rs.692/ha in top 25 per cent. The fertiliser use was higher for top quartiles group (160kg/ha) compared to bottom quartile group (129 kg/ha). Irrigation use was also much higher among top 25 per cent of the farms (75 hours/ha) compared to average irrigation use (57 hours/ha). Whereas manure use and share of family labour was higher among bottom 25 per cent of the farms compared to top 25 per cent. As these two indicators were more or less represent subsistence nature of farming compared to fertiliser use and farm machinery use which represent moving towards market oriented farming. This indicates that small

farmers were still relying on traditional inputs to some extent to reduce dependence on purchased inputs and reduce costs and risk of going into losses, but this resulted in less yields and profits.

TABLE 2.CHANGE IN FARM SIZE AND INPUT USE BETWEEN 2002 AND 2010

	Year TE 2002					Year TE 2010				
Variables	Bottom 25 per cent	25 to 50 per cent	50 to 75 per cent	Top 25 per cent	Total	Bottom 25 per cent	25 to 50 per cent	50 to 75 per cent	Top 25 per cent	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10	(11)
Fertiliser use (kg/ha)	104	104	101	129	109	129	123	125	160	133
Irrigation (hours/ha)	55	70	65	79	67	54	49	52	75	57
Manure use (q/ha)	26	23	18	15	21	19	17	14	12	15
Share of family labour (per cent)	55	45	37	29	43	58	45	37	27	43
Labour productivity (Rs./ha)	145	155	165	253	178	297	331	397	692	426

Plot Size and Productivity and Profitability

Table 3 presents the difference in yield between top and bottom 25 per cent of the farmers in each state. The top 25 per cent of the farmers (large plots) have significantly higher yields than bottom farmers (small plots) in Madhya Pradesh (by 133.3 per cent), Punjab (52.4 per cent), Kerala (25.7 per cent), Haryana (16.7 per cent) and Gujarat (10 per cent). In these states, in general the share of small and marginal farms was less, there is scope for large scale farm mechanisation and the

TABLE 3. PRODUCTIVITY AND PROFITABILITY OF PADDY CROP IN TE 2010

	Yield (q/ha)		Difference in yield between top and bottom 25 per cent	Profitability (Rs.1000/ha)		Difference in yield between top and bottom 25 per cent
State	Bottom 25 per cent	Top 25 per cent		Bottom 25 per cent	Top 25 per cent	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	52	56	7.7	27.6	32.8	19
Assam	27	27	0	9.1	13	43
Bihar	26	26	0	10.7	12.4	16
Chhattisgarh	29	27	-6.9	8.9	14.2	60
Gujarat	40	44	10	23.9	34.2	43
Haryana	36	42	16.7	29.5	49.4	67
Himachal Pradesh	19	20	5.3	14.1	20.4	45
Jharkhand	19	16	-15.8	2.7	5.4	100
Karnataka	47	50	6.4	15.2	30.4	100
Kerala	35	44	25.7	9.5	31.7	234
Maharashtra	30	15	-50	-0.8	1.4	275
Madhya Pradesh	12	28	133.3	-1.3	31.7	2538
Orissa	31	32	3.2	10.8	15.8	46
Punjab	42	64	52.4	27.2	43.6	60
Tamil Nadu	49	48	-2	5.6	24.5	338
Uttar Pradesh	36	38	5.6	17.9	21	17
Uttarakhand	43	40	-7	20.3	22.5	11
West Bengal	39	40	2.6	16.3	21.4	31
Total	35	42	20	13.2	26.2	98

production structure is much advanced in terms of use of purchased inputs (like fertilisers and pesticides). On the other hand, in states like Maharashtra, Jharkhand, Uttarakhand, Chhattisgarh and even in Tamil Nadu the yield levels in the large plots is lower than small plots. There was almost no difference between top and bottom 25 per cent of the farmers in yields in Bihar, Assam and West Bengal and Orissa. In these states the share of marginal and small farmers were high and most of the operations were done with family labour with little mechanisation. If the production structure is dominated by small and marginal farms with less mechanisation the large farms did not have comparative advantage in yields.

The profitability of top 25 per cent of the farmers was much higher among Haryana (Rs.49.4 thousand/ha), Punjab (Rs.43.6 thousand/ha), Gujarat (34.2 thousand/ha), Andhra Pradesh (32.8), Madhya Pradesh (31.7) and Kerala (31.7). It was less than ten thousand in Maharashtra and Jharkhand and less than 20 thousand in Assam, Bihar, Orissa and Chhattisgarh. For the whole sample, the difference in profitability between top and bottom 25 per cent of farms is about 100 per cent, although reduced slightly between the TE 2001 and the TE 2010. The difference was much higher in states like Kerala, Madhya Pradesh, Karnataka, Tamil Nadu, Jharkhand and Maharashtra mainly due to the meagre profitability (or losses) among bottom 25 per cent farms. The difference in profitability was less among Andhra Pradesh, Bihar, Uttar Pradesh, West Bengal and Uttarakhand. But overall, there is significant difference in profitability exists among bottom and top 25 per cent of the farms.

Characteristics of Loss Making Farms

Table 4 presents share of loss making farmers in both TE 2002 and TE 2010. The share of loss making farms increased/decreased from 14 per cent in 2002 to 8 per cent in 2010. In both the years, the share of bottom 25 per cent farms was higher (23 per cent in 2002 and 17 per cent in 2010). Only 3 per cent of the top 25 per cent farms were in loss in 2010. The share of farms with losses was higher in Maharashtra (52 per cent), followed by Jharkhand (29 per cent), Kerala (14 per cent) and Tamil Nadu (12 per cent). The share of farms with losses was less in Haryana, Punjab, Gujarat, Himachal Pradesh and Andhra Pradesh. These states were in general highly mechanised and use higher doses of fertilisers with more irrigation. In Maharashtra, Jharkhand, Tamil Nadu and Bihar some of the large farms were also in losses. In these states, in general farm mechanisation, use of fertilisers and irrigation was less. These data indicate that the structural characteristics of the states were important factors in determining the profitability of the farms.

The cost structure of loss making and profit making farms are given in Table 5. The average yield of loss making farms was low (22.8q/ha) compared to profit making farms (38.1q/ha). Consequently gross returns were also low. It is interesting to see that the most of the losses were explained by the low yields and high costs.

Among loss making farms even though yield were low, the costs are high (32.2 thousand/ha) compared to profit making farms (19.3 thousand/ha). The average losses of loss making farms was Rs.9.3 thousand/ha, while average profit of profit making farms was Rs.20.3 thousand/ha. Fertiliser use was less among loss making farms (120kg/ha) compared to profit making farms (135kg/ha), similarly farm machinery use was also less. But use of manure, human labour, animal labour use and irrigation (especially hired irrigation which make them more exposed to fluctuation in water supply and higher costs), rent paid for leased in land and depreciation costs were high. The higher cost of loss making farms was mainly due to higher labour use, manure use, animal labour use and hired irrigation.

TABLE 4.SHARE OF LOSS MAKING FARMERS (BASED ON COST A2) BY PLOT SIZE QUINTILE GROUPS

	TE 2002					TE 2010				
State	Bottom 25 per cent	25 to 50 per cent	50 to 75 per cent	More than 75 per cent	All	Bottom 25 per cent	25 to 50 per cent	50 to 75 per cent	More than 75 per cent	All
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Maharashtra						56	48	53	37	52
Jharkhand	29	17	15	16	18	34	19	21	19	22
Kerala	20	10	8	3	13	32	9	7	2	14
Tamil Nadu	24	8	8	5	11	22	15	11	6	12
Uttarakhand	2	0	0	0	1	24	14	0	3	10
Bihar	19	13	8	7	11	17	10	7	6	9
Karnataka	30	17	12	9	15	17	10	11	3	9
West Bengal	20	14	15	25	17	14	5	5	1	8
Uttar Pradesh	32	12	9	6	17	21	4	3	2	7
Assam	22	14	9	4	11	13	7	4	1	6
Madhya Pradesh	63	41	21	11	18	69	12	8	2	6
Chhattisgarh	33	38	28	12	20	0	6	7	4	5
Orissa	27	15	14	10	17	11	3	4	4	5
Andhra Pradesh	23	10	7	1	6	8	4	5	4	4
Himachal Pradesh						7	1	1	4	4
Gujarat						7	2	1	0	3
Punjab	40	17	10	4	10	14	1	2	1	2
Haryana	0	7	4	3	4	13	0	1	0	1
Total	23	14	11	6	14	17	7	6	3	8

TABLE 5. STRUCTURE OF LOSS MAKING FARMS (TE 2010)

	Gross Returns	Cost A2	Profit A2	Cost C2	Profit C2	Yield	Fertiliser	Labour productivity	Machine use	Manure	Total labour	Irrigation
		(Rs.1000/ha)				(q/ha)	(kg/ha)	(Rs./day)	(hours)	(q/ha)	(day/ha)	(hours/ha)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Loss making	22.9	32.2	-9.3	82.5	-59.6	22.8	120	197.5	9.1	20.9	130	60.2
Profit making	40.2	19.3	21.0	48.1	-7.9	38.1	135	445.7	9.5	15.0	112	56.7
All	38.8	20.3	18.5	50.9	-12.0	36.9	133	425.7	9.5	15.5	113	57.0

Cost Structure of Tenants, Unirrigated Farms

In the total sample, tenants are under-represented (only 2.8 per cent of the total sample). The share of irrigated plots were only about 30 per cent, which was also

represented. Even then the data provide some understanding of what was happening to tenants and unirrigated farms in rice. The cost structure of tenants versus owner cultivators and irrigated versus unirrigated is given in Table 6. The major difference between tenants and the owner cultivators was the share of rent paid for leased in land in case of tenants and imputed rent in the case of owners. The share of rent paid for leased in land comprises 46.8 per cent of the costs, ranging from 29.1 per cent in case of bottom 25 per cent of farms to 53.6 per cent in case of top 25 per cent farms. While for owner-farms, the imputed rent is ranging from 21.9 per cent in case of bottom 25 per cent of farms to 35.7 per cent in case of top 25 per cent of the farms. Overall the cost A2 was much higher among tenants (Rs.37 thousand/ha) compared to owner-farmers (Rs.20 thousand/ha). The same is true for cost C2. Yields were higher among tenants (45qtl/ha) compared to owner-farms (37qtl/ha). Even though tenants were with higher yields, the much higher costs leaving them with less profit (Rs.10 thousand/ha) compared to owner-farms (Rs.19 thousand/ha). Again the findings points to the precarious position of the tenants, even though they put almost equal efforts in farming as that of the owner-cultivator, the profits were less due to high land rents(comprising about half of the cost of cultivation).

TABLE 6. SHARE OF DIFFERENT COST COMPONENTS (PER CENT OF TOTAL COST) AND PROFITABILITY OF TENANTS AND OWNERS (TE 2010)

	Tenants			Owners				
Cost/returns	Bottom 25 per cent	Top 25 per cent	All	Bottom 25 per cent	Top 25 per cent	All	Unirrigated	Irrigated
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Family labour	21.6	5.9	9.8	21.2	7.5	11.1	12.4	9.5
Attached labour	0.3	2.2	1.7	0.5	1.9	1.4	1	1.9
Casual labour	11.4	11.6	12.5	17.6	22.1	22.1	25.1	17.7
Hired animal labour	0.3	0.1	0.1	0.9	0.3	0.4	0.6	0.2
Owned animal labour	4.4	0.4	1.8	6.2	1.4	2.9	4.3	1.1
Hired machine	6.8	5.7	5.9	4.4	9.2	7.8	8.3	7.1
Own machine	0.5	3.4	2.6	0.3	1.9	1.3	0.5	2.4
Seed value	3.6	2.8	3.1	3.7	4.8	4.6	4.5	4.5
Total fertiliser	5	5.8	5.5	4.7	6.9	6.3	5.9	6.6
Manure	1.7	0.2	0.7	2	1.1	1.4	1.6	1.1
Insecticides	1.5	3.4	3	0.7	2.9	2.2	1.7	2.8
Own irrigation machine	1.2	2.2	1.9	1.4	1.9	1.7		3.9
Hired irrigation machine	1.6	0.1	0.6	1.1	0.3	0.5		1
Rent paid for leased in land	29.1	53.6	46.8				0.6	3.2
Imputed rent				21.9	35.7	31.7	28.6	32.8
Total depreciation	11	2.6	4.1	13.4	2.2	4.6	4.9	4.2
Total	100	100	100	100	100	100	100	100
Yield (q/ha)	40	55	45	35	41	37	34	44
GN (Rs.1000/ha)	40	59	47	37	46	39	34	49
Cost A2 (Rs.1000/ha)	37	43	37	23	19	20	12	21
Profit A2 (Rs.1000/ha)	3	16	10	14	27	19	25	52
Cost C2 (Rs.1000/ha)	80	65	68	74	41	50	16	24
Profit C2 (Rs.1000/ha)	-39	-6	-21	-37	4	-12	-7	-22

The profitability of irrigated and un-irrigated farms also given in Table 6 indicate that among irrigated farms imputed rent was higher than unirrigated farms. The rental value of leased in land was also higher among irrigated farms (reaching about half of the cost), while among unirrigated farms it is only two-thirds of cost. Gross returns, yields, cost A2 and profits were higher among irrigated farms. However, if we consider full costs (cost C2) irrigated farms incur higher losses than unirrigated farms.

Labour Use and Productivity

The use of labour per unit per land was an important indicator, which provides long run sustainability of farms in the wake of higher wages and declining availability of land (Table 7). As expected in all the states, large farms use less labour compared to small farms (40 per cent less in 2010; only 33 per cent less in 2002). There were two categories of states with less labour use, one with higher level of yields and farm machinery (like Punjab, Haryana and Kerala) and other with high land to labour ratio (Chhattisgarh, Uttaranchal and Madhya Pradesh). On the other hand, states with high labour use with large share of small and marginal farmers (Karnataka, West Bengal, Orissa) and states with highly skewed distribution of land (like Andhra Pradesh and Maharashtra) where small farms were predominant. There was significant inter-state differences coupled with differences among different farm size groups making uniform policy towards judicious use of farm machinery was very difficult.

TABLE 7. LABOUR USE

(*days/ha*)

	Year TE 2002			Year TE 2010		
State	Bottom 25 per cent	Top 25 per cent	Different in yield between top and bottom 25 per cent	Bottom 25 per cent	Top 25 per cent	Different in yield between top and bottom 25 per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Himachal Pradesh				72	47	-35
Punjab	111	60	-46	88	50	-43
Chhattisgarh	115	71	-38	103	56	-46
Kerala	126	87	-31	112	57	-49
Uttarakhand	114	90	-21	111	63	-43
Madhya Pradesh	92	78	-15	60	68	13
Haryana	73	71	-3	121	72	-40
Assam	103	84	-18	97	81	-16
Tamil Nadu	143	106	-26	122	81	-34
Jharkhand	125	96	-23	111	84	-24
Uttar Pradesh	127	85	-33	119	89	-25
Bihar	127	94	-26	112	91	-19
Andhra Pradesh	203	107	-47	143	92	-36
Maharashtra				209	98	-53
Gujarat				134	104	-22
Karnataka	231	135	-42	210	116	-45
West Bengal	160	136	-15	159	125	-21
Orissa	149	127	-15	151	126	-17
Total	142	95	-33	139	83	-40

High Risk Among Small Farms

Risk (measured in terms of coefficient of variation in percent) was much higher among bottom 25 per cent of farms, although small farms have slightly lower risk in gross returns and yields. The risk decreased as plot size increases especially in profitability in both 2002 and 2010 (Table 8). This might be attributed to high variation in cost of cultivation due to unseasonal rains, irrigation costs (hired), labour charges, tenancy among small farms. The high risk in profitability is one of the main reasons for farmer distress in many of the states including Andhra Pradesh Telangana and Maharashtra. The risk in profitability was much lower in states with assured water availability either through irrigation or rainfall (Punjab, Haryana, Andhra Pradesh, Orissa, Gujarat) compared to low-rainfall and rain-fed dependent states (Maharashtra, Tamil Nadu, Madhya Pradesh, Jharkhand and Kerala).

TABLE 8. CV OF RETURNS AND PROFITS

(*per cent*)

TE 2002	GR	Yield	Profit A2	Profit C2
(1)	(2)	(3)	(4)	(5)
Bottom 25 per cent	49	40	196	-197
Bottom 50 per cent	49	42	105	-174
Bottom 75 per cent	52	44	102	-207
Top 25 per cent	55	48	85	-844
Total	52	44	116	-260
TE 2010				
Bottom 25 per cent	46	39	149	-261
Bottom 50 per cent	47	39	92	-253
Bottom 75 per cent	52	43	86	-401
Top 25 per cent	51	46	77	419
Total	51	43	98	-430

Determinants of Gross Returns

A regression equation was run to understand the relationship between farm size and profitability (after controlling for state effects and input use) with gross returns as dependent variable (Table 9). We have used important inputs (seed, fertiliser, machine use, manure, labour and also state dummies as control variables. We have constructed farm size categorical variable (less than 1 ha, 1-2ha, 2-4 ha and > 4 ha as marginal, small, medium and large farms with small (1-2 ha) category as comparison group. We found that large farms earn Rs.2880.1/ha more, medium farms earn Rs.1166.1/ha more and marginal farms earn Rs.1647.8/ha less than small farms in the TE 2010. We have tested robustness of the results by running similar regression for the TE 2002 and found similar results.

TABLE 9. DETERMINANTS OF PROFITABILITY IN TE 2010

(*Gross returns Rs./ha dependent variables*)

(1)	Coefficient (2)	t-value (3)	Mean (4)	MC (5)	MR/MC (6)
Farm size group(small 1-2 ha comparison group)					
Marginal (<1ha)	-1647.8	-7.7			
Medium (2-4 ha)	1166.1	3.0			
Large (>4 ha)	2880.1	4.0			
Seed (Rs./ha)	1.8	22.2	1463.4	1.0	1.8
Fertiliser (kg/ha)	53.1	51.9	133.4	14.6	3.6
Machine (hours/ha)	72.0	11.6	9.5	315.9	0.2
Manure (q/ha)	4.5	3.0	15.5	62.1	0.1
Labour (hours)	3.9	15.7	907.0	15.0	0.3
Tenant	-228.5	-0.5	0.03		
Irrigation	1700.4	9.3	0.32		
State					
Punjab	25268.0	56.9			
Haryana	25130.3	40.9			
Andhra Pradesh	13409.8	40.7			
Kerala	11789.3	27.7			
Gujarat	4761.2	11.4			
Karnataka	4517.1	8.4			
Tamal Nadu	1730.2	4.2			
Uttarakhand	4273.8	3.7			
Madhya Pradesh	1745.7	2.8			
Himachal Pradesh	-3644.7	-5.7			
Uttar Pradesh	-2585.2	-7.1			
Maharashtra	-10028.3	-17.0			
Chhattisgarh	-8320.3	-18.0			
Assam	-7659.5	-23.3			
Orissa	-5826.1	-24.1			
Jharkhand	-16163.2	-36.5			
Bihar	-11326.6	-37.2			
Constant	25988.0	65.9			
Adjusted R2	0.55				
Sample size	37516.0				

Note: Gross return (dependent variable) mean = Rs. 38848/ha.

CONCLUSION

The paper examined the state level trends in profitability of rice cultivation in India from the TE 2002 to the TE 2010 by using unit level data of cost of cultivation scheme, Government of India. The sample size was 11, 794 in TE 2002 and 12,385 in the TE 2010. The results show that there was a convergence of profitability across states mainly driven by the spread of irrigation, use of fertiliser and farm machinery. The costs were computed based on Cost A2 and Cost C2. The yield levels, gross returns and profits are having positive association with farm size. About 17 per cent of all farmers were in losses in the TE 2002 and 8 per cent in the TE 2010. The share of loss making farms was 17 per cent among bottom 25 per cent and only 3 per cent among top 25 per cent farmers in the TE 2010. The main finding of the study was after controlling for state effects and other inputs use, plot size having significant positive influence on the profitability.

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