TEMPORAL AND STRUCTURAL CHANGES IN COST AND RETURNS IN PADDY CULTIVATION IN INDIA

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Abstract- **The study evaluates the growth trends in Cost A1, C2, C3, gross returns, and yield. An attempt is also made to examine per cent change in cost A1, C2, C3, expenditure on seed, fertilizer, manures, human labour, and Animal labour in different states of India. Data used for the study consisted eighteen years (2004-05 to 2021-22). The upward trajectory in Cost A1 for paddy cultivation across all Indian states surpassed Cost C3, indicating a faster rise in input and paid-out costs than indirect expenses like land rent and fixed capital interest. Maharashtra exhibited the highest growth in Cost C (9.74%), contrasting with lower rates in central region states like Madhya Pradesh (4.67%), Jharkhand (5.27%), and Chhattisgarh (5.87%). Negative yield changes were observed in Maharashtra, while Assam, Bihar, Chhattisgarh, Madhya Pradesh, and Himachal Pradesh demonstrated improved performance. Uttarakhand exhibited a negative trend in manure expenditure, unlike the rest of India, where a substantial increase was noted. Despite rising costs in both manures and chemical fertilizers, strategic planning is imperative to curb input cost escalation, given the comparatively lower growth in yield.**

Keywords: **Cost, Paddy, Temporal and Structural Changes.**

1. INTRODUCTION

India, predominantly an agrarian nation, underwent significant development in its primary sector following the mid-1960 s implementation of the "Green Revolution." This revolution introduced high-yielding crop varieties, fertilizers, and technological advancements in agriculture, primarily benefiting specific crops and regions. The Commission for Agricultural Costs and Prices (CACP) is an advisory body in India that provides recommendations to the government on the minimum support prices (MSPs) for various agricultural commodities. The primary goal of CACP is to ensure that farmers receive a fair and remunerative price for their produce, and it plays a crucial role in shaping the agricultural policies of the Indian government. Rice is the most efficient crops in Indian agriculture and myriads of farmers are dependent on income of these crops. Rice cultivated in about 40 per cent of the gross sown area, and cost and returns structure of those can help out in deciding future price policies. The production and productivity of rice are critical in the current scenario of population growth and food security with sustainable resource use. In this paper an attempt has been made to study the issue of profitability in paddy crops in an in-depth manner using temporal data.

2. DATA SOURCE AND METHODOLOGY

Secondary data regarding cost of cultivation and input use for paddy were collected from published reports as well as soft copies of cost estimates provided by the Directorate of Economics & Statistics, Ministry of Agriculture and Farmer Welfare, GOI. The time series data were collected for 18 years starting from 2004-05 to 2021-22 for trend analysis. Various cost concepts were used for the analysis. Different cost concepts and items of cost of cultivation (per ha) of farm management are taken in the present study are as follows:

Cost A1 = All paid-out costs. These includes , Value of seed , Value of insecticides and pesticides, Value of fertilizers, Value of manure Irrigation charges ,Value of hired bullock labour, Value of owned bullock labour , Value of hired human labour, Value of owned machine labour , Value of hired machine labour , Depreciation on implements and machinery, Land revenue , Interest on working capital ,Miscellaneous expenses

Cost A1 = Rent paid for leased-in land + Cost A1

Cost A2 +FL= Imputed value of family labour + Cost A2

Cost B1 = Interest on values of owned fixed capital assets (excluding rent) + Cost A1

Cost B2 = Rental value of owned land + Rent paid for leased-in land +Cost B1

Cost C1 = Imputed value of family labour+ Cost B1

Cost C2 = Imputed value of family labour +Cost B2

Cost C3 = C2 + 10 per cent of Cost C2 as management cos

2.1 Estimation of Compound Annual Growth Rates

The growth rates in A1, A2, C2, C3 costs, yield and gross return in India was studied by using compound growth rates. The growth rate was estimated using following model

$$Y = a.b^t$$

Where,

Y = Depended variable for which growth rate is to be estimated

(Quantity exported / export value / unit value)

a = Intercept

b = Regression Coefficient

t = Time Variable

This equation was estimated after transforming (1) as follows,

Log y = log a + t Log b

Then the percent compound growth rate (g) was computed using the relationship.

CGR (g) = (antilog b – 1) ✕ 100

The significance of the regression coefficient was tested using the student 't' test.

2.2 Percentage Change

Percentage change in A1, C2, C3 costs yield and gross return of paddy in India was calculated following formula:

[(F-I) /I)]*100

Where,

F= Value of final year

I= Value of base initial year

3. RESULTS AND DISCUSSION

3.1 Temporal changes in Cost A1, C2, C3 in Paddy cultivation

The information provided in table 3.1 offers insights into the temporal changes in the costs associated with paddy cultivation, specifically focusing on Cost A1, Cost C2, and Cost C3. Notably, the Compound Annual Growth Rates (CAGR) of Cost A1 in Madhya Pradesh and Himachal Pradesh were statistically significant at the one per cent level, standing at 12.02 per cent and 11.96 per cent, respectively. These findings highlight considerable variations in the rates of growth in actual expenses related to crop production across states, revealing regional disparities. States like Assam, Chhattisgarh, and Himachal Pradesh also exhibited noteworthy CAGR ranging from 11.06 per cent to 11.96 per cent.

Table No. 3.1 State wise Temporal changes in cost A1, C2 and C3 for paddy in India

Sr. No	States	Cost A1		Cost C2		Cost C3	
		CAGR	R^2	CAGR	R^2	CAGR	R^2
1	Andhra Pradesh	8.01***	0.78	7.25***	0.70	7.74***	0.65
2	Assam	11.06***	0.94	9.92***	0.92	5.71***	0.78
3	Bihar	9.18***	0.95	9.38***	0.96	6.81***	0.82
4	Chhattisgarh	11.27***	0.96	10.16***	0.95	5.87***	0.75
5	Haryana	9.18***	0.95	9.38***	0.96	6.85***	0.75
6	Jharkhand	9.99***	0.96	10.66***	0.96	5.27***	0.66
7	Karnataka	9.97***	0.91	8.43***	0.94	7.68***	0.84
8	Kerala	9.16***	0.95	9.55***	0.96	8.23***	0.94
9	Madhya Pradesh	12.02***	0.97	10.86***	0.93	4.67***	0.71
10	Orissa	9.28***	0.97	9.41***	0.95	6.98***	0.81
11	Punjab	7.29***	0.96	7.75***	0.95	6.71***	0.89
12	Tamil Nadu	9.81***	0.94	7.05***	0.93	6.65***	0.91
13	Uttar Pradesh	9.56***	0.97	8.71***	0.93	7.64***	0.92
14	Uttarakhand	8.94***	0.87	8.64***	0.94	7.99***	0.88
15	West Bengal	9.1***	0.90	8.85***	0.91	7.44***	0.92
16	Gujarat	9.78***	0.92	9.49***	0.90	6.92***	0.72
17	Himachal Pradesh	11.96***	0.93	11.1***	0.97	6.02***	0.78
18	Maharashtra	9.86***	0.95	9.31***	0.93	9.74***	0.91

(***, **, and * level of significance at 1 per cent 5 per cent and 10 per cent)

In case of Cost C2, which represents comprehensive expenses in crop production across Indian states, Himachal Pradesh recorded the highest CAGR at 11.1 per cent, signaling a substantial increase in cultivation costs. In contrast,

Tamil Nadu displayed the lowest CAGR at 7.05 per cent, indicating a slower growth in comprehensive agricultural expenses. States such as Madhya Pradesh, Chhattisgarh, and Jharkhand demonstrated CAGR above 10 per cent, suggesting a rapid escalation in costs. Conversely, Punjab and Andhra Pradesh showed relatively lower CAGR, indicating a more moderate increase in expenses.

Regarding Cost C3, the provided data revealed diverse Compound Annual Growth Rates (CAGR) for an undisclosed metric across different states in India. These rates ranged from 4.67 per cent in Madhya Pradesh to 9.74 per cent in Maharashtra, indicating varied trends in the growth of this undisclosed metric over a specific period. Kerala, Uttarakhand, and Maharashtra demonstrated relatively high CGR, suggesting substantial growth in the specified metric. Conversely, Madhya Pradesh exhibited the lowest CGR, implying a slower rate of growth. This data underscores the diverse regional patterns in the undisclosed metric, with potential implications for regional development and policy considerations.

It was revealed that the growth rates for cost A1 for all states are higher than the cost C3 impling the higher pace of prices of inputs included paid out expenses by farmer than the indirect cost as well as family labour charges. The growth in cost C3 was found be highest in Maharashtra (9.74%) and relatively lower in central region states like Madhya Pradesh (0.71%) and Chhatisgarh (0.75%), whereas in rest of India it was within the range 4 to 8 per cent.

3.2 Structural changes in cost of cultivation of paddy

Table No 3.2 Structural changes in cost A1, C2 and C3 in paddy cultivation

Sr. No	State	Per Cent Change in cost (TE 2021-22 over TE 2006-07)		
		Cost A1	Cost C2	Cost C3
1	Andhra Pradesh	316	256	207
2	Assam	355	301	112
3	Bihar	250	271	143
4	Chhattisgarh	415	320	127
5	Haryana	201	219	144
6	Jharkhand	364	367	143
7	Karnataka	191	208	188
8	Kerala	255	279	223
9	Madhya Pradesh	439	420	50
10	Orissa	297	291	204
11	Punjab	197	219	194
12	Tamil Nadu	213	192	170
13	Uttar Pradesh	335	277	205
14	Uttarakhand	204	260	212
15	West Bengal	246	204	203
16	Gujrat	278	265	183
17	Himachal Pradesh	351	339	120
18	Maharashtra	293	266	354

The information regarding Structural changes in cost of cultivation in Triennium ending (TE) 2021-22 over (TE) 2006-07 in different states of India is presented in table 3.2. It was observed from table that in case of cost A1 per cent increase for different states was ranging from 191 per cent in Karnataka to 439 per cent in Madhya Pradesh. The maximum increase Cost A1was in state of Madhya Pradesh indicating increase in cost of inputs used in paddy cultivation. The changes in cost C2 were found to be ranged between 208 per cent in Karnataka to 420 per cent in Madhya Pradesh.

The per cent changes in TE 2021-22 are TE 2006-07 in case of cost C3 revealed that the minimum changes was observed between Assam state 112 per cent. Whereas highest increase in case of Maharashtra 354 per cent. The states showing comparatively lesser hike were Assam, Chhatisgarh, Jharkhand, Haryana and Himachal Pradesh. The States registering higher increase in cost C3 were Maharashtra, Gujarat and Andhra Pradesh. It was concluded that structural changes in cost of cultivation of paddy across different states of India indicated that the changes in cost A1 were larger than cost C3 in all the states of India which is attributed higher increase prices of paid out cost or inputs than indirect costs such as, interest on fixed capital, rental value of land, rent paid for land etc.

3.3 Temporal changes in gross return and yield of Paddy

Table No. 3. 3 Temporal changes in gross return and yield of Paddy

Sr. No	State	Gross return/ ha			Yield/ ha		
		CAGR	R^2	Per cent Change	CAGR	R2	Per cent Change
1	Andhra Pradesh	6.84***	0.64	211	-4.46	0.003	16
2	Assam	9.83***	0.93	339	3.98***	0.82	89
3	Bihar	8.84***	0.93	281	2.41***	0.48	53
4	Chhattisgarh	10.88***	0.97	409	4.06***	0.78	85
5	Haryana	8.8***	0.80	274	1.72***	0.48	30
6	Jharkhand	11.5***	0.87	385	5.11***	0.58	92
7	Karnataka	7.52***	0.85	212	0.7	0.08	7
8	Kerala	9.99***	0.89	331	1.22***	0.34	17
9	Madhya Pradesh	12.16***	0.84	749	5.92	0.78	246
10	Orrisa	8.69***	0.94	251	2.28***	0.60	29
11	Punjab	8.1***	0.93	236	0.97***	0.43	9
12	Tamil Nadu	7.15***	0.84	217	0.37	0.09	8
13	Uttar Pradesh	6.97***	0.81	231	1***	0.38	24
14	Uttarakhand	6.85***	0.79	233	0.61	0.07	15
15	West Bengal	7.36***	0.89	172	1.06	1.06	0.19
16	Gujrat	7.66***	0.81	226	2.41	0.48	29
17	Himachal Pradesh	11.25***	0.97	378	4.79***	0.79	99
18	Maharashtra	6.23***	0.71	132	-0.39	0.02	-19

(***, **, and * level of significance at 1 per cent 5 per cent and 10 per cent)

Table 3.3 represent state wise compound annual growth rate of changes in gross return/ ha in paddy in India. The data reveals the compound annual growth rates (CAGR) for gross returns per hectare in various states in India. These CAGRs range from 6.23 per cent in Maharashtra to 12.16 per cent in Madhya Pradesh, indicating the diverse growth rates in gross returns over time. Madhya Pradesh had the highest CAGR, suggesting a substantial increase in gross returns per hectare, while Maharashtra had the lowest CAGR, implying slower growth. States like Jharkhand, Chhattisgarh, and Himachal Pradesh also displayed notably high CAGR, reflecting significant growth in agricultural returns, while Uttar Pradesh, Uttarakhand, and Andhra Pradesh had comparatively lower CAGR.

The per cent changes in gross returns, TE 2021-22 over TE 2006-07 indicated very wide range such as, lowest about 132 per cent in Maharashtra to 409 per cent in Chhattisgarh.

As regard to Compound annual growth rates (CAGR) of paddy yield for various states in India. It was noticed that some states have experienced robust economic expansion, with Jharkhand leading the pack with a remarkable CAGR of 5.11, closely followed by Madhya Pradesh at 5.92 and Chhattisgarh at 4.06. Himachal Pradesh also demonstrates strong growth at 4.79. On the other hand, Andhra Pradesh displays a negative CGR of -4.46, suggesting a contraction in economic activity. Several states, including Assam, Bihar, Haryana, Orissa, Punjab, Kerala, Uttar Pradesh, Uttarakhand, and West Bengal, exhibit positive but varying levels of growth rates, showcasing a diverse economic landscape across different regions of the country. Maharashtra, however, experiences a slight decline with a CGR of -0.39, while Tamil Nadu and Karnataka show relatively modest growth rates of 0.37 and 0.7, respectively. Gujarat stands out with a CGR of 2.41, indicating a healthy pace of economic advancement. The per cent changes in case of yield noticed negative (-19) in case of Maharashtra. The per cent change in yield ranged from -19.26 per cent (Maharashtra) to 92 per cent in Jharkhand. As far yield is concerned Maharashtra (-19%), Karnataka (7 %), West Bengal (0.19 %), these states have shown poor progress in yield improvement. The Assam, Bihar Chhattisgarh, Madhya Pradesh, Himachal Pradesh, these states of India have shown good performance in yield.

3.4 State wise Temporal changes in input cost in Paddy cultivation

The data table offers a comprehensive overview of agricultural indicators across various Indian states, encompassing seed usage, manure and fertilizer application, and human and animal labor. Notably, Andhra Pradesh exhibits positive trends, with a significant CAGR of 8.99 in seed usage and robust correlations, especially in human labor and fertilizer application, indicating a strong link with crop growth and yield. Assam follows with a positive CAGR of 7.54 in seed

usage and strong correlations in manure, fertilizer, and labor inputs. Bihar, despite variability, shows a positive CAGR in seed usage, emphasizing the impact of manure and fertilizer on crop outcomes.

The seed is indispensable input which registered positive growth in various states such as Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, West Bengal, Himachal Pradesh and Maharashtra, which may attributed to increase in quantity of seed or its price or both. It was also good sign about manures which scored positive growth in many of states .Fertilizer expenditure showed a similar trend as like seed and manure registering growth to the tune of 0.74 per cent in Andhra Pradesh to 9.77 per cent in Gujarat. Human labour and animal labour also indicated positive growth rates in majority of the states. It was concluded that the expenditure in all the inputs in majority of the states is increasing.

Table 3.4 State wise temporal changes in input cost in paddy cultivation

Sr. No	States	Seed		Manure		Fertilizer		Human Labour		Animal labour	
		CAGR	R^2	CAGR	R^2	CAGR	R^2	CAGR	R^2	CAGR	R^2
1	Andhra Pradesh	8.99***	0.72	2.91[NS]	0.01	0.74***	0.84	13.7***	0.96	13.25***	0.93
2	Assam	7.54***	0.98	10.72***	0.96	5.27***	0.825	11.68***	0.95	17.89***	0.95
3	Bihar	9.9***	0.96	18.38[NS]	0.12	6.46***	0.87	13.14***	0.97	-7.46[NS]	0.038
4	Chhattisgarh	9.88***	0.92	9.2**	0.95	5.44***	0.8	11.44***	0.9	21.52***	0.97
5	Haryana	-	-	6.65[NS]	0.018	4.61***	0.84	11.49***	0.85	-32.99[NS]	0.47
6	Jharkhand	17.67***	0.92	11.16***	0.91	6.95***	0.9	12.8***	0.96	16.25***	0.91
7	Karnataka	10.46***	0.83	14.05**	0.92	6.48***	0.81	12.67***	0.92	17.92***	0.94
8	Kerala	-	-	13.53***	0.86	7.83***	0.79	12.44***	0.97	17.06***	0.88
9	Madhya Pradesh	12.19***	0.92	9.56***	0.95	5.75***	0.98	12.07***	0.96	13.05***	0.84
10	Orissa	9.98***	0.98	13.87***	0.98	7.11***	0.81	12.92***	0.95	8.53***	0.93
11	Punjab	-	-	9.85***	0.92	3.93***	0.93	11.19***	0.91	7.36***	0.89
12	Tamil Nadu	-	-	13.88***	0.96	7.09***	0.88	11.46***	0.94	18.44***	0.93
13	Uttar Pradesh	-	-	11.96***	0.79	5.8***	0.84	12.28***	0.97	7.63***	0.45
14	Uttarakhand	-	-	-14.69[NS]	0.01	5.61***	0.79	10.3***	0.92	8.89***	0.48
15	West Bengal	14.44***	0.84	9.65***	0.96	6.04***	0.78	12.4***	0.94	14.47***	0.92
16	Gujrat	-	-	8.96***	0.59	9.77**	0.58	10.74***	0.92	11.6***	0.92
17	Himachal Pradesh	21.16***	0.81	8.03***	0.85	8.81***	0.58	10.02**	0.7	22.46***	0.91
18	Maharashtra	12.85***	0.81	6.15***	0.57	6.46***	0.84	10.91***	0.96	11.38***	0.93

(***, **, and * level of significance at 1 per cent 5 per cent and 10 per cent)

3.5 Structural changes in input cost in Paddy cultivation

It was revealed that changes in cost of seed triennium ending 2021-22 over triennium ending 2006-07 in various states indicated that west Bengal (22 47 %) and Jharkhand (1076%) has showed maximum increase . whereas Assam (209%), Andhra Pradesh (274 %) indicated comparatively slower growth in seed expenditure.

As regards to Uttarakhand which indicated decreasing values for manure expenditure by -100 per cent. The per cent changes in manure expenditure were ranging from 171 per cent in Himachal Pradesh to 610 per cent in Orissa. Fertilizer expenditure changes were comparatively lower than human labour and animal labour in all the states of India. Per cent increase in fertilizers in Himachal Pradesh (84%), Madhya Pradesh (99%), Haryana (82%), West Bengal (91%), however it was higher in Kerala (210%) and Tamilnadu (183%). The per cent increase in expenditure on human labour was maximum in Orissa (517%), Kerala (477%), and Madhya Pradesh (475%). The per cent change in animal labour

expenditure showed maximum hike in Chhattisgarh (2105 %) followed by Himachal Pradesh (1604 %) and Karnataka (1021 %) the comparative change in selected input items for Andhra Pradesh depicted lesser increase in Manure and fertilizer than human as well as animal labour.

Table 3.5 Structural changes in input cost in Paddy cultivation

Sr. No	State	Per Cent Change in cost (TE 2021-22 over TE 2006-07)				
		Seed	Manure	Fertilizer	Human Labour	Animal labour
1	Andhra Pradesh	274	303	167	857	595
2	Assam	209	350	135	418	948
3	Bihar	389	706	137	556	855
4	Chhattisgarh	360	256	100	427	2105
5	Haryana	-	418	82	355	290
6	Jharkhand	1076	427	157	492	679
7	Karnataka	265	598	149	487	1322
8	Kerala	-	397	210	477	1022
9	Madhya Pradesh	859	245	99	475	708
10	Orissa	384	610	185	517	220
11	Punjab	-	341	85	412	228
12	Tamil Nadu	-	558	184	451	949
13	Uttar Pradesh	-	458	116	472	664
14	Uttarakhand	-	-100	100	362	221
15	West Bengal	2247	250	91	408	837
16	Gujarat	-	575	106	331	405
17	Himachal Pradesh	2683	171	84	592	1604
18	Maharashtra	355	196	157	416	342

Conclusion

The growth trend in Cost A1 in paddy cultivation in all the states of India were higher than Cost C3 implying higher pace of prices of inputs and paid out cost than indirect cost such as, rental value of land, interest on fixed capital, land rent etc. The growth trend in Cost C was highest in Maharashtra (9.74%) and lower in central region states, such as, Madhya Pradesh (4.67%), Jharkhand (5.27%) and Chhatisgarh (5.87%). The per cent change in case of yield noticed negative score in case of Maharashtra while Assam, Bihar, Chhattisgarh, Madhya Pradesh, and Himachal Pradesh shown better performance. The Uttarakhand indicated negative pattern in expenditure of manures used for paddy cultivation, however in rest of India. Per cent expenditure on manure expenditure showed significant hike. The per cent hike in expenditure on chemical fertilizer was lower as compared to manures though expenditure on both inputs are increasing. It was concluded that the considering lower growth in yield, the strategic planning is required to control acceleration in input cost which showed larger hike than gross returns.

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