International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2024; SP-9(3): 79-87

https://www.mathsjournal.com
Received: 01-02-2024
Accepted: 02-03-2024

Vijaya S Shinde
PG Student, Department of Agricultural Economics and Statistics, Dr. PDKV, Akola, Maharashtra, India

NV Shende
Head, Department of Agricultural Economics and Statistics, Dr. PDKV, Akola, Maharashtra, India

Corresponding Author:
Vijaya S Shinde
PG Student, Department of Agricultural Economics and Statistics, Dr. PDKV, Akola, Maharashtra, India

Growth dynamics of input cost and output prices of paddy in West Bengal

Vijaya S Shinde and NV Shende

Abstract
Agricultural growth with stability has been a matter of concern in West Bengal. As paddy is the major crop growing in the state, the present study was therefore carried out with the objectives to examine the changes in cost and prices, growth, trend, parity between cost and prices, gap between FHP (Farm Harvest Prices) and MSP (Minimum Support Prices), impact of MSP on area, production and productivity of Paddy in West Bengal. The data of cost and prices of Paddy were collected form the period 2000-01 to 2019-20 and analysed the temporal change, growth by using CGR (Compound Growth Rate), instability by using CV (Coefficient of Variation), trends by using linear and non-linear trend model, index number, effectiveness of the price policy during the harvest periods was examined by the deviations of FHP from MSP and classified into positive and negative deviations. These deviations calculated by using MAPD, MAND, AMPD and AMND formulas. To study the impact of lagged Minimum Support Prices (MSPs) on the acreage allocation, production and productivity, linear Regression equations have been fitted. The result shows that the temporal change of cost of Paddy crop increased subsequently over the period of time. This increase could due to increase in level of input use for Paddy is increases in West Bengal. The growth analysis revealed that the growth in various cost of Paddy are found positively significant at 5 per cent level for overall period. For FHP and MSP of Paddy crop are found positively significant at 5 per cent level for overall period. The Coefficient of variation for various cost and prices was found to be high in the Period-I and low in the Period-II, on the whole, it was observed that the degree of stability is increasing for over the period. There was an increase in trend in cost and prices of Paddy crop during overall period and among the competitive parametric models third degree model are found best fitted based on R^2 significance. The gap analysis in which deviations of FHPs from MSPs of Paddy results in maximum positive deviations (FHP ruled higher than MSP) in West Bengal. The result shows that previous year price influences current years' area, production and productivity of West Bengal.

Keywords: Prices, growth, trend, parity

1. Introduction
West Bengal is the richest reservoir of rice bio-diversity and the rice bowl of the country. The ecotypes of rice, spontaneously evolved in the state, are so diverse and different that Scientists at one time coined them as Oryza sativa var. benghalensis. It is not only the essential staple food for the Bengalese, but also a number of cultural festivals and rituals have been intermingled with rice.

Agriculture is the mainstay of the lives of about 65 % of the people living in villages in West Bengal, with more than 95 % of them being small & marginal farmers. In terms of area, West Bengal is the thirteenth of 35 states and union territories of India with the highest population density per unit area and the lowest per capita area of 1 land area among all the states in the country. The importance of agriculture in the economy of West Bengal is reflected in the fact that it contributes around 30 % of the total SDP.

West Bengal is located in strategic position of eastern India, lies between 21°31' and 27°14' N latitude and between 84°91' and 89°53' E longitude. West Bengal is the highest rice-producing state of the country with the production of 16.6 million tons of rice in 5.5 million hectares with an average yield of 2.6 tons per hectare. It contributes 13.3% of rice production in the 12.2% rice area of the country.

Rice in West Bengal is grown under varying eco-systems on a variety of soils under varying climatic and hydrological conditions ranging from waterlogged and poorly drained to well drained soils and by adaptation of rice to the agro-ecological.

Rice occupied almost 53% of the total agricultural crop areas of the state during 2007-08 and it contributed the same percentage (53%) towards the total production of all agricultural crops during the same period. In West Bengal, the area and production under food grains during 2007-08 were 63.70 lakh hectare and 160.61 lakh metric tonnes respectively, out of which percentage share of rice.

The importance of agriculture in the state's economy is reflected by its contribution of about 20.69% to the total net State Domestic Product (SDP). In WB, rice is cultivated in a range of eco-systems on a range of soil types in a range of meteorological and hydrological circumstances, from wet and poorly drained to well drained, thanks to the rice's tolerance to these agro-ecological variables.

2. Material and Methodology

The data was used for study is entire based on secondary source from Agriculture statistics at a glance. The data was collected from various government publications, and websites. Data from the previous 20 years was collected for the study and analysis from 2000-01 to 2019-20. The entire data was split up into two periods and overall i.e. period I: 2000-01 to 2010-11, period II: 2011-12 to 2019-20 and Overall: 2000-01 to 2019-20.

The study was undertaken to study the temporal changes in input use, cost and return of paddy. To estimate growth rates of input utilization and costs of paddy. To examine parity between cost and prices. To work out the impact of prices on area, production and productivity.

1. The growth rates were used to measure the past performance of the economic variable. The growth rates are used to examine cost and prices change over a period of time.

Growth rate was worked from using the following exponential function.

$$Y = a\, b^t$$

Where, Y= Cost/Prices**,** T= time in years**,** b = regression coefficient**,** a = intercept

The compound growth rates 'r' was calculated by using the following formula

$$CGR(r) = [\text{Antilog}(\log b)-1]\times 100$$

Where, r = compound growth rates

2. To measure the instability in cost of cultivation and input utilization, an index of instability was used as measure of variability. The coefficient of variation (CV) will be calculated by the formula.

$$C.V.(\%) = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

3. The factors affecting the cost of cultivation of rice crops from the last 20 years was determined the differentials in costs of cultivation and Input use of crops. The significance level of changes in cost will be tested by 't' test.

The effect of cost of cultivation were explained to a certain degree by multiple regression analysis**.**

4.The behaviour of cost and prices of paddy for major states was studied by analysing the trend in the cost and prices of paddy for major states was worked out by fitting linear, quadratic, 3rd degree polynomial equation.

Table 1: Linear and Non-linear trend model

Model No.	Model	Name of model
1.	$Y_t=b_0+b_1t$	Linear equation
2.	$Y_t=b_0+b_1t+b_2t^2$	Second degree polynomial
3.	$Y_t=b_0+b_1t+b_2t^2+b_3t^3$	Third degree polynomial

5. An index number is a statistical measure design to show the changes in variables or group of related variables or group of related variables with respect to time.

The index number was calculated by choosing the 1^{st} triennium average as a base year.

$$\text{Index Number} = \frac{\text{Current Year Value}}{\text{Base Year Value}} \times 100$$

6. Factors affecting cost of cultivation was analysed by using multiple linear regression analysis. Multiple linear regression analysis is a statistical technique used to understand the relationship between multiple independent variables and a dependent variable. In the context of calculating the cost of cultivation, it can be employed to predict the costs based on various factors that influence cultivation expenses. The equation for multiple linear regressions can be represented as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon$$

Where

Y = the dependent variable (cost of cultivation).

β_0 = intercept or constant term.

$\beta_1, \beta_2, \ldots, \beta_5$ = coefficients associated with independent variables

$X_1, X_2 \ldots X_5$.

X_1 = Seed, X_2 = Fertilizer and Manure, X_3 = Human labour, X_4 = Animal labour

X_5 = Machin labour, X_6 = Plant protection, ϵ = error term, representing the unexplained variability in the model.

7. The study was based on the farm harvest prices and minimum support price is of major crops in India. To study the parity between the cost and prices, the tabular analysis was used. To study the effectiveness of the price policy during the harvest period of deviation of farm harvest prices from the MSP was worked out and classified into the negative and positive deviation to examine whether the market price ruled higher or lower over the MSP. Hence the absolute positive deviation (APD) or absolute negative deviation (AND) and mean absolute positive derivation (MAPD) or mean absolute negative deviation MAND) calculated. Also adjusted mean positive deviation (AMPD) and adjusted mean negative deviation (AMND) was worked out.

$$\text{MAPD or MAND} = 1/n \sum | FHPi - MSPi |$$

If, FHP > MSP = Positive deviation (PD)

FHP < MSP Negative deviation (ND)

Where,

MAPD = Mean absolute positive deviation,

MAND= Mean absolute negative deviation,

FHP = Farm harvest price,

MSP = Minimum support price, and

n = Frequency of positive or negative deviations.
These deviations were adjusted with MSP in order to examine the degree of their deviation from the MSP. The formulae used for the adjusted mean negative/positive deviation was as follows:

AMPD or AMND= 1/n ∑ (FHPi-MSPi|/MSPi) *100

Where,
AMPD = Adjusted mean positive deviation, and
AMND = Adjusted mean negative deviation
The significance of gap between FHP and MSP of paddy for major states was tested by two sample t-test.

$$t = \frac{(x - y)-(u_x-u_y)}{\sqrt{\frac{1}{n_x} + \frac{1}{n_y}}}$$

Where, x= mean of FHP of size n_x, y= mean of MSP of size n_y, Sp^2= pooled variance

$$Sp^2 = \frac{(n_x-1)s_x^2}{(n_x-1)+(n_y-1)}$$

To study the impact of lagged minimum support prices on the area, production and productivity of the paddy. Linear form of equation was used. The previous year MSP generally influence the producer farmer decision on a carrier location for the current year the linear.

1. Linear regression equation
a. A_t= a + b Pr_{t-1}
b. P_t = a + b Pr_{t-1}
c. Y_t = a + b Pr_{t-1}

2. Logarithmic regression equation
a. Log. A_t= log a + b Pr_{t-1}
b. Log. P_t = log a + b Pr_{t-1}
c. Log. Y_t = log a + b Pr_{t-1}

Where,
A_t = Area of paddy crop at (t^{th}) period,
P_t = Production of paddy crop at (t^{th}) period,
Y_t = Productivity of paddy crop at (t^{th}) period,
Pr_{t-1} = Minimum Support Prices of major crops taken in per quintal at ($t - 1^{th}$) period.

3. Result and Discussion
3.1 Temporal changes in input use, cost and returns of paddy.
The Temporal changes in cost and prices crop have been examined as a whole for Paddy. The temporal changes in cost and prices were estimated form the period 2000-01 to 2019-20.
The temporal changes in cost of paddy in West Bengal was presented in Table 1. The total cost of paddy has gone up from Rs. 28771.13 per hectare in 2000-01, Rs. 63729.38 per hectare in 2010-11 to Rs. 122792.6 per hectare in 2019-20 depicting an increase 200 per cent and 400 per cent during a period of study. The increase has occurred in paddy of cost like hired human labour, family labour, bullock labour, machine labour, seed, fertilizer, farm yard manure, insecticide, rental value of owned land and interest on working capital, costs of interest on fixed capital and depreciation cost. The cost of human labour, family labour, machine labour, seeds, fertilizer, and insecticide has increased at a faster rate. Among total hired human labour (433.17 per cent) in 2010-11 and (945.80 per cent) in 2019-20 recorded the maximum share followed total family labour (122.27 per cent) in 2010-11 and (260.65 per cent) in 2019-20 followed by machine labour (399.87 per cent) in 2010-11 and (1665.96 per cent) in 2019-20 in the increase in cost of cultivation over time. Out of the total increase of 221.50 per cent and 426.79 per cent in the total cost of cultivation in 2010-11 and 2019-20. The items contributed about 224.52 per cent and 472.06 per cent and the remaining 216.27 per cent and 348.25 by fixed cost items in 2010-11 and 2019-20 respectively.

Table 1: Temporal changes in cost of Paddy in West Bengal

Particulars	Rs/ha			Percent charges over Base period i.e. 2000-01	
	2000-01	2010-11	2019-20	2010-11	2019-20
Hired human labour	4526.02	19605.4	42807.14	433.17	945.80
Total family labour	8169.33	9988.66	21293.02	122.27	260.65
Bollock labour	1381.2	2020.93	1852.2	146.32	134.10
Machine labour	423.75	1694.44	7059.49	399.87	1665.96
Seed	594.38	1256.27	2539.75	211.36	427.29
Fertilizer	1204.72	2275.98	5400.2	188.92	448.25
Manures	522.06	1117.08	828.63	213.98	158.72
Irrigation charges	923.46	1860.11	1885.15	201.43	204.14
Insecticides	226.6	522.02	1168.25	230.37	515.56
Interest on working capital	279.4	636.89	1322.37	227.95	473.29
Cost A	18250.92	40977.78	86156.2	224.52	472.06
Fixed costs	5285.39	12013.67	18954.16	227.30	358.61
Rental value	4009.39	9265.08	15721.14	231.08	392.11
Interest on fixed capital	913.96	882.06	1220.5	96.51	133.54
Depreciation	293.43	551.96	740.45	188.11	252.34
Land revenue	18.04	38.83	0.16	215.24	0.89
Cost B	10520.21	22751.6	36636.41	216.27	348.25
Cost C	28771.13	63729.38	122792.6	221.50	426.79

The increase in insecticide and fertilizer charges has been to the tune of 230.37 per cent, 515.56 per cent and 188.92 per cent, 448.25 per cent in 2010-11 and 2019-20 respectively, of the total increase in cost of cultivation. The percent changes over inputs in the cost of cultivation of Paddy at two points of time are also given in Table 1.1 the per cent changeover has remained around per cent in 2010-11, which was lower than that in 2019-20. Within the operational cost, the share of machine labour in the total cost increased from 399.87 per cent in 2010-11 to 1665.96 per cent in 2019-20 and the share of bullock labour in the total cost decreased from 146.32 per cent in 2010-11 to 134.10 per cent in 2019-20. The decrease in the share of bullock labour is on account of substitution by machine labour. The share of fertilizer in the total cost increases from 188.92 per cent in 2010-11 to 448.25 per cent in 2019-20, for Paddy.
The extent of change in physical inputs and their prices along with changes in physical output and their prices and gross return for Paddy over time is given in Table 1.2. It is remarkable to note that the physical quantity of bullock labour, seed and manure has come down for Paddy due to increase in the wage rate of bullock labour and prices of manure, seed.
Only physical quantity of fertilizer is increase and decrease in human labour due to increase in price of fertilizer and demand for human labour. The gross return for Paddy has recorded a

200 per cent in 2010-11 and 400 per cent in 2019-20 during the period study.

The increase in gross return from Paddy is attributable to the Increase in the main and by-product of Paddy as well as increase in their prices over the years. It worth mentioning that the rate of increase in the prices of main product and by-product of Paddy has much higher compared to the increase in the physical yield of main product and by-product. The cost of production of Paddy has increased from 2000-01, 2010-11 and 2019-20 i.e. 497.04 Rs per quintal 1022.83 Rs per quintal 1812.97 Rs per quintal respectively. While the cost of production has recorded 205.78 per cent and 272.04 per cent in 2010-11 and 2019-20 during the period being study.

Table 2: The extent of changes in physical inputs, input prices, physical output, output prices and gross return for paddy in West Bengal

S.N.	Particular	2000-01	2010-11	2019-20	Percent charges over Base period i.e. 2000-01	
					2010-11	2019-20
A	**Quantity of input**					
1	Seed (Kg/Ha)	71.59	63.32	53.30	88.45	74.45
2	Fertilizer (Kg/Ha)	95.81	140.48	160.22	146.62	167.23
3	Manure (Qtl/Ha)	28.02	17.92	8.50	63.95	30.34
4	Human labour (hrs/ha)	1131.15	1222.56	993.79	108.08	87.86
5	Bullock labour (hrs/ha)	130.60	75.17	17.53	57.56	13.42
B	**Price of input**					
1	Seed (Rs/Ha)	8.30	19.84	47.65	239.04	574.10
2	Fertilizer (Rs/Ha)	12.57	16.20	33.70	128.88	268.10
3	Manure (Rs/Ha)	18.63	62.34	97.51	334.62	523.40
4	Human labour (Rs/ha)	7.22	16.04	43.07	222.16	596.54
5	Bullock labour (Rs/ha)	10.58	26.89	105.66	254.16	998.68
C	**Yield (Qtl/Ha)**					
1	Main Product	30.37	36.85	41.55	121.34	136.81
2	By- product	7.87222	5.188319	4.702612	65.91	59.74
D	**Price of output (Rs/Qtl)**					
1	Main Product	425.05	993.30	1477.65	233.69	347.64
2	By- product	110.18	139.85	167.24	126.93	151.79
E	**Value of output (Rs/Ha)**					
1	Main Product	12908.74	36602.98	61396.30	283.55	475.62
2	By- product	3346.08	5153.54	6948.81	154.02	207.67
3	Gross Return	16254.82	41756.52	68345.11	256.89	420.46
F	Cost of production (Rs/Qtl)	497.04	1022.83	1812.97	205.78	272.04

3.1.2 Temporal changes in Farm Harvest Prices of paddy:

The results shown in Table 3 shows the changes in farm harvest price of paddy in West Bengal. The increase has occurred form the year 2000-01 to 2019-20. West Bengal and MSP shows 371.91 per cent, 190.74 per cent change during 2019-20 over 2000-01 respectively. West Bengal shows the positive increase in farm harvest price of paddy.

Table 3: Changes in Farm Harvest Prices of paddy in West Bengal

S.N.	States	2000-01	2019-20	% change during 2019-20 over 2000-01
1	West Bengal	438	1629	371.91
2	Minimum Support Price	540	1030	190.74

3.2 Growth rates of cost and prices of paddy in West Bengal

The rate of change in terms of various Costs of paddy in West Bengal expressed in terms of compound growth rates estimated through exponential function were presented in Table 12

Table 4: Compound growth rate of cost of paddy in West Bengal

S.N.	Particular	Period I	Period II	Overall
		2000-01 to 2010-11	2011-12 to 2019-20	2000-01 to 2019-20
1	Cost -A	5.90*	7.10*	9.01*
2	Cost -B	6.82*	4.81*	8.18*
3	Cost -C	6.50*	5.97*	8.66*
4	Cost of production	5.64*	4.19*	7.46*

Note: *= Significance at 5 per cent level

During the first period 2000-01 to 2010-11 (Period-1) the estimated compound growth rates were found to be significant for all the Cost of paddy is found to be satisfactory. Cost of production shows the positive and significant growth rate at 5 per cent level.

During the 2011-12 to 2019-20 (Period-II) all the costs of Paddy showed positive and significant growth rates at 5 per cent level. Cost of production shows the positive and significant growth rate at 5 per cent level.

In the overall period, all the costs of Paddy showed positive and significant growth rates at 5 per cent level. In general, it can be concluded that there was positive and significant growth rate during the period of study.

3.3 Instability of cost of paddy in West Bengal

As seen from Table 18, that coefficient of variation of Cost-A for paddy in West Bengal was highest during overall period by 50.04 per cent. For period-l the coefficient of variation is highest for Cost-B i.e. 21.65 per cent. And for period-ll it is highest for Cost-C i.e. 20.71 per cent.

Table 5: Instability for cost of paddy in West Bengal

S.N	Particular	Coefficient of variation (CV)(%)		
		Period-I	Period-II	Overall
1	Cost -A	19.46	20.48	50.04
2	Cost-B	21.65	19.16	47.55
3	Cost-C	21.07	20.71	49.73
4	Cost of production	18.64	17.30	44.19

3.4 Trends in cost and prices of paddy in India

The trend equations were fitted to assess the cost and prices of paddy crops in India. Depending upon its better fit, was analysed by the production model viz, linear, second degree and third degree polynomial equation trends results are assessed and presented under cost and prices of selected crops.

Table 6: Trend in cost of paddy in West Bengal

S.N.	Particulars	Model	R^2	Coefficients			
				b_0	b_1	b_2	b_3
1	Cost A	Third Degree Polynomial	0.98	14376.96	-11.41	422.81	-2461.90
2	Cost B	Third Degree Polynomial	0.99	20368.30	-15.99	575.52	-3056.06
3	Cost C	Third Degree Polynomial	0.99	27392.67	-21.56	799.07	-4552.37
4	Cost of production	Third Degree Polynomial	0.99	588.24	-0.35	13.24	-66.65

For trend analysis of Cost-A of paddy (Table 1.6), maximum value of R^2 is 0.98 third degree polynomial trend is best fitted. In trend analysis of Cost-B, maximum value of R^2 i.e. 0.96 is best fitted for third degree polynomial trend. In trend analysis of Cost-C, maximum value of R^2 i.e. 0.97 is best suited for third degree polynomial trend. For trend analysis of cost of production, maximum value of R^2 i.e. 0.98 is for third degree polynomial trend which is best suited.

For trend analysis of Cost-A of paddy (Table 1.6), maximum value of R^2 is 0.98 third degree polynomial trend is best fitted. In trend analysis of Cost-B, maximum value of R^2 i.e. 0.99 is best fitted for third degree polynomial trend. In trend analysis of Cost-C, maximum value of R^2 i.e. 0.99 is best suited for third degree polynomial trend. For trend analysis of cost of production, maximum value of R^2 i.e. 0.98 is for third degree polynomial trend which is best suited.

3.5 Index number

An index number is a statistical measure design to show the changes in variable or group of related variables with respect to time. The index numbers were worked out for the cost and prices of paddy crop. The basic object of estimating index numbers was to make the trends in cost and prices of selected crops. For this analysis the data pertaining to the year 2000-01 to 2019-20 i.e. last 20-year data were used. The results are presented in following tables.

In table 1.7 indicate that the highest increase in index number of Cost-A was (394.13) in the year 2019-20 and with lowest (84.65) in the year 2000-01. Index number for Cost-B was recorded highest (375.87) among all the cost from 2019-20 and with lowest (8711) in year 2000-01. For Cost-C index number was (390.00) the highest value in 2019-20 and with lowest (88.48) in the year 2000-01. Cost of production has the highest index number of in 2019-20 (351.85) and lowest (96.46) in year 2000-01.

Table 7: Index number for cost of paddy in West Bengal (First triennium average as a base year)

YEAR	COST A	COST B	COST C	Cost of production
2000-01	84.65	87.11	88.48	96.46
2001-02	100.40	99.55	100.33	96.97
2002-03	114.95	113.35	111.19	106.56
2003-04	111.57	112.81	112.09	105.92
2004-05	112.05	115.97	113.46	112.20
2005-06	112.80	119.53	116.99	112.76
2006-07	119.98	126.73	124.24	121.31
2007-08	123.95	133.41	130.84	129.71
2008-09	149.32	157.05	153.64	141.92
2009-10	166.44	179.38	177.19	167.90
2010-11	191.90	198.35	200.01	198.51
2011-12	239.51	232.83	228.47	210.72
2012-13	255.16	254.49	260.27	239.89
2013-14	279.03	282.04	283.25	265.27
2014-15	331.45	324.26	334.00	273.91
2015-16	334.73	328.87	335.84	276.23
2016-17	353.34	348.77	360.91	290.54
2017-18	352.52	343.56	362.90	316.76
2018-19	342.42	342.11	360.81	305.03
2019-20	394.13	375.87	390.00	351.85

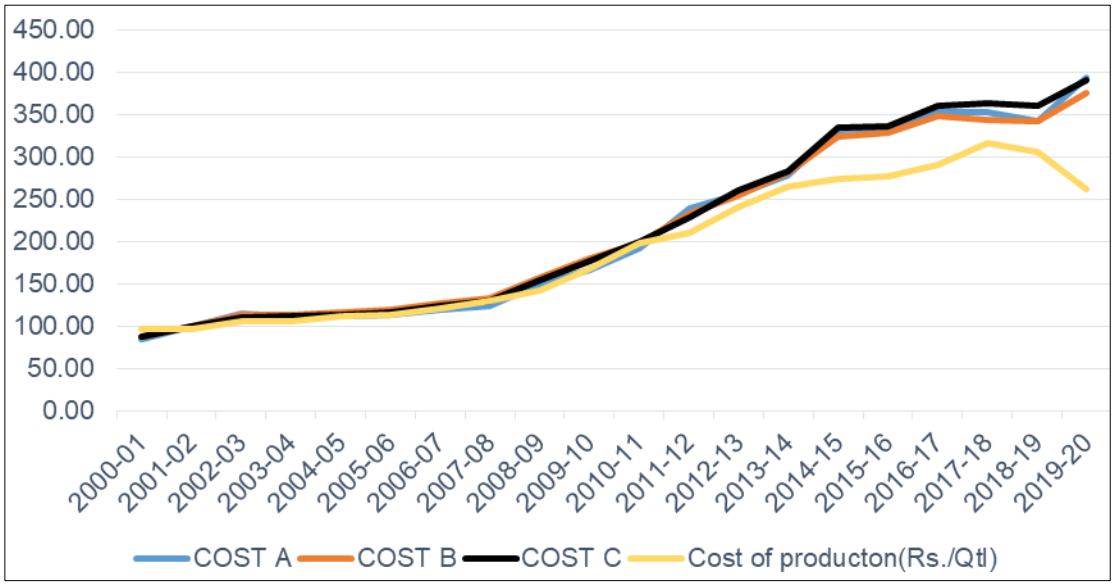

Fig 1: Index number for cost of Production and Cost of Production in West Bengal

3.6 Factors affecting cost of cultivation of paddy in West Bengal

The multiple linear regressions were carried out between the independent variables and dependent variable. The independent variables that represent seeds, fertilizer and manure, human labour and bullock labour, machine labour and plant protection while dependent variable represent cost of cultivation of paddy in West Bengal for overall period (2000-01 to 2019-20).

Table 8: Factors affecting cost of cultivation of paddy in West Bengal

S.R. No	Variables	Coefficients	Standard Error	t Stat
1	Intercept	3134.67	2661.59	1.18
2	X_1 (Seed)	12.09**	4.90	2.47
3	X_2 (Fertilizer & Manure)	5.67**	1.47	3.85
4	X_3 (Human Labour)	-0.01	0.12	-0.06
5	X_4 (Bullock Labour)	0.05	0.93	0.05
6	X_5 (Machine Labour)	1.69	0.96	1.76
7	X_6 (Plant protection)	2.94	3.00	0.98
8	R^2	0.99		
9	F	645.81		

Note: **Significant at 5% level

Table 1.8 shows that the coefficient of determination (R^2) is used to measure how much the ability of the independent variable in explaining the bound variation. The coefficient of determination (R^2) obtained was 0.99. This means that 99 per cent variation explained by the studied independent variable while the remaining 1 per cent is influenced by other variable. Seed and fertilizer & manure were found to be statistically significant at 5 per cent level.

3.7 Parity between cost and prices

In this objective the gap between Minimum Support Prices (MSP) and cost of production of major crops and gap between the Farm Harvest Prices (FHP) and Minimum Support Prices (MSP) of paddy crop from 2000-01 to 2019-20 was studied.

3.7.1 Gap between Minimum Support Prices and Cost of cultivation of paddy in West Bengal

The gap between Minimum Support Prices and cost of cultivation of paddy in West Bengal is presented in the Table 9 The gap is calculated for the study period i.e. 2000-01 to 2019-20. The results revealed that the gap between MSP and cost of cultivation in West Bengal recorded which ranged from -42.12 Rs/Qlt to 198.33 Rs/Qlt.

Table 9: Gap between Minimum Support Prices and cost of production of Paddy in West Bengal

YEAR	MSP	Cost of production	Gap
2000-01	540	497.04	42.96
2001-02	560	499.67	60.33
2002-03	560	549.06	10.94
2003-04	580	545.77	34.23
2004-05	590	578.11	11.89
2005-06	590	581.02	8.98
2006-07	610	625.07	-15.07
2007-08	675	668.34	6.66
2008-09	880	731.25	148.75
2009-10	1030	865.12	164.88
2010-11	1030	1022.83	7.17
2011-12	1110	1085.76	24.24
2012-13	1280	1236.05	43.95
2013-14	1345	1366.8	-21.8
2014-15	1400	1411.34	-11.34
2015-16	1450	1423.29	26.71
2016-17	1510	1497.01	12.99
2017-18	1590	1632.12	-42.12
2018-19	1770	1571.67	198.33
2019-20	1835	1812.97	22.03

3.7.2 Gap between Farm Harvest Prices and Minimum Support Prices of paddy in India

The gap between Farm Harvest Prices and Minimum Support Prices of paddy in West Bengal markets of are presented in the Table 10 results revealed that the average gap between FHP and MSP of paddy in West Bengal recorded was 69.35 Rs. /Qlt.

Table 10: Gap between Farm Harvest Prices and Minimum Support Prices of Paddy in West Bengal

S.N.	STATES	FHP	MSP	Gap (MSP-FHP)
1	West Bengal	977.40	1046.75	69.35

3.7.3 Deviations of FHPs from MSPs of paddy in West Bengal

To examine the effectiveness of MSP policy for paddy in West Bengal, difference between its FHP and MSP was calculated in different years and is given in Table 1.11 West Bengal shows positive deviations 5, times in 20 years during 2000-01 to 2019- 20. This means that the average FHP was ruled higher than MSP in 5 times out of 20 years. The adjusted difference (Positive) between MSP and FHP was low as 25 per cent of MSP and the negative difference was 75 per cent.

Table 1.11: Deviations of FHPs from MSPs of paddy in West Bengal

		POSITIVE DEVIATION				
S.N.	STATE	Frequency	MAPD	Range	AMPD	Per cent
1	West Bengal	5	90	18-216	6.72	25
		NEGATIVE DEVIATION				
		Frequency	MAND	Range	AMND	Per cent
1	West Bengal	15	-122.47	(-19)-(258)	-14.29	75

3.8 Impact of MSP on Area, production and productivity of Paddy on West Bengal

The numerical values of the linear lag function for paddy indicates that R^2 is significant at 1 per cent level and supports the results that variation in Area of paddy is explained by the explanatory variable, i.e. previous year's minimum support prices of the Paddy. Table no 1.12 revealed that 39 per cent variation in area 48 per cent variation in production 76 per cent variation in productivity of West Bengal is explained by independent variable i.e. lagged MSP.

The elasticity for these variables is significant at 1 per cent level in case of area, production and productivity found as 0.83 per cent, 4.27 per cent, 0.52 per cent respectively indicating thereby that previous year price influences current year's area production and productivity of major growing State West Bengal.

Table 12: Impact of MSP on Area, production and productivity of Paddy on West Bengal

S.N.	Variables	R^2	S.E. of R	Linear regression equation
1	Area	0.39	457.75	A_t= 3722.43+(0.83)Pr_{t-1}
2	Production	0.48	1925.34	P_t=7621.32+(4.27) P_{rt-1}
3	Productivity	0.76	126.49	Y_t=2023.42+(0.52)Pr_{t-1}

A_t= Area of paddy crop at (t^{th}) period,
P_t = Production of paddy crop at (t^{th}) period,
Y_t= Area of paddy crop at (t^{th}) period,
Pr_{t-1} = MSP of paddy taken in Per quantal at ($t-1^{th}$) period

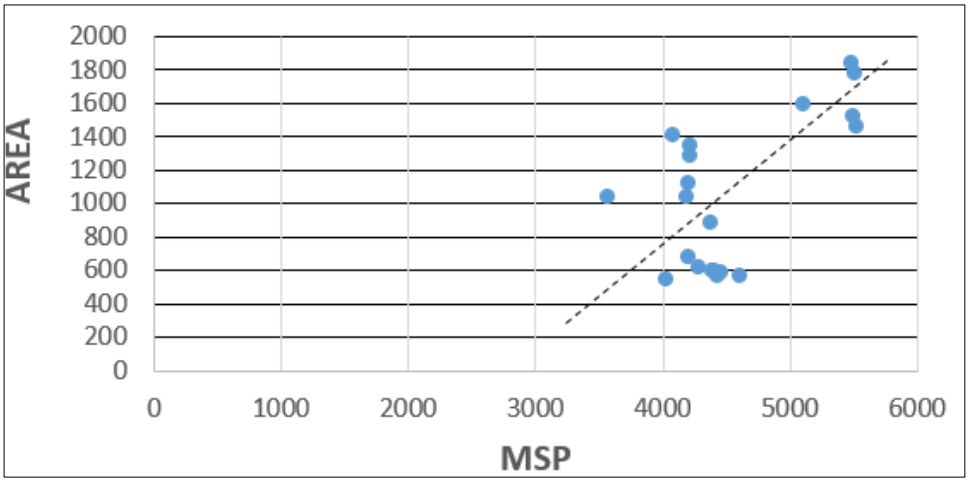

Fig 2: Impact of MSP on Area of paddy in West Bengal

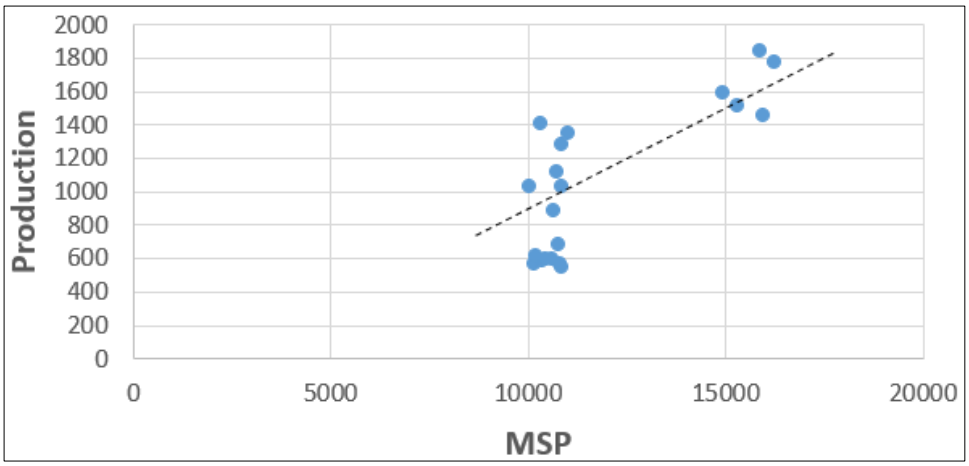

Fig 3: Impact of MSP on Production in West Bengal

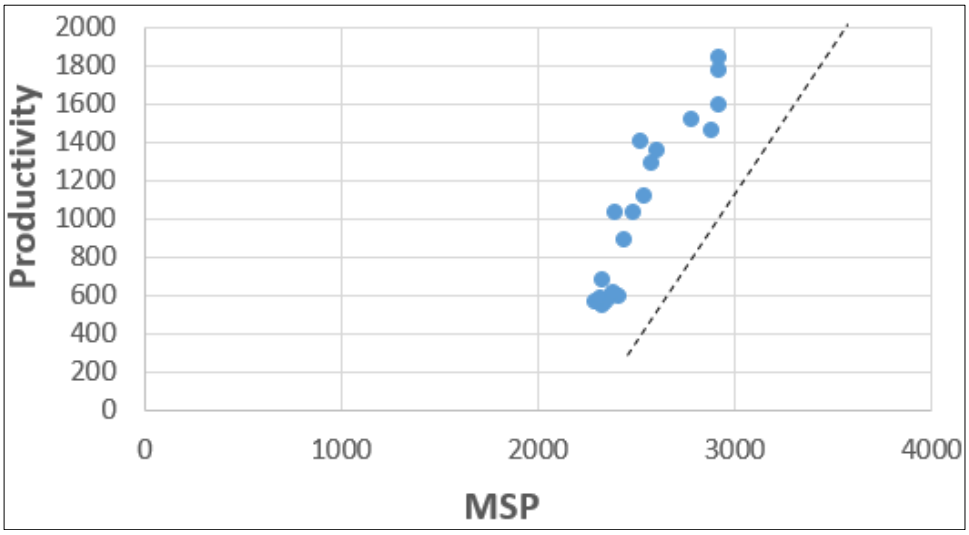

Fig 4: Impact of MSP on Productivity in West Bengal

4. Conclusions

The study of temporal changes, growth rate and trend enable one to indicate the general direction of change in prices in different markets. To study the effectiveness of the price policy during the harvest periods, the deviations of farm harvest prices (FHP) from the Minimum Support Prices (MSP) were worked out and divided into positive and negative deviations to examine whether market prices ruled higher or lower than the minimum support prices. The negative deviations reflected ineffectiveness of MSP policy for producers. These deviations were adjusted with MSP in order to examine the degree of their departure from the minimum support price. By using linear and logarithmic regression equations we examined the impact of previous year Minimum Support on farmer decision on acreage allocation, production, productivity for the current year.

The total cost of Paddy in West Bengal has gone up from 28771.13 per hectare in 2000-01 to 63729.38 per hectare in 2010-11 and 122792.6 per hectare in 2019-20 depicting an increase during a period of study. The increase has occurred in all major items of cost total machine labour 399.87 per cent and 1665.96 per cent recorded the maximum share during percent change over in 2010-11 to 2019-20 respectively. The gross return for Paddy has recorded 256.89 per cent and 420.46 per cent 2010-11 to 2019-20 respectively during the period study.

The compound growth rates of various cost revealed that, during overall period growth rates of cost were increasing significant at 5 per cent level. Among the cost the growth rate for Cost-A found highest increased significantly by 9.01 per cent during the study period followed by Cost-B, Cost-C and Cost of production has found increased significantly by 8.18 per cent 8.66 per cent and 7.46 per cent resp. during the study period.

Trend analysis of cost of paddy and prices i.e. MSP and FHP for the overall period showed that, a wide range of models has been explored, among the competitive models the best fitted models are selected based on the R^2 significance. Among the competitive parametric models, almost all cases Third Degree Polynomial models are found best fitted; thereby indicating that the movement of all the series was uniform throughout the India. The gap between MSP and cost of production of Paddy in West Bengal recorded which ranged from -42.12 to 198.33 Rs/Qlt. The highest gap was registered in year 2018-19 (198.33 Rs/Qlt).

5. References

1. Barmon BK, Chaudhury M. Impact of price and price variability on acreage allocation in rice and wheat production in Bangladesh. Agriculturists. 2012;10(1):23-30.
2. Gandhimathy B. Growth and Instability of Rice Production in India. Social vision. 2020;7(2):119-126.
3. Jambhulkar NN, Jena SS, Mondal B, Samal P. Estimation of Growth Rate and Instability Analysis of Area, Production and Yield of Rice in Odisha State of India. Int J Curr Microbiol Appl Sci. 2020;9(7).
4. Korem Sunitha, Gowda DM, Rajashekar K. Analysis of growth rates in area, production and productivity of rice crop in Telangana State. Int J Chem Stud. 2018;6(3):283-286.
5. Monga S, Sidana BK. Temporal Changes in Cost Structure and Profitability of Wheat and Paddy Crops in India. J Agric Dev Policy. 2020;30(2):184-194.
6. Nitiprasad NJ, Sushree SJ, Biswajit Mondal, Parshuram Samal. Estimation of Growth Rate and Instability Analysis of Area, Production and Yield of Rice in Odisha State of India. Int J Curr Microbiol Appl Sci. 2020;9(7):3107-3115.
7. Prabhakaran K, Sivapragasam C. Analysis of growth rates of rice and sorghum in Andhra Pradesh. Int J Farm Sci. 2013;3(1):1-9.
8. Punit KA, Yadav P, Mondal S. Economic Analysis of Cost and Return Structure of Paddy Cultivation Under Traditional and Sri Method: A Comparative Study. Int J Agric Sci. 2018;10(8):5890-5893.
9. Sawarkar PS, Shende NV, Bhopale AA, Koshti NR. Impact of Agricultural Price Policy on Soybean in Vidarbha region of Maharashtra. PKV Res J. 2022;46(2).
10. Shayequa ZA, Sidhu RS, Kamal Vattac. Effectiveness of Minimum Support Price Policy for Paddy in India with a Case Study of Punjab. Agric Econ Res Rev. 2012;25(2):231-242.
11. Shende NV, Valvi IU, Shende PV. Growth Dynamics and Acreage Response of Paddy in Eastern Vidarbha Zone of Maharashtra. Int Res J Agric Econ Stat. 2017;8(1):121-129.
12. Shende NV. Impact of Prices on Paddy Performance in Eastern Vidarbha Zone. Int J Curr Microbiol Appl Sci. 2020;9(08):2993-2999.

13. Thakare SS, Shende NV. Temporal variation in input-output prices and cost of cultivation of soybean in Vidharbha. J Food Legumes. 2012;25(3):222-226.
14. Thakare SS, Shende NV. Price Deviation and its Impact on Major Kharif Crops in Maharashtra. Agric Situat India; c2023. p. 16-35.
15. Thorat VA, Dhekale, RM Joshi, Bhosale JM, Talathi. The temporal and structural changes in cost of cultivation of rice in Konkan region. AGROSCO report, Dept. of Agricultural Economics; c2017.
16. Tingare AS, Bhopale AA, Deshmukh RG. The temporal variation in input cost and output prices of major crops in Vidharbha. Maharastra J Agric Econ, 2015, 18(1).