AN IMPACT ASSESSMENT OF TECHNOLOGICAL DEVELOPMENTS IN PADDY PRODUCTION IN INDIA

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Abstract - The present study understands the role of technology in paddy production, and finds the gap for technological developments across regions and draws inferences for potential regions. The results suggest that Haryana, Punjab and Kerala are most stable state for sustained paddy production, well equipped with technological advancements. Regions Andhra Pradesh and Tamil Nadu are more adapt at technology. In sum, the higher return generating states have adopted technology faster than other states. From panel data estimation it is found that there is a positive and statistically significant impact of technology on paddy yield in Indian regions. States such as Assam, Bihar, Orissa and West Bengal are identified as potential states for adoption of technology. The study builds an argument to incentivize the paddy growers through remunerative price for their produce. Based on input use pattern of fertilizers, irrigation and pesticides, there is ample scope for Punjab, Haryana and West Bengal towards implementation of System of rice intensification techniques for sustainable development.

Keywords - Benefit cost analysis, financial position, panel data estimation and technology.

I. INTRODUCTION

Agriculture sector in India has caught centre stage for its pre-dominant contribution to employment , having backward linkages for the industrial sector, and most recently the realization of ambitious goal of food security . Apart, the lasting impact of developed agriculture sector in terms of self sufficiency, poverty alleviation, food security, etc. is well envisaged in the economics literature. In this backdrop Indian government has laid down substantial efforts for agriculture sector in terms of introducing high yield varieties, improved technologies, practices, ensuring procurement at reasonable price, etc. The recent launch of crop insurance scheme, understanding the need for fertilizer reforms and broadening the minimum support price procurement basket, etc. are among the few sleuths perceived to boost the agricultural produce.

Few economics literature pointed out that cereals yield growth has slowed down in developing countries, and thereby puts the question for realization of food security target. Even the food security problem is aggravated under WTO provisions of capping on subsidies in agreement on agriculture. Herein the possible solution rests on boosting agricultural output through enhanced investment. It is observed that farmers being rational agent base their production decisions on profitability condition of crops. In this direction the protection of economic interests of farmers which rest on crop profitability is the most promising agenda. The importance for return generating capacity is heightened when literature points out the ill effects of irregular income and inadequate flows in terms of surmountable indebtness , farmers' suicides , below potential investment , social disequilibria, etc. Few studies have argued that the technological advancements have resulted into enhanced yield, but parallel concern for stagnant prices for agriculture produce with rising prices for other inputs render them with low returns and thereby resulting below potential level investment in the agriculture sector.

It is hypothesized that ensured profit boosts investment and help in adoption of technologies in-turn sustaining the agricultural production. The bi-directional causality between ensured profit and technological advancement is subject matter of discussion in the recent economic literature. In light of these hypotheses, the present study captures the profitability scenario of paddy production in India and goes in-depth in exploring possible reasons thereof associated with either growing yield or cost controlling or rising prices of paddy produce or any combination thereof for different regions of India. Moreover the study adds the knowledge in terms of identifying the alignment of Indian rice regions with the technological development and exploring the next potential states. Finally study captures the role of technological developments in enhancing the return capacities of producers.

Remaining part of the study is organized as follows-next section reviews the existing relevant literature. Third section outlines the methodology of study. Fourth section explores the role of technology. Finally the study is concluded.

II. REVIEW OF LITERATURE

In terms of benefit-cost ratio it is pronounced that the rice yield has increased over the period of time. But there is parallel concern of rising input costs to the farmers eventually lending them to the lower net returns. Singh at el (1990) observed the benefit cost ratio in Uttar Pradesh region of India during 1986-88 for the different cropping pattern where it was found that highest benefit cost ratio of 2.08 for Rice-Lentil-fallow followed by rice wheat of 1.77. In Punjab the farm income per hectare has come down over the years because Minimum Support Price (MSP) increased on average by one percent while the prices of inputs rose by 3.5 percent (Singh 2009). The steep rise in the cost of cultivation is one of the main reasons for the low profit margin or loss in crop cultivation (Bhalla and Singh, 2009). Dev and Rao (2011) found that rice cultivation is becoming less and less remunerative to the cultivators. They observed the varying cost of cultivation and same has increased substantially over the period of time, thus resulting to declining trends of net returns to rice producers. The declining return trend may put a pressure on the sustainability of paddy as farmers may get discourage if their risk exposure to crop yield is not addressed. Narayanmoorthy (2013) pointed out for Andhra Pradesh that farmers were not able to recover the cost of cultivation from the value of output of paddy. Cost of cultivation of crops has been increasing over the years because of rise in wage rate of labor, input prices and other managerial costs (CACP, various reports). In state-wise analysis Samal (2013) highlighted that states like Andhra Pradesh, Punjab, and Haryana could score positive and significant growth in profits. However the profits for states Assam, Bihar, Madhya Pradesh, Orissa, West Bengal, Uttar Pradesh, Kerala and Tamil Nadu have been found negative.

In terms of cost composition states have different cost structures as Punjab stands out as having among the highest fixed costs of total cultivation costs. In 2011, fixed costs accounted for 53.4 and 57.9 percents of rice and wheat cultivation costs, respectively in the state. This has been attributed to the higher land rental cost in Punjab relative to other states. In economic theory, the higher proportion of fixed costs to overall costs increases farmers' vulnerability to an agricultural downturn. In Orissa, the working animals are contributing significantly in total operating costs. In Punjab, machinery has displaced human labor. In West Bengal, the share of machine labour in total input costs is quite low. The paddy and potato farmers in this state are operating at mere subsistence level, with gross revenue covering only the operational costs (Shekhar and Bhatt, 2014). The study extends the existing literature by two ways- first, quantifying the profitability scenario of paddy production in the recent environment particularly when India has travelled a long journey of extensive research and technological advancement. Second, to the best knowledge of author existing literature has addressed return pattern, yield behavior, cost components, benefit-cost analysis, technical advancements for different crops across regions partly, this study brings all these dimensions under one umbrella for leading rice producing regions of India.

III. RESEARCH METHODOLOGY

The study utilizes leading Indian paddy producing twelve regions contributing more than 80 percent of rice output. These regions are Andhra Pradesh (AP), Assam, Bihar, Haryana, Kerala, Karnataka, Madhya Pradesh (MP), Orissa, Punjab, Tamil Nadu (TN), Uttar Pradesh (UP) and West Bengal (WB). The study is descriptive in nature and utilizes secondary data for the period 2000 to the latest published data 2013. The cost of cultivation includes general expenditure of manpower, raw material, etc. plus the rented value of owned land plus imputed value of family labor. The cost composition is highlighted in terms of contribution of individual component to the total operational cost of rice for respective state. Impact of technology is captured through econometric methodology as discussed in section 5. The data is extracted from national sources- cost of cultivation survey compiled from the various reports of the Commission for Agriculture Cost and Pricing (CACP) and Agriculture Statistics at Glance (ASAG).

3.1. Econometric Models

The present study identifies the impact of technology on paddy yield for Indian regions. Keeping into account the availability of panel data, study employs the fixed effects (FE) and random effects (RE) models. The specification of ordinary least square technique for panel data under fixed effect model is as follows:

$$G_{it} = \beta_{1i} + \beta_2 X_{2it} + \beta_3 X_{3it} + \varepsilon_{it} \quad (1)$$

Where i and t subscript are for each individual and time respectively. G is the dependent variable (paddy yield) and X_is are explanatory variables. In this model slope coefficients remain constant across time and individual. But in many panel data sets the fixed effects may appear random also. In order to capture this effect, random effect model was introduced. This model considers orthogonal condition of no correlation between white noise (u_i) and explanatory variables. It is defined as:

$$G_{it} = \alpha_1 + \alpha_2 X_{2it} + \alpha_3 X_{3it} + (\varepsilon_{it} + u_i) \quad (2)$$

$$= \alpha_1 + \alpha_2 X_{2it} + \alpha_3 X_{3it} + v_{it} \quad (3)$$

Where now α_1 is the intercept parameter, and v_{it} is composed of a component u_i that represents a random individual effect and a component e_{it} is the usual regression error term (Hill et al. 2011). The selection of either of these two techniques is made on the basis of Hausman statistic.

The study specifies following models while considering the given explanatory variables as:

$$G_{it} = \gamma_1 + \gamma_2(lal_{it}) + \gamma_3(lhl_{it}) + \gamma_4 lmc_{it} + \theta_2 lseed_{it}) + \theta_3 lfmd_{it} + \theta_4 linsct_{it} + \varepsilon_{it} \quad (4)$$

Where G represents paddy yield, lal is animal labor cost, lhl- human labor cost, lmc- machine costand proxy for technological advancements, lseed- seed cost, lfmd- fertilizer and manure cost, linsct is insecticide cost. All variables are in per hectare form and presented in log form. Here machine cost is considered as proxy for technological developments.

IV. COST STRUCTURE FOR PADDY PRODUCTION

The cost composition explores the plausible sources of rising costs and highlights the vulnerabilities of paddy producers towards a caution on its further usage. The key cost components are animal cost, fertilizer cost, human labor cost, insecticide cost, irrigation cost, machine cost and seed cost. It also helps in identifying the potential exposure of farmers towards technological advancements.

4.1. Operational Cost out of Total Cost in Respective State

It is observed that TN has highest per hectare operational cost followed by Kerala, Karnataka, AP and WB. In most of states the operational cost has gone up by more than two folds in the past decade. The share of operational cost stood more than 70 percent in the total cost for respective states such as Bihar, Kerala, Tamil Nadu, Uttar Pradesh (UP) and West Bengal (WB). Haryana and Punjab are more exposed with fixed cost which puts the rice production under vulnerable condition. It may be interpreted that the enhanced yield through varietal developments is inviting the attention of farmers as an opportunity and thereby they are ready to hire the land even at higher rent. On the one hand it is very interesting but it may put a wrong incentive for the paddy growers as once they are exposed with high fixed cost then they try hard to increase the yield by using more of fertilizers and pesticides which has implications for environment degradation. It is evident that insecticide cost is high in Punjab and Haryana however the fertilizer cost is on lower side. Lower fertilizer cost is not associated with less usage of fertilizer rather due to higher subsidies rate. But these states are among the extensive users of fertilizers.

4.2. Component wise Cost Analysis

The cost structure is further presented in terms of share of individual cost components in total operational cost of respective region. In the operational cost share Andhra Pradesh has increased the spending on machine cost meaning by more adoption of technology (Table 1). The cost of fertilizer and manure has decreased substantially from 16 percent during 2000-03 to 12 percent during 2010-13. In all the select regions, larger chunk of operational cost is coming from human labor, however it has come down in recent past. In Assam one fifth is contributed by animal labor cost. Fertilizer and insecticide cost occupy less than 5 percent of total operational cost. In Bihar fertilizer and machine costs hold 10 percent each of the operational cost. State is standing on third position after UP and MP for seed cost. It may be outcome of inadequate supply of seeds by government agencies in the states. In Haryana the highest spending goes to irrigation and machine purposes, after the human labor. Punjab is the second region in terms of highest irrigation cost, and surprisingly the state is standing on first position in spending on insecticide purpose. Haryana and Punjab have experienced a sharp fall in machine cost shares after the peak level of 15.6 and 21.4 percents during 2007-09 to 11.8 and 18.5 percents, respectively in the recent years. It may be interpreted that these states are already endowed with considerable technological advancements.

Composition	State	2000-03	2004-06	2007-09	2010-2013	2000-03	2004-06	2007-09	2010-2013
		Cost (%) of total operational cost of respective state				**Per-hectare cost**			
Animal Labor Cost	AP	5.8	4.4	3.1	1.8	1033	788	689	641
	ASM	23.5	25.6	25.2	21.5	2102	2564	2989	4233
	BHR	8.7	7.7	5.9	4.8	716	746	645	865
	HRY	0.4	0.4	0.5	0.5	63	72	95	151
	KRL	1.3	1	0.2	0.5	249	218	61	190
	KRNTK	9.6	9	8.6	6.4	1969	1990	1853	2172
	MP	22.2	18.6	15.7	12.4	1761	1529	1555	2088
	ORSA	18.1	16.8	15.8	14.2	2030	2110	2311	3392
	PNJB	0.4	0.3	0.6	0.4	55	50	114	106
	TN	4.2	3.2	2	0.9	864	695	519	356
	UP	5.4	5	6.5	4.2	582	627	978	1119
	WB	14.9	14.7	10.3	6.1	2403	2553	2055	2052
Fertilizer cost	AP	16	16.4	14.6	12.4	2830	2919	3354	4604
	ASM	3.8	3.5	3.6	3.8	340	349	420	776
	BHR	10.4	11.1	11.5	9	855	1084	1248	1683
	HRY	15.9	14.9	12.3	9.8	2458	2830	2583	3160

Composition	State	2000-03	2004-06	2007-09	2010-2013	2000-03	2004-06	2007-09	2010-2013
		Cost (%) of total operational cost of respective state				**Per-hectare cost**			
	KRL	14.1	13	11	11.5	2730	2778	2677	4273
	KRNTK	21	23.4	20	17.7	4279	5176	4214	6516
	MP	14.8	16.9	13.1	16	1175	1387	1305	2868
	ORSA	14.6	14.4	13.7	11.6	1624	1808	2007	2835
	PNJB	15.9	15.7	15.6	12.8	2203	2497	2683	3366
	TN	16	16	15.3	14.5	3244	3470	3987	6207
	UP	13.4	13.8	13.2	12.9	1431	1726	2000	3555
	WB	11.6	10.9	11.9	11.5	1827	1893	2432	3891
Human Labor	AP	49.9	49.6	53.4	54.4	8811	8809	12626	19915
	ASM	62.9	61.9	60.7	61.8	5610	6187	7282	12320
	BHR	58.5	54.3	56.9	60.5	4802	5300	6220	11150
	HRY	44.3	41	44.6	51.3	6852	7812	9441	16381
	KRL	66.7	68.5	65.5	54.9	12959	14612	16002	19511
	KRNTK	43.6	42.6	45.4	47.8	8800	9389	9821	16958
	MP	46.1	43.9	46	45.2	3644	3609	4580	7691
	ORSA	55.9	55.9	57.6	62.9	6244	7025	8463	15310
	PNJB	31.8	29.9	36.1	43.7	4394	4767	6335	11493
	TN	47.5	44.5	46.6	45.7	9655	9628	12142	19115
	UP	48.6	46.3	45.9	46.9	5177	5775	6922	12886
	WB	55.9	55.8	59.7	63	8789	9708	12209	21417
Insecticide cost	AP	5.1	6	5	4.5	903	1068	1183	1646
	ASM	0.1	0.1	0	0	5	5	2	8
	BHR	0	0	0.2	0	2	5	26	4
	HRY	5.8	8.1	6.5	5.4	907	1533	1379	1759
	KRL	1	1	1.4	2.8	196	207	343	1019
	KRNTK	4	4.2	2.3	3	807	924	475	1162
	MP	0.2	0.2	1.3	2.2	15	16	143	402
	ORSA	1	0.9	0.9	0.4	112	116	132	85
	PNJB	8.6	9.1	9	9.7	1163	1447	1572	2554
	TN	1.6	2.1	2	2.5	335	444	516	1056
	UP	0.5	0.6	0.8	1.3	57	76	127	400
	WB	1.6	1.3	1.5	1.6	243	220	314	541
Irrigation cost	AP	7	5	2.5	2.2	1236	891	574	822
	ASM	0.4	0.2	0.8	0.7	35	24	95	137
	BHR	0.9	4.9	1.9	4.7	80	499	197	757
	HRY	17	16	14.3	15.8	2692	3048	3003	5234
	KRL	0.2	0	0.1	0.5	33	7	35	179
	KRNTK	5.6	3.1	3.9	1.3	1147	677	821	478
	MP	2.7	2.7	2.3	0.9	210	223	223	130
	ORSA	0.7	0.9	0.7	0.5	80	116	105	114
	PNJB	16.1	18.3	10.1	7.7	2383	2922	1686	2029
	TN	5.1	6.1	4.4	3.1	1051	1311	1128	1299
	UP	9.2	11	9.7	8.1	995	1401	1429	2144
	WB	6.5	6.8	5.8	5.9	1020	1188	1211	1934
Machine Cost	AP	9.2	11	14.4	16.4	1631	1962	3411	6020
	ASM	2	1.8	2.9	6.4	179	177	370	1293
	BHR	9.8	11.1	12.7	11.6	797	1110	1366	2100
	HRY	11.7	14.5	15.6	11.8	1821	2762	3295	3772
	KRL	9	9.1	14.8	22	1739	1952	3667	7842
	KRNT	9.2	10.8	13.4	16.1	1847	2352	2860	5845

Composition	State	2000-03	2004-06	2007-09	2010-2013	2000-03	2004-06	2007-09	2010-2013
		Cost (%) of total operational cost of respective state				**Per-hectare cost**			
	K								
	MP	3.3	7.1	9.7	12.4	268	585	950	2246
	ORSA	2.4	4.2	4.3	4.4	271	529	633	1070
	PNJB	20.5	20.2	21.4	18.2	2835	3230	3723	4746
	TN	11.6	15.5	18	18.6	2373	3354	4705	7728
	UP	11.2	11.5	11.5	14	1203	1441	1765	3972
	WB	3.4	4.2	4.6	5.9	542	735	945	2003
Seed Cost	AP	4.5	4.7	4.3	5.5	790	829	994	1935
	ASM	5.7	5.2	5.2	4.1	505	524	615	786
	BHR	9.3	8.4	8.4	7.2	759	821	921	1254
	HRY	2.5	2.5	3.8	3	381	475	800	972
	KRL	5	4.6	4.4	5	967	983	1076	1807
	KRNTK	4.2	4.3	3.8	5.2	851	939	819	1898
	MP	8.5	8.5	9.7	8.6	665	700	963	1468
	ORSA	5.1	4.7	4.7	4	563	590	689	959
	PNJB	4	3.8	4.4	5	541	607	760	1303
	TN	11.3	9.9	9.1	12	2293	2134	2396	4994
	UP	9.3	9.5	10.2	10.3	987	1193	1527	2893
	WB	4	4	3.9	3.9	627	691	789	1329

Source: Author's Computation from Directorate of Economics and Statistics, Government of India (GOI)

Table 1: Disaggregate Level Analysis of Cost of Cultivation across States

In Kerala, the machine cost share out of total operational cost has increased from 9.0 percent during 2000-03 to 22 percent during 2010-13. One interesting observation is that Kerala has reduced substantially the human labor cost share from 66.7 percent during 2000-03 to 54.9 percent in the recent couple of years. Notably the state could score better profitability in the recent past. It may be inferenced that the technology adoption by Punjab, Haryana and Kerala has proved beneficial for these states and vice versa as well.

In case of Karnataka, fertilizer consists 17.7 percent of total operational cost, machine cost 16.1 and irrigation cost 1.3 percent. Tamil Nadu and Andhra Pradesh are also standing on higher side. These states have increased the intake of fertilizers , and at the same time it is costly in these states. The high exposure to these costs motivated the states to launch the of System of Rice Intensification (SRI) technique eventually reducing the fertilizer, irrigation and insecticide cost as percentage of operational cost. SRI is method of cultivation for increasing the productivity of irrigated rice by changing the management of plant, soil, water and nutrients. SRI has been purposefully called a system rather than a technology as it involves the holistic management to give ideal growing condition to rice plant. Punjab has substantially reduced the irrigation spending in the recent past mainly subsidized electricity. Karnataka has also reduced the per hectare spending from Rs. 1147 during 2000-03 to Rs. 478 recently. The launch of solar energy by Government of India puts forth ample scope for paddy producers to use it for irrigation purposes.

For MP, the dominating cost factors are animal labor, fertilizer cost and machine cost. However with the passage of time, the state could move towards more technological advancements as observed with the rise in machine cost share from 4 percent during 2000-03 to 12.4 percent during 2010-13 and fall in animal labor cost from 22 percent to 12 percent for the same period. Orissa is largely spending on human labor consisting three fifths of total operational cost along with animal labor and fertilizers. Tamil Nadu has experienced sharp increase in machine cost from 11.6 percent during 2000-03 to 18.6 percent in the recent past. Irrigation and insecticide cost contributed around 5 percent of the total operational cost in the state. Uttar Pradesh is also adapting at mechanization. In case of West Bengal, the share of machine cost is marginal in the total cost. A substantial amount is spent for fertilizers and irrigation purposes. Punjab and Haryana are the top states among irrigation spending. In this case the experiences of AP, Karnataka and Kerala can be utilized in terms of exploitation of SRI techniques for Haryana, Punjab , UP and West Bengal.

In terms of machine cost the utilization of machines has taken place in India in early 2000s however the states Kerala and others have pursued for mechanization in the recent years. Per hectare spending is substantial in states Kerala followed by

TN and AP. Interestingly the increase in price of paddy has been proportional to input prices and coupled with rise in yield has turned these states into profitable states. Kerala was a state having 6th rank in profitability during 2000-03 and moved to 2nd stage during 2011-13, whereas AP and TN have ensured top ranking in yield but could not improve the profitability condition in the past decade. The difference was mainly emanated from remunerative price of paddy produce. Assam, Bihar, Orissa and WB are less aligned to the technology adoption as evidenced from lower share of machine cost in total operation cost. These states have much spending on human labor. It is contributing more than 60 percent of overall operational cost in the respective state. For Assam the animal labor cost accounts for one fifth. Bihar and Orissa are also trapped with high fertilizer cost. Notable these states have experienced upsurge in the yield but still they are occupying the lowest ranks in overall paddy yield in the country. It may be inferenced that the decreasing returns of labor are associated with paddy production amid lower exposure towards technologies. Herein lays the scope for advancements of mechanization in these states for improvement in paddy yield.

V. IMPACT OF TECHNOLOGICAL ADVANCEMENTS ON PADDY YIELD

5.1. Empirical Results

For investigating the role of technology, the model given in equation 4 is tested for applicability of random effects or fixed effects technique. For selection of appropriate model, Hausman test is applied. Acceptance of null hypothesis that there is no systematic difference in coefficients, suggests for fitting the random effects model and rejection of it supports the fixed effects model. The results of test statistic are presented in Table 2 where calculated test statistic is 14.14 and is distributed χ^2 (6). It rejects the null hypothesis and suggests that the fixed effects model is suitable technique for given data set.

Variable	(b) FE	(B) RE	(b-B) Difference	Sqrt(diag(V_b-V_B)) S.E.
lhl	0.2241	0.2480	-0.0240	0.0416
lal	0.0221	0.0014	0.0207	0.0108
lmc	0.1705	0.1689	0.0016	0.0082
lseed	-0.1084	-0.1348	0.0264	0.0298
lfmd	0.0144	0.0524	-0.0380	0.0338
linsct	-0.0025	0.0087	-0.0112	0.0047
χ^2 (6)[(b-B)'[(V_b-V_B)^(-1)](b-B)] = 14.14, Prob. > χ^2 = 0.0281				

b = consistent under H_o and H_a; obtained from xtreg, B = inconsistent under H_a, efficient under H_o; obtained from xtreg, Test: H_o: difference in coefficients not systematic

Table 2: Hausman Test Statistic

The results for equation 4 are presented in Table 3. It is found that there is a positive and statistically significant impact of human labor and machine cost on paddy yield in India. The coefficient values are 0.22 and 0.17 indicating that one percent increase in human labor and machine cost results into 0.22 and 0.17 percentage increase in yield, respectively. It reflects that technological advancements have significant positive impact on paddy yield. The F statistic is significant suggesting for overall fitness of the model. The coefficient values for seed cost and insecticide cost are negative though insignificant. This outcome may be attributed to the higher level of asymmetry of information prevailing in the market. This situation prompts for spreading awareness among farmers for classifying the quality seeds and effective delivery of seeds and insecticides through authorized dealers.

Variable	Coefficient	Std. Error	T- Statistic	P. Value
lhl	0.2241	0.0941	2.3800	0.0190
lal	0.0221	0.0252	0.8800	0.3810
lmc	0.1705	0.0360	4.7400	0.0000
lseed	-0.1084	0.0687	-1.5800	0.1170
lfmd	0.0144	0.0705	0.2000	0.8390
linsct	-0.0025	0.0149	-0.1700	0.8690
_cons	2.1593	0.3284	6.5800	0.0000
F(6, 138) = 8.34, P-value =0.0000				

Source: Author's Computation

Table 3: Impact of Technology on Paddy Yield (Fixed Effects Model)

From panel data estimation it is found that there is a positive and statistically significant impact of technology on paddy yield in Indian regions. In sum enhanced yield through technological advancements and remunerative price may ensure sustained investment to realize the stable output for paddy.

CONCLUSION

The cost composition reveals that Kerala, AP and TN are more technological prone states. Assam, Bihar, Orissa and WB, having lower exposure to the technology and more tuned to human and animal factors, are occupying the lowest ranks in overall paddy yield in the country and supplementing the decreasing returns to factor phenomenon. Study finds significant positive contribution of technological advancements in paddy yield across states. More technological advanced states have been able to deliver the higher returns to factors of production. It is intuitive that prosperous agriculture might be passing the reward to other economic agents as well and supporting the creative destruction phenomenon. Herein lays the scope for advancements of mechanization in Assam, Bihar, Orissa and WB states for improvement in the paddy returns. As per the experience of Karnataka and AP there is ample scope for Punjab, Haryana and West Bengal towards implementation of SRI techniques. Also, the higher return generating states have adapted technology faster than other states.

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