

Trend and Pattern of Costs and Varying Profitability and Determinants of Paddy Crop in Eastern India: A Fixed Effect Approach Using Cost of Cultivation Data

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ABSTRACT

The major eastern Indian states rely heavily on paddy cultivation and since millions of farmers rely on increased agricultural returns, it is pertinent and imperative to understand the factors that determine the value of paddy cultivation's output. The proposed study concentrated on the key factors that influence the value of the output of paddy farming across the states during last two decades and thoroughly covered the trend, pattern and CAGR (compound annual growth rate) of various costs. The Comprehensive Data on Cost of Cultivation published by Commission for Agricultural Prices and Cost (CACPC), Government of India for the last two decades have been used. The results indicate a significant increase in value of output (VoP) as well as total cost (both fixed and operational cost) for the eastern region states during the study period. It has been revealed that an sharp increase in operational cost which may be the result of farm waiver scheme introduced in 2008-09 and further the gap became wider after 2015-16 which may be the result of different agri-based schemes. The extent of profit over cost A2 was not notable in all the selected eastern Indian states while the profits become negative by considering cost C2 and revised C2. The ratio of average profit over cost A2 was highest in Jharkhand followed by West Bengal, Bihar and Odisha. The regression result shows that fertilizer cost, animal labour cost and seed cost are very important in generating value of output of paddy crop.

Keywords: Paddy cultivation, cost of cultivation, farm waiver scheme, agricultural policy

JEL codes: D24, Q10, Q11, Q18

I

INTRODUCTION

The importance of the Indian agriculture to the Indian economy is notable which may be observe by its share of employment and ensuring food security since independence. It has been the most important sector from the perspective of poverty alleviation and employment generation. The agricultural sector has attained a remarkable growth in area and yield in almost all crops and in 1960s the green revolution enhanced the growth rate of crops which led India to become net exporter of some agricultural products. The gross cropped area and net sown area has increased from 131.89 million hectare (mha) to 211.36 mha and 118.75 mha to 139.90 mha respectively during 1950-51 to 2019-20. The net irrigated area has also increased from 20.85 mha to 75.46 mha during this time period. There has been a significant increase in cropping intensity during this time and it rose from 111 percent to 151 percent. The institutional reforms in different point of time in agriculture affected the land distribution of Indian agriculture. It has been seen that 86.07 percent of marginal and small farmers operate 46.96 percent of total area in 2015-16 (Agricultural census, 2015-16).

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The area under production of food grain enhanced from 97.32 mha to 126.99 mha while the production augmented from 50.82 million tones (MT) to 297.50 MT during 1950-51 and 2019-20 at the national level. The yield rate of food grain has been significantly increased from 522 kg/ha to 2343 kg/ha during 1950-51 to 2019-20 in India. It has been observed that the area under irrigation of food grain has increased tremendously from 18.10 percent to 56.96 percent at the same time period. There has been a significant increase in other crops like pulses, high value or commercial crops and horticulture crops etc.

However, the share of agriculture to national income has been declining over the time period and the gross value added of agriculture and allied activities (2019-20 current prices) stood at 18.3 percent while the crop section put the value of 10.3 percent (revised estimates of national accounts) at the national level in 2019-20 (Economic survey, GoI, 2022). It has also been observed that the GDP of agriculture rose 3.2 percent annually which is below the targeted rate of 4 percent in last two decades. The share of gross value of capital formation in agriculture and allied sector in gross capital formation to the economy has also declined 2.35 percent (2019-20 current prices) in 2019-20. It has also observed that the average land holding of all classes of farmers have decreased over time.

Further from late 80's and early 90's, the growth rate of productivity of major crops have been deteriorated due to several policies as neo-liberal policies like reduction of public investment and government subsidies, formal credit support to the farmers, low level of agricultural trade etc. (Dev, 2000; Rao 2003). These led to increase the burden of non-institutional credit and high incidence of indebtedness of small and marginal farmers, low level of farmer's income, agricultural input and product market volatility, and significant crop failure which enhance the distress among the farmers and high rate of farmers' suicide at the national level (Deshpande and Arora, 2010; Reddy and Mishra, 2009). Moreover, in the early 2000, the extensive and enormous farmer's suicides led to the researchers to study on the farmer's income at the national level as well as at the state level. It has observed that the development for agriculture depends on high rate of agricultural growth and improvement in food security which imply that this could done by improved technology, public investments, healthy prices of crops, institutional reforms. It can be argued that any policy was not recognized to raise the farmer's income and welfare (Chand, 2017). But the welfare of the million of farmers depends on the income from the farm sector not only for sustenance but also reinvestment in agriculture. But unfortunately, the farm income issue related study were absent not only by the perspective from various researcher but also from policy makers (Deshpande et.al., 2004; Narayanamoorthy, 2021).

The concern of farmer's income has been discussed in many literatures in last two decades. The "Situation Assessment of Agricultural Households and Land and Holdings of Households in rural India-2003" (SAS) has been completed by Government of India through NSSO which dealt with the details of farmer income as well as the complete situation of farmers at the national level. Two another round report

published in 2013 and 2019 where the data on farmers' incomes as well as overall farmers' situation have discussed. The report indicates that the income from crop and allied sector production dropped while the income from cultivation increased as land size enhances during 2003 and 2016. Gulati et. al. (2021) observed that the farmer income was highest in Punjab (Rs. 23,133 /month) followed by Haryana (Rs. 18,496/month), Kerala (Rs. 16,927/month) and Gujarat (Rs. 11,899 /month) while the bottom states were Odisha (Rs. 7731/month), Bihar (Rs.7175/month), Jharkhand (Rs. 6991/month), Andhra Pradesh (Rs. 6920/month) and Uttar Pradesh farmers (Rs. 6668/month). Further it revealed that the average income of the households was Rs. 2115 per month in 2002-03 which has increased to Rs. 6427 per month 2012-13 which further moved to Rs. 8931 per month 2015-16 (Gulati et. al., 2021).

Another critical study on estimation of farmers' income has been done by Sen (State of Indian Farmer: A Millennium Study, 2004; with 27 Vols., more specifically Sen and Bhatia, 2004) which discussed comprehensively the several issues of Indian farmers along with farmers' income and cost of cultivation etc. Based on cost of cultivation data published by Commission of Agricultural Costs and Prices (CACP), the study revealed that on an average the farm business income was only sufficient to meet the costs. Narayanamoorthy (2006) based on SAS report estimated that farm income only the farm business income as a whole was only Rs 2,837 in 2002-03 for the country. Chand et. al. (2011) estimated farm income based on SAS report and CSO report and found that at the national level the farm income was Rs. 33267 per ha in 2008-09 at 2004-05 prices and marginal farmers who were below to the poverty line occupied 62 percent of farm income. There has an insignificant increase in profit of food grain crops at constant prices due to increase in cost of cultivation (Narayanamoorthy, 2013). Chand et.al. (2015) found that the farm income per cultivator increased by 2.74% a year from 1983-84 to 1993-94 and it dropped to below 2% in the next decade. There exist several studies estimating the farm profitability, farm business income and determinants of input use by taking different crops by using specific Indian states (having highest either production or yield) over time period by taking the data of cost of cultivation published by CACP. Narayanamoorthy et.al. (2022) argued that during 2002-03 and 2018-19, there has been a significant enhancement in income of households associated with agriculture at the national level (both in current prices & 2004-05 prices) by reflecting regional income diversity.

Apart from estimation and report regarding farm income in early 2000, there were several steps have taken by central and different state government not only by giving appropriate minimum support prices for crops but also other targeted schemes for the farmers to enhance the farm income to prevent widespread farmer suicides. These are –The National Agricultural Insurance Scheme (in 2000) which led to relief the farmers for crop fluctuations, Farm Income Insurance Programme (in 2004) was taken to provide income protection to farmers, National Horticulture Mission (in 2006) to increase the production of horticulture crops; National Food Security Mission (in 2007) to raise the production of staple food; Rastriya Krishi Vikas Yojana (in 2007);

Pradhan Mantri Annadata Aay Sanrakshan Abhiyan (in 2008) to provide remunerative prices; most importantly “Debt Waiver and Debt Relief Scheme” in 2008 (the waiver amount was Rs. 10 billion in 2007-08, and it rose to fifty thousand crore in next five years (Mandal, 2022); and in recent time the initiatives were Doubling Farmers’ Income (in 2016); Per Drop More Crop (in 2016) to increase water use efficiency, reducing cost of inputs and increasing productivity at the farm level; the Pradhan Mantri Fasal Bima Yojana (in 2016) an an instrument for insurance service for farmers for their yields; Pradhan Mantri Kisan Samman Nidhi (in 2019) to provide direct cash transfer to the farmers.

The difference between CACP data and SAS data is that SAS provides annual income from crop cultivation per household while CACP deals with crop wise cost and income and input details per ha. The cost of cultivation data published by CACP is very reach data to analysis the income of farmers of any particular crop at any specific states over the time which leads to encourage the policy maker to set the minimum support prices and product & input market volatility.

Thus the present study will look into the trend & pattern of different cost of paddy and determinants of value of output of paddy crop in eastern states of India over the time which is absent in literature. The agricultural growth as well as the performance is dependent on several factors. These are physical inputs development (such as seeds, fertilizers & pesticides); technological development (like irrigation & mechanization); infrastructural development (connectivity, ware house and market facilities); and structural reforms (prices of the product, extension services, training facilities etc.). The present study analyses the physical inputs of paddy crop in India as paddy cultivation is the principle occupation of the selected eastern region states. The specific purpose of the present study is

- (i) to find out the spatio-temporal difference of different costs and CAGR across the states;
- (ii) estimation of profit over different selected costs of paddy crop and
- (iii) different factors associated in determining value of output (VoP) in the selected states.

The paper has been split into four parts viz. significance and relevance of the study, data source and methodology, results and discussion and conclusions.

II

DATA SOURCE AND METHODOLOGY

The major eastern Indian region consists of four states viz. Bihar (BR), Jharkhand (JH), Odisha (OD) and West Bengal (WB). The major crops grown in the selected states are- BR: Rice, Wheat, Maize, Jute, Sugarcane, Potato; JH: Rice, Pulses, Gram, Lentil; OD: Rice, Sugarcane, Jute, Mustard; WB: Rice, Maize, Jute, Potato (Agricultural statistic, Government of India. 2022). In food grain production, Bihar and West Bengal shared 9.9 percent of area and 11.1 percent of production to the national

level in 2019-20. Importantly, at all India level, these three states Bihar, Odisha and West Bengal cover 28.22 percent and 25.69 percent of area and production of paddy in 2019 respectively (Table 1).

TABLE 1. THE IMPORTANT INDICATORS OF THE SELECTED STATE IN 2019-20

Sl No (1)	Indicator (2)	Bihar (3)	Jharkhand (4)	Odisha (5)	West Bengal (6)	All India (7)
1	GVA of agriculture and allied sector (at 2011-12 Constant Prices) growth rates	0.40	-9.51	11.87	2.13	5.5
2	Paddy Yield (kg/ha)	2182	2219	2122	2926	2722
3	Net Irrigated area (thousand ha)	3059	249	1137	3108	75456
4	Gross Irrigated Area to Total Cropped Area (%)	74.5	15.3	29.2	65.7	53.1
5	Cropping Intensity (%)	143	136	114	192	151
6	Irrigated Area under Principal Crops (%)	74.5	15.3	29.2	65.7	53.1
7	Irrigated Area under Paddy (%)	71.1	4.8	31.9	51.1	65.0
8	Per cent of small and marginal farmers (2015-16)	12.6	1.8	3.5	5.5	
9	Per cent of small and marginal farmers operated area (2015-16)	6.6	1.0	4.6	6.0	

Source: Agricultural Statistics at Glance, Government of India, 2022.

The present study has been concentrated on panel data (time-series & cross-section data). The study captures the period from 2000-01 to 2019-20 (two decades) which has been divided into 2 periods *viz.* from 2000-01 to 2009-10 as period 1 and from 2010-11 to 2019-20 as period 2 as the waiver scheme has been launched in 2009 which has an impact on inputs across the states. Next, VoP and cost A2, C2 and Revised-C2 (R-C2), profit, average profit has been calculated. The cost-A2 reflects all actual expenses including the rent paid for lease-in land, cost-C2 indicates all actual expenses plus the imputed value of family labour and cost-R-C2 comprises all the factor of cost C2 with additional value of human labour based on use of higher wage rate. The VoP represents the addition of main and by product of the crop. Finally, for the estimation purpose, FE model of regression has been adopted in determining VoP for the paddy crop.

The FE regression model are represented as-

$$Y_{it} = \alpha_i + \beta_i X_{it} + u_{it}$$

Where Y_{it} = Dependent variable where i reflects BR, JH, OD and WB;

t = from 2000-01 to 2019-20 (total observation is 80);

α_i = intercept term;

β_i = coefficient of the independent variables;

X_{it} = independent variables (the selected independent variables are- \log_{sd} = seed cost (Rs./ha); \log_{fert} = fertilizer cost (Rs./ha); $\log_{anilabpestc}$ = animal labour cost; $\log_{maclabpestc}$ = machine labour cost (Rs./ha);

\log_{irric} = irrigation cost (Rs./ha); and

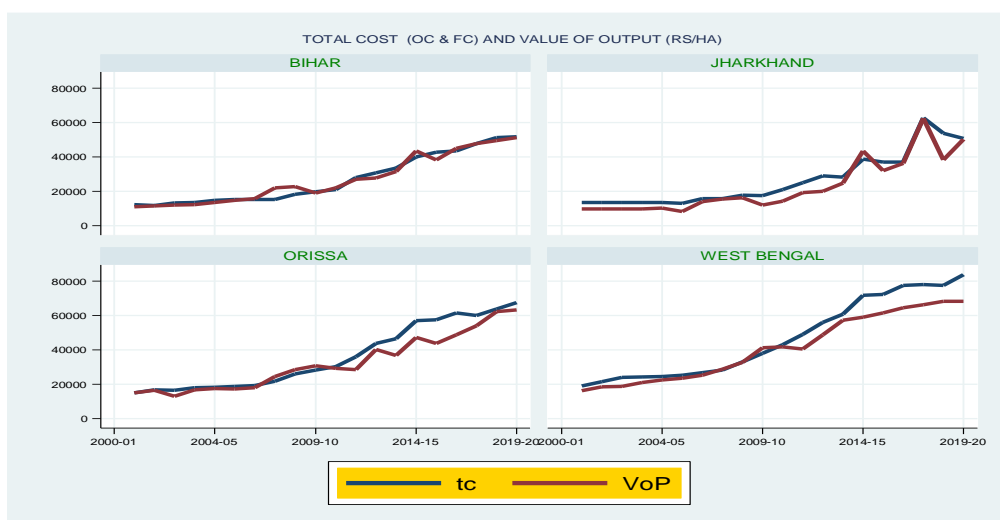
u_{it} = error term.

The FE has been accepted after checking the Hausman test, robust, normality of the data, multi-colinearity, heteroscedasticity. The regression model has been run by taking the log values of the independent variables.

III

RESULTS AND DISCUSSION

The high rate of profit in agricultural sector by the farming households lead to increase in agricultural investment. It has been argued that higher agricultural gross domestic product growth rate may or may not increase the farmer's income while higher returns on cultivation raises agricultural gross domestic product through reinvestment of income generated from cultivation by the farmers (Gulati et. al., 2021). The spatio-temporal variations of total cost and VoP over time is represented Figure 1.



Source: Author's own calculation based CACP data (various years, GoI).

Figure 1 Spatio-Temporal Variation of Total Cost (TC) and Value of Output (VoP)

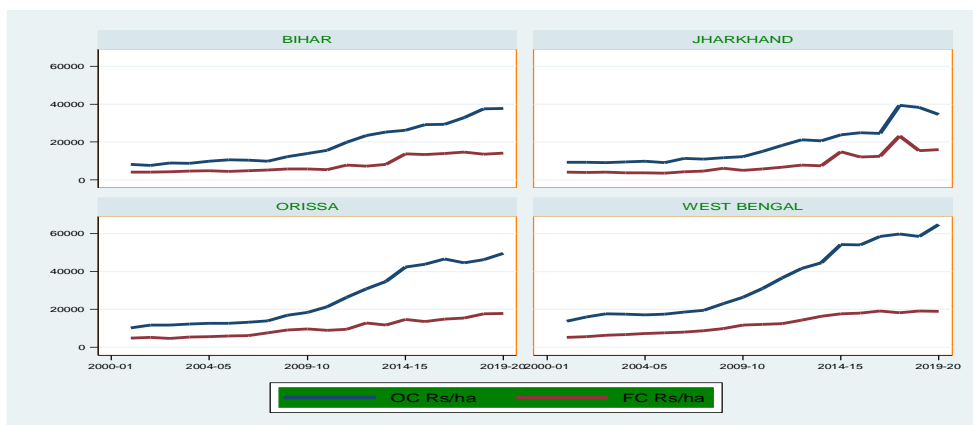
Regular suitable and adequate returns from cultivation are not only important from the food security perspective but also reinvestment the capital in the next agricultural year. Paddy is the principle crops and mainly grown in irrigated area. The total cost and VoP indicates a clear upward trend across the states after 2009-10. It reveals that total cost has always greater that value of output implying farmers were unable to reap profit from paddy cultivation across these four major eastern Indian states. The mean value of total cost was Rs.34057 per ha where as the value of output was Rs. 30843 per ha (Table 2).

TABLE 2 SPATIO-TEMPORAL BASIC STATISTICS OF DIFFERENT COST AND VOP

Variable (1)	(2)	BR(n=20) (3)	JH (n=20) (4)	OD (n=20) (5)	WB (n=20) (6)	Overall (N=80) (7)
Operational Cost	Mean	18899.8	18175.8	26012.5	34562.9	24412.8
	Std. Dev.	10413.5	10007.8	14680.6	18170.1	15022.6
	Min	7565.7	9203.0	10195.1	13746.1	7565.7
	Max	37646.8	39433.2	49555.4	64931.8	64931.8
Fixed cost	Mean	8032.2	8288.9	10092.0	12164.6	9644.4
	Std. Dev.	4141.0	5542.8	4439.7	5136.7	5038.0
	Min	4059.3	3630.1	4760.0	5285.4	3630.1
	Max	14718.8	23316.6	17931.5	19171.3	23316.6
Total Cost	Mean	26932.1	26464.6	36104.5	46727.5	34057.2
	Std. Dev.	14387.3	15374.2	19023.8	23238.5	19816.7
	Min	11625.0	12833.1	15093.6	19031.5	11625.0
	Max	51708.7	62749.7	67486.9	83886.0	83886.0
Value of Output	Mean	26842.3	22726.1	32583.5	41222.2	30843.5
	Std. Dev.	14167.3	15758.7	16172.4	19042.0	17518.0
	Min	10846.3	8084.0	13026.1	16254.8	8084.0
	Max	51245.3	62499.9	63307.0	68345.1	68345.1

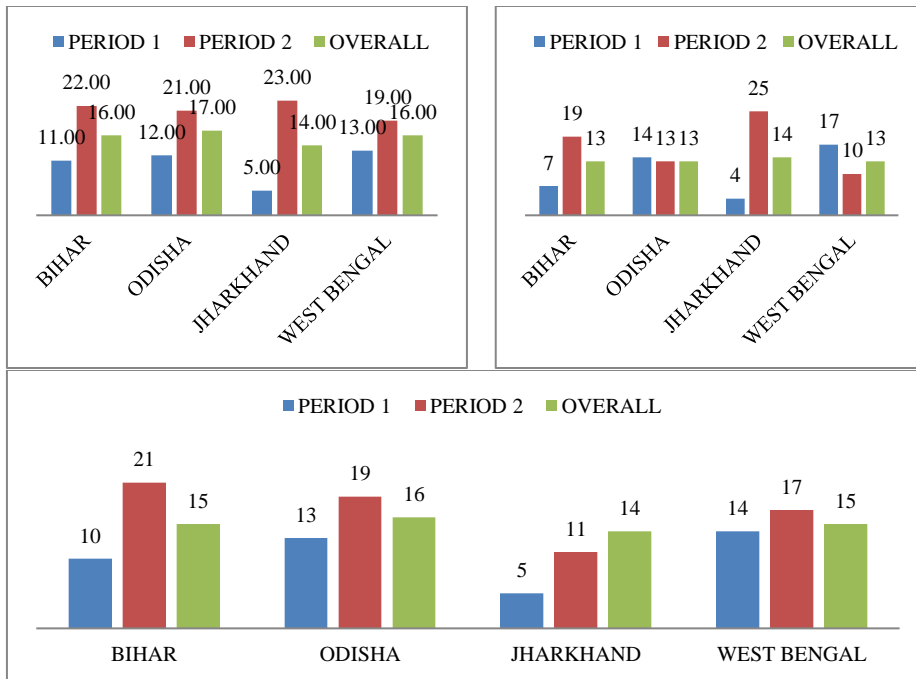
Source: As in Figure 1.

It has been observed that the operational cost increases more compared to fixed cost of the selected states in last two decades. The operational cost was highest in West Bengal (Rs.64931 per ha) followed by Odisha (Rs. 49555 per ha), Jharkhand (Rs. 39433 per ha) and Bihar (Rs. 37646 per ha) while the fixed cost was highest in Jharkhand (Rs. 23316 per ha) followed by West Bengal (Rs. 19171 per ha), Odisha (Rs. 17931 per ha) and Bihar (Rs. 14718 per ha). It has seen that gap between operational cost and fixed cost was highest in Jharkhand and West Bengal. It has revealed that the gap between value of output and total cost of paddy become more widen in Odisha and West Bengal after 2016 compared to Bihar and Jharkhand. It may be argue that due to the debt waiver scheme and different aspects of doubling farmers’ income induced the level of income of the farmers which enhance the investment. The spatio-temporal variation in OC & FC and CAGR has been shown Figure 2 and 3.



Source: As in Figure 1

Figure 2 Spatio-Temporal Variation in OC and FC (Rs. per ha)



Source: As in Figure 1.

Figure 3. CAGR of OC, FC and TC in Selected States

It has been observed that the operational cost and total cost has increased during the selected time zone in the selected eastern Indian states. It has noted that except West Bengal and Odisha, the fixed cost did not increase accordingly. The Figure 3 clearly indicates the rapid increase in operational cost from 2009-10 may be due to the introduction of farm waiver scheme. It has observed that massive increase operational cost for the paddy cultivation across the major states eastern India.

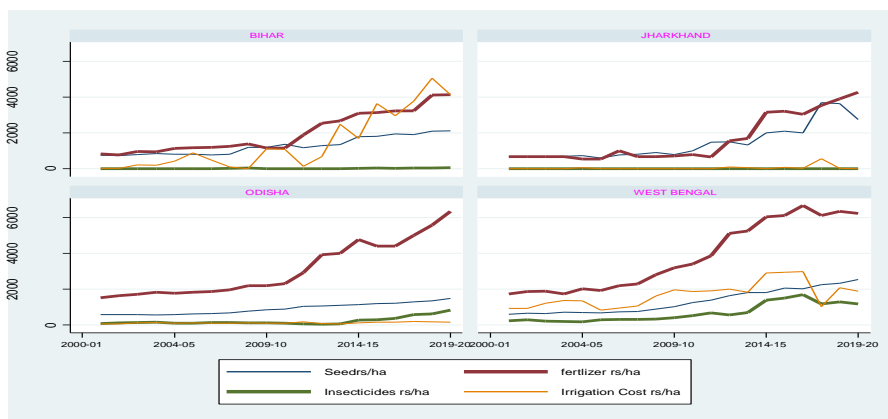
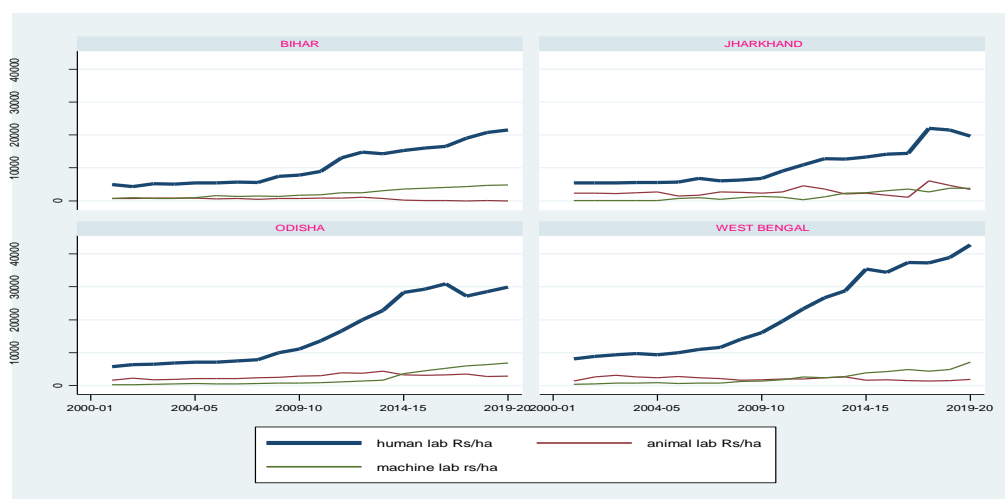


Figure 4 Spatio-Temporal Variation of Inputs Distribution (Rs./ha)



Source: As in Figure 1

Figure 5 Spatio-temporal variation of Labour costs (Rs./ha)

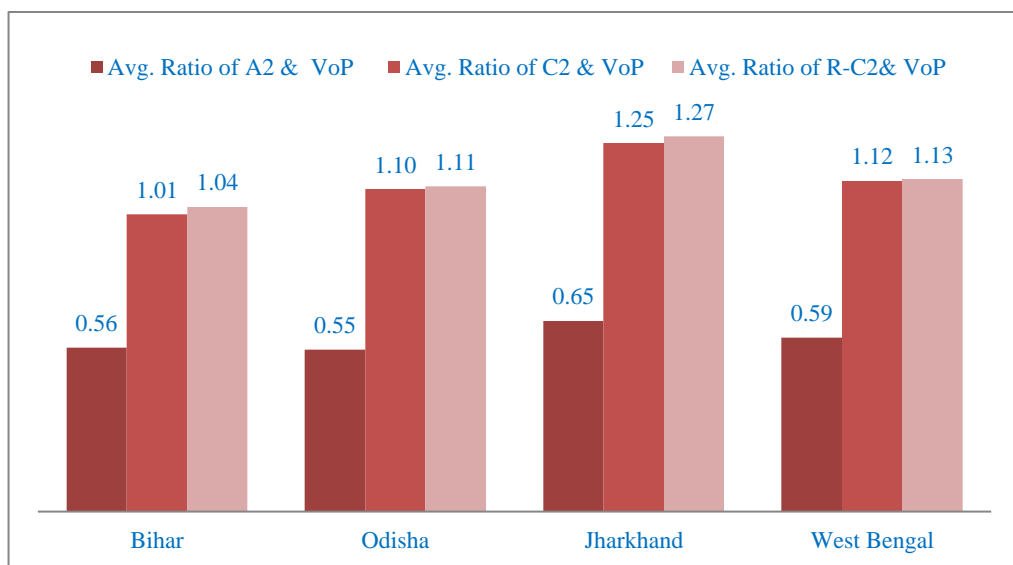
The operational cost includes total labour cost (sum of hired labour cost, animal labour cost and machine labour cost), seed cost, fertilizer cost, pesticides cost, irrigation cost and interest on working capital cost (Figure 4 & 5). It has been revealed that the labour cost accounts for the largest among all expenses across the states. It has been observed that the burden of hired labour cost is more compared to animal labour and machine labour. The human labour cost was highest in West Bengal (Rs. 42807 per ha) followed by Odisha (Rs. 30927 per ha), Jharkhand (Rs. 22076 per ha) and Bihar (Rs. 21493 per ha). The animal labour cost was also highest in Jharkhand while the machine labour was highest in West Bengal followed by Odisha, Bihar and Jharkhand. This implies poor state like Jharkhand has been still using the traditional method for agriculture. It has revealed that the gap between hired labour cost and animal & machine labour cost has increased tremendously after 2009-10. The mean value of hired labour is almost double in West Bengal than other states.

Seed cost has been an important indicator for the cultivation. It has observed that seed cost was highest in Jharkhand compared to Odisha, Bihar and West Bengal. The cost on fertilizer was huge in West Bengal (Rs 6660 per ha) followed by Odisha (Rs. 6337 per ha), Jharkhand (Rs. 4265 per ha) and Bihar (Rs. 4129 per ha). Importantly, in spite of high-quality monsoon, Bihar was spending highest on irrigation. It is evident that the seed cost is more required in paddy cultivation which has been reflected in the table. Fertilizer has been efficiently used in all the states of eastern region. The proper use of fertilizer depends on the optimal doses of the input and the education of the farmers. Further, another important input which has discussed little in literature is the

interest on working capital. It has observed that in all the states, interest on working capital grew at an average of 3.54 percent which is above the agricultural growth.

The welfare of the farmers and doubling farmer's income policy mainly depend on income generated from cultivation and profit from cultivation is very crucial for the overall development of the farmers. As discussed, paddy is the principle crops and mainly grown in irrigated area which will lead to the farmers' to a stay at an improved position and investment.

The spatio-temporal variation of farm profit, cost-A2, C2 & R-C2, average ratio of VoP of paddy crop has been shown in Table 3 & Figure 6 respectively. The magnitude of average profit has not been impressive and shown the positive trend over cost only A2 while costs C2 and R-C2 showing the negative trend in all the states. The farm business income was only sufficient to meet the costs (Sen and Bhatia, 2004). The situation still remains the same. It has noted that the value of profit over cost A2 is highest in West Bengal followed by Odisha, Bihar and Jharkhand. It has also observed that the magnitude of profit over cost A2 in all the states increased significantly after 2009-10. The circumstances of profit over cost C2 and R-C2 is very critical as showing the negative return (average) implying the threat towards the farmers in general and small and marginal farmers in particular. The situation has been slightly better for farmers of Bihar as the farmers were getting 12 negative returns in cost C2 while it stood 16 negative in R-C2 cost.



Source: As in Figure 1

Figure 6 Spatio-Temporal Variation Average Ratios of A2, C2 & R-C2 with Value of Output (VoP)

TABLE 3 SPATIO-TEMPORAL VARIATION OF FARM PROFIT FOR PADDY OVER COST A2, C2 AND R-C2 (RS. '000 PER HA)

State	Profit	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	Avg.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
	Profit over	4.28	5.17	4.63	5.29	5.33	5.43	6.81	13.51	12.60	7.78	10.05	13.10	9.71	12.08	23.26	15.24	21.96	22.28	20.88	21.47	12.0
	A2																					
BR	Profit over	-1.40	-0.20	-1.32	-1.26	-1.26	-0.58	0.41	6.81	4.40	-0.81	0.99	-0.98	-2.93	-1.84	3.39	-4.38	1.49	0.03	-1.86	-0.46	-0.1
	C2																					
	Profit over	-1.95	-0.88	-1.39	-1.26	-1.26	-0.58	-0.84	6.01	4.28	-2.33	-0.36	-0.98	-2.93	-2.38	3.39	-4.54	-0.84	0.03	-2.18	-2.78	-0.7
	R-C2																					
	Profit over	7.36	7.61	4.21	7.31	7.87	7.23	7.75	13.85	15.42	16.55	13.28	10.50	19.63	14.10	20.89	16.75	19.77	25.11	30.75	29.27	14.8
	A2																					
OD	Profit over	-0.02	-0.37	-3.42	-1.15	-0.73	-1.69	-1.45	2.71	2.68	2.61	-1.15	-7.39	-3.37	-9.84	-9.76	-13.62	-12.67	-6.03	-1.58	-4.18	-3.5
	C2																					
	Profit over	-0.02	-0.37	-3.82	-1.52	-0.78	-1.76	-1.57	1.45	2.40	1.80	-1.56	-7.51	-3.80	-10.14	-9.79	-13.62	-12.67	-6.03	-2.27	-4.75	-3.8
	R-C2																					
	Profit over	3.54	3.48	3.60	3.37	3.25	1.44	4.98	6.41	6.65	1.37	1.83	6.10	3.51	7.70	25.12	13.21	18.58	34.24	10.93	25.74	9.3
	A2																					
JH	Profit over	-3.77	-3.73	-3.80	-3.65	-3.40	-4.75	-1.84	-0.37	-1.48	-5.42	-6.75	-5.72	-9.09	-3.46	4.58	-5.09	-0.86	-0.25	-15.45	-0.49	-3.7
	C2																					
	Profit over	-3.84	-3.86	-3.81	-3.91	-3.23	-4.91	-1.88	-0.37	-1.48	-7.19	-7.83	-5.89	-10.33	-3.90	3.56	-5.91	-1.31	-0.25	-15.64	-0.77	-4.1
	R-C2																					
	Profit over	6.67	7.14	5.74	8.39	9.82	10.46	11.47	14.54	14.78	21.28	18.87	12.93	19.73	25.49	21.05	23.30	24.45	25.97	28.70	22.69	16.7
	A2																					
WB	Profit over	-2.78	-3.08	-5.15	-3.02	-1.90	-1.78	-1.56	0.51	-0.43	3.03	-1.26	-8.63	-7.08	-3.61	-12.88	-10.69	-12.99	-11.85	-9.42	-15.54	-5.5
	C2																					
	Profit over	-3.39	-3.30	-5.54	-3.22	-2.08	-1.78	-1.61	0.46	-0.43	3.03	-1.26	-8.63	-7.08	-3.61	-12.88	-10.69	-12.99	-11.85	-9.42	-16.08	-5.6
	R-C2																					

Source: As in Figure 1

It has been anticipated that the farmers would not get any benefit from agricultural production if the ratio of cost and VoP is equal to 1. The ratio larger than 1 is referred to a negative profit and smaller than 1 is referred to a positive profit (Narayanamoorthy, 2013). The present study reveals that the farm profit ratio of VoP & cost A2 are positive whereas VoP & C2 and VoP & R-C2 reflect the negative profit across the states.

IV

THE DETERMINANT GROSS VALUE OF OUTPUT: A FIXED EFFECT APPROACH

The farmer's welfare depends on the profit of the positive value of output from agricultural practice. As the major states of eastern region is highly dependent on paddy cultivation and millions of farmers' income depend on higher return from cultivation, it has very crucial to study the important factors associated in generating the VoP of paddy crop. The paddy crop are generally grown in irrigated area and all the states having higher rate of gross and net irrigated area. The share of area and production of paddy cultivation of these states are 27.49 percent and 25.69 percent respectively compared to the national level in 2019-20 which could be a good representation of the paddy grower.

The important regression coefficient of value of output has been presented in Table 4. The present study has covered those determinants (by removing the variance influencing factor and heteroscedastics problems like there was highly correlation between fertiliser cost and pesticides cost, human labour and machine labour, irrigation cost and human labour cost etc.) having an impact on dependent variable. It has been revealed that the fertilizer cost is positively and significantly associated (1 percent level) with value of output implying higher uses of fertilizer increases the productivity which ultimately increases the rate of return. Seed is very important indicator for paddy

TABLE 4 RESULTS OF REGRESSION MODEL: DEPENDENT VARIABLE LOGVOP

Fixed-effects (within) regression		Number of observation =	80
Group variable: year1		Number of groups =	20
R-sq: within = 0.9043		observation per group: min =	4
between = 0.9574		avg =	4.0
overall = 0.9174		max =	4
corr(u _i , X _b) = 0.6668		F(5,55) =	103.91
		Prob > F =	0.0000
	Coefficient	Std. Err.	P>t
Log Fertilizer Cost	0.5152	0.0474	0.00*
Log Animal Labour Cost	0.0450	0.0285	0.12****
Log Seed Cost	0.2904	0.1525	0.06***
Log Irrigation Cost	0.0539	0.0209	0.01**
Log Machine Labour Cost	-0.0182	0.0383	0.63
Constant	5.138	0.6375	0.00*
sigma_u	0.2029		
sigma_e	0.1035		
rho	0.7935	(fraction of variance due to u _i)	
F test that all u _i =0:	F(19, 55) = 3.56	Prob > F = 0.0001	

Source: As in Figure 1;

*, **, ***, and **** represents 1%, 5%, 10% and 15% level of significance.

cultivation and the association is positive (10 percent level of significant). This showed that seed has used efficiently across the states. The irrigation cost is significant (1 percent level) and positively associated with value of output implying utilizing the input appropriately. The machine labour cost has been negatively associated with VoP for paddy crop. It may be argued that the small and marginal farmers have still engaged in traditional agriculture by employing higher rate of animal labour which is significantly associated with value of output. Thus it has been observed that yield augmenting cost intensive inputs are highly and significantly associated with the value of output.

V

CONCLUSION

According to the current analysis, all states experienced a significant increase in both the total cost and VoP after 2009-10. It may be argued that the Government of India's 2008-09 farm waiver initiative was the cause of the sharp rise in operating costs from 2009-10. Furthermore, it has been noted that in four eastern Indian states where paddy is the main crop, the cost of paddy has grown since 2016. It is also apparent that the operational cost's CAGR increased from 2009-10 to 2019-20 (period 2) as opposed to from 2000-01 to 2009-10 (period 1).

In all states, the profit margin over cost A2 was not very significant; nevertheless, when cost C2 and R-C2 are taken into account, the profit margin turns negative. Nonetheless, there has been variation in profit over various costs among the states. Jharkhand had the highest average farm profit ratio during this period over cost A2, followed by West Bengal, Bihar and Odisha. In case of cost C2 and R-C2, farmers were in losses from cost of cultivation. The regression result shows that fertilizer cost, animal labour cost and seed cost are very important in generating value of output.

It is challenging to make any conclusive remarks about paddy crops throughout the selected eastern states. Importantly, the price of any particular input varies across the states which ultimately reduce the level of profit. More specifically, authorized seed, fertilizer, insecticides dealer (at the grass root level) and informal water market may be played a significant role in suppressing the high return from cultivation. For example, farmers borrow money at a high interest rate from the local moneylender before planting and the farmers ended-up with post-harvest loss which enhances the burden of indebtedness. Another cause may be the land relation for low return in paddy cultivation across the states.

The different type of rigorous dissemination program should be arranged at the village, block and district level for the awareness of the farmers regarding inputs for the paddy cultivation. The central government's special programmes viz., National Food Security Mission (NFSM), Rastriya Krishi Vikas Yojana (RKVY), National Horticulture Mission (NHM) and Agricultural Technology Management Agency (ATMA), minimum support prices and so on and parallel to this state government

scheme, training and facilities would be useful across the states in improving income of the farmer and indeed the growth and equity in agriculture.

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