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Assessing Economic Sustainability in Gujarat's Cereal Sector: Trends in Costs, Prices, and MSP (2001 – 2022)

Damor Joyal [a++*], M.R.Chandrakar [b#], V. K. Choudhary [b#] and Chanchal [a++]

[a] Department of Agricultural Economics, (Ag) Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh -492012, India.
[b] Department of Agricultural Economics, College of Agriculture, Raipur, Chhattisgarh-492012, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The data highlights the changes in MSP over the years for each cereal. It's evident that MSPs have generally increased over time, although the rates of increase vary among different crops and years. The correlation analysis provides valuable insights into the relationships between MSP, wholesale prices, farm harvest prices, and the cost of production. Strong positive correlations between these variables indicate significant interdependence within the agricultural market. Notable changes in increasing order in MSP (Minimum support price) was seen over years in all cereals. Years with negative values in excess of actual MSP over COP (Cost of Production) suggested farmers were

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[++] Ph.D (Scholar);
[#] Professor;
**Corresponding author: E-mail: damorjoyal14@gmail.com;*

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not able to cover even COP and years with positive values suggested farmers were in profitable margin after covering COP. Cost and prices of all the selected cereals were having high correlation between MSP, WP (Wholesale Price), FHP (Farm Harvest Price), COP (C2) and COP (A2 + FL (Family Labour). Highest growth rate amongst the particulars was seen for MSP in pearl millet and lowest for COP (A2 + FL) in pearl millet. More variability was seen in MSP for pearl millet and low variability was seen in MSP for Wheat. Overall, analysis provides a comprehensive understanding of the agricultural landscape in Gujarat state.

Keywords: Economic sustainability; pricing policy; correlation analysis; farm harvest price; minimum support price.

1. INTRODUCTION

In agriculture, the behaviour of costs and prices is highly interdependent and can be influenced by a complex web of factors, including natural conditions, market dynamics, policy decisions, and consumer trends. Farmers and agricultural businesses must carefully manage these variables to make informed decisions about what to produce, how to produce it, and at what price to offer their products in the market. The primary focus is on the Minimum Support Price (MSP), which establishes a price floor to prevent prices from falling below a certain level. Based on the MSP, there are two key indicators. (Excess of Actual Support Price over Cost of Production) This indicator evaluates the margin between the actual Minimum Support Price (MSP) and the cost of production. It provides valuable insights into the degree to which MSP surpasses the production cost. Two cost components, namely Cost A2 + FL and Cost C2, are considered for this assessment. (Annual Change in Support Price), this indicator tracks the year-to-year fluctuations in the Minimum Support Price (MSP), Devi. G et al. [1]. Monitoring the annual changes in MSP is crucial for understanding the evolving pricing policies of the government and their impact on the agricultural sector.

Objective:

1. To examine the behaviour of Minimum Support Price, Farm Harvest Price and cost of production over the time for major cereals.

2. METHODOLOGY

Descriptive analysis was done to get more idea regarding the behaviour of support prices (MSP) over time. The data highlights the changes in MSP over the years for each cereal. Government of India [2]. On the basis of support prices, three indicators such as excess of actual support price over recommended price, annual change in support price and excess of support price over cost of production were calculated. Trend of Farm Harvest Price (FHP), Minimum Support Price (MSP) and Cost of Production (COP) of selected cereals was examined over the years by plotting these series with respect to time, Devi. G et al. [3]. The relationship among minimum support prices, farm harvest prices, cost of production and wholesale prices was analysed through correlation analysis. The growth and variability in these variables was also estimated to know the trend over the period. The growth rates and variability analysis offered insights into the performance and dynamics of each cereal market. It's notable that while there is growth in various aspects, there's also variability, indicating fluctuations that farmers and policymakers need to consider.

3. RESULTS AND DISCUSSION

The results, analysed on a crop-specific basis, shed light on the patterns and changes in support prices for major cereals over the entire study period.

Pearl Millet: The Table 1 provided data on trends in Minimum Support Prices (MSP) for Pearl millet (pearl millet) in the Gujarat state over a 22-year period, spanning from 2001-2002 to 2022-2023. It includes three key indicators for each year:

Change in support price over the previous year (%): It represented the annual percentage change in the Minimum Support Price (MSP) for Pearl millet compared to the MSP of the previous year Katarki, M. V. [4]. A positive value indicated an increase in the MSP compared to the previous year. The annual change in support prices for Pearl millet in Gujarat fluctuates over the years. Some years witness increases (e.g., 2007-2008 and 2018-2019) the government made efforts to increase Pearl millet farmers' income and incentivize production, while others

experience more moderate changes or even decreases.

Excess of actual MSP over cost of production (A2+FL) (%): It calculated the percentage by which the actual Minimum Support Price for Pearl millet exceeded the cost of production (COP) when considering the A2+FL cost components. Negative values (year 2001-2002 to 2007-2008) in this column indicated that the MSP was typically lower than the cost of production.

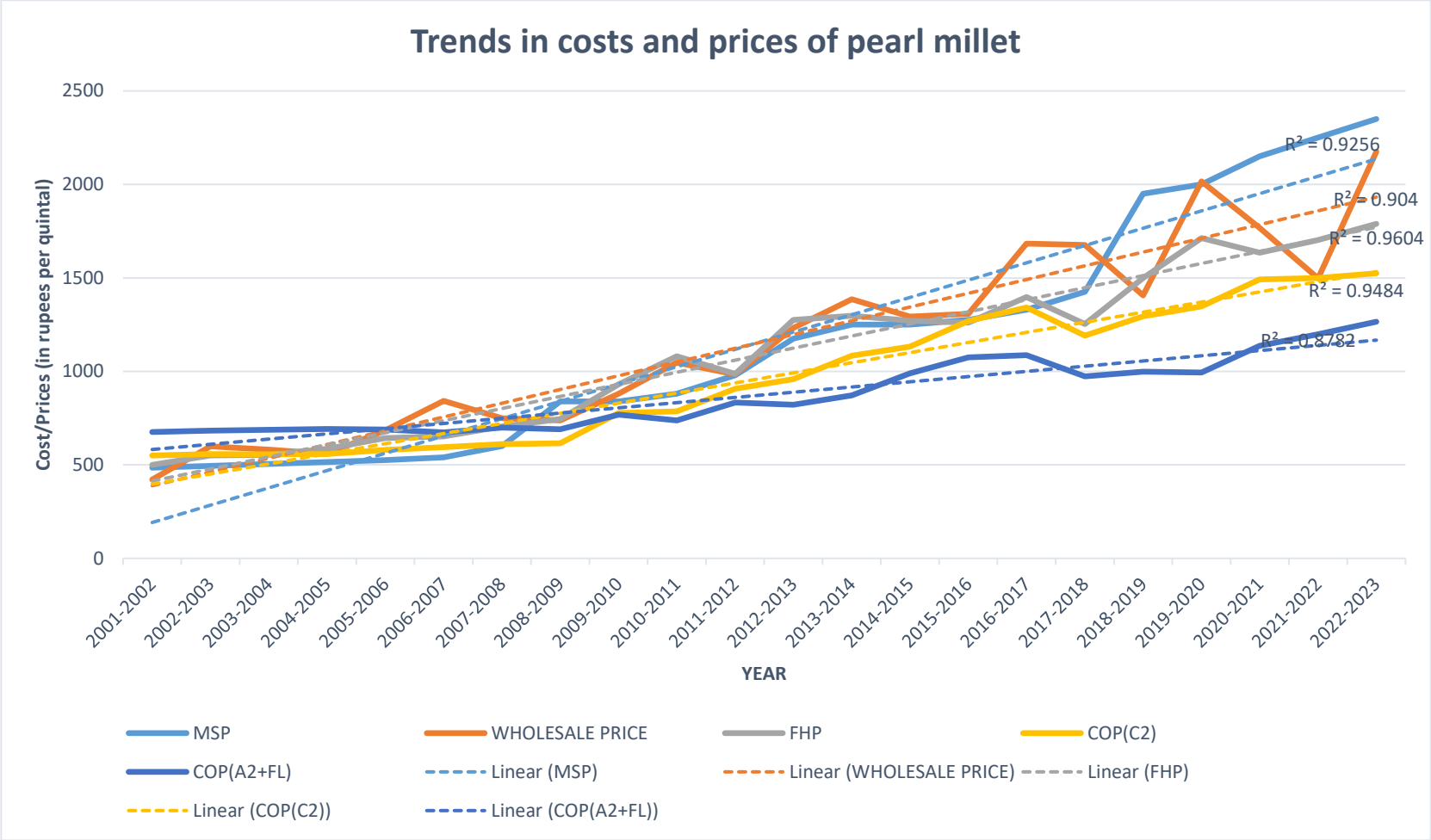
Excess of Actual MSP Over Cost of Production (C2) (%): Similar to the previous calculations, this column calculated the percentage by which the actual MSP surpasses the cost of production, but it takes into account the C2 cost components, which include additional factors beyond A2+FL.Negative percentages (year 2001-2002 to 2007-2008) in this column suggest that the MSP for Pearl millet tends to be lower than the comprehensive cost of production, which encompasses various elements like imputed rent and interest on owned land and capital.

The presence of negative values in both the "Excess of Actual MSP Over Cost of Production" columns, considering both A2+FL and C2 cost components, highlights the financial challenges that Pearl millet farmers face due to the frequent inadequacy of the Minimum Support Price (MSP) in covering their production expenses. Furthermore, the differences observed between the A2+FL and C2 cost components within the "Excess of Actual MSP over Cost of Production" columns provide insight into how comprehensive cost calculations play a pivotal role in shaping the MSP for Pearl millet in Gujarat.

Graph 1 depicted the trend of costs and prices of Pearl millet in the markets of Gujarat state for variables like Minimum support price, Wholesale price, Farm harvest price and cost of production from year 2001-2022 [5]. Trend of all costs and prices showed a flat upward risings towards right in the initial years of study. Thereafter trends of cost of production and farm harvest price showed some fluctuations with high ups and downs in wholesale price in recent years. Whereas minimum support price showed an constant increase in last five years, Mittal [6].

Table 1. Trends in minimum support prices of pearl millet in gujarat state during 2001-2022

Year	Change in support price over previous year (%)	Excess of Actual Msp Over Cop (A2+FL) (%)	Excess of Actual Msp Over Cop(C2) (%)
2001-2002		-39	-13.45
2002-2003	0.2	-38	-12.70
2003-2004	0	-36	-10.26
2004-2005	0.1	-35	-8.44
2005-2006	0.1	-31	-10.47
2006-2007	0.1	-25	-10.21
2007-2008	2.7	-17	-1.85
2008-2009	0	18	26.78
2009-2010	1	9	7.47
2010-2011	0.5	16	10.61
2011-2012	0.8	15	7.39
2012-2013	1.7	30	18.42
2013-2014	0.6	30	13.34
2014-2015	0.5	21	9.36
2015-2016	0.5	16	0.38
2016-2017	0.6	18	-0.92
2017-2018	0.8	32	16.39
2018-2019	2	49	33.65
2019-2020	0.65	50	32.59
2020-2021	0.53	47	30.61
2021-2022	0.72	47	33.35
2022-2023	1	46	35.12



Graph 1. Trends in costs and prices of Pearl millet in the markets of Gujarat state from year 2001-2022

Maize: The Table 2 outlines the trends in minimum support prices (MSP) for a particular agricultural crop, maize, in Gujarat state over a span of several years. The data is presented in three columns, each with its own significance:

Change in support price over previous year (%): A positive value indicates an increase in the MSP compared to the previous year. The annual change in support prices for maize exhibited variations, with some years experienced significant increase (2002-2003, 2007-2008, 2009-2010, 2012-2013, and 2018-2019) and showed an significant decremental change in very next year. Also none of the year showed a negative change in support prices throughout the study time. The values 0% for year 2003-2004 and 2008-2009 showed that there were no change in support price, the same price were carried forward from the previous year.

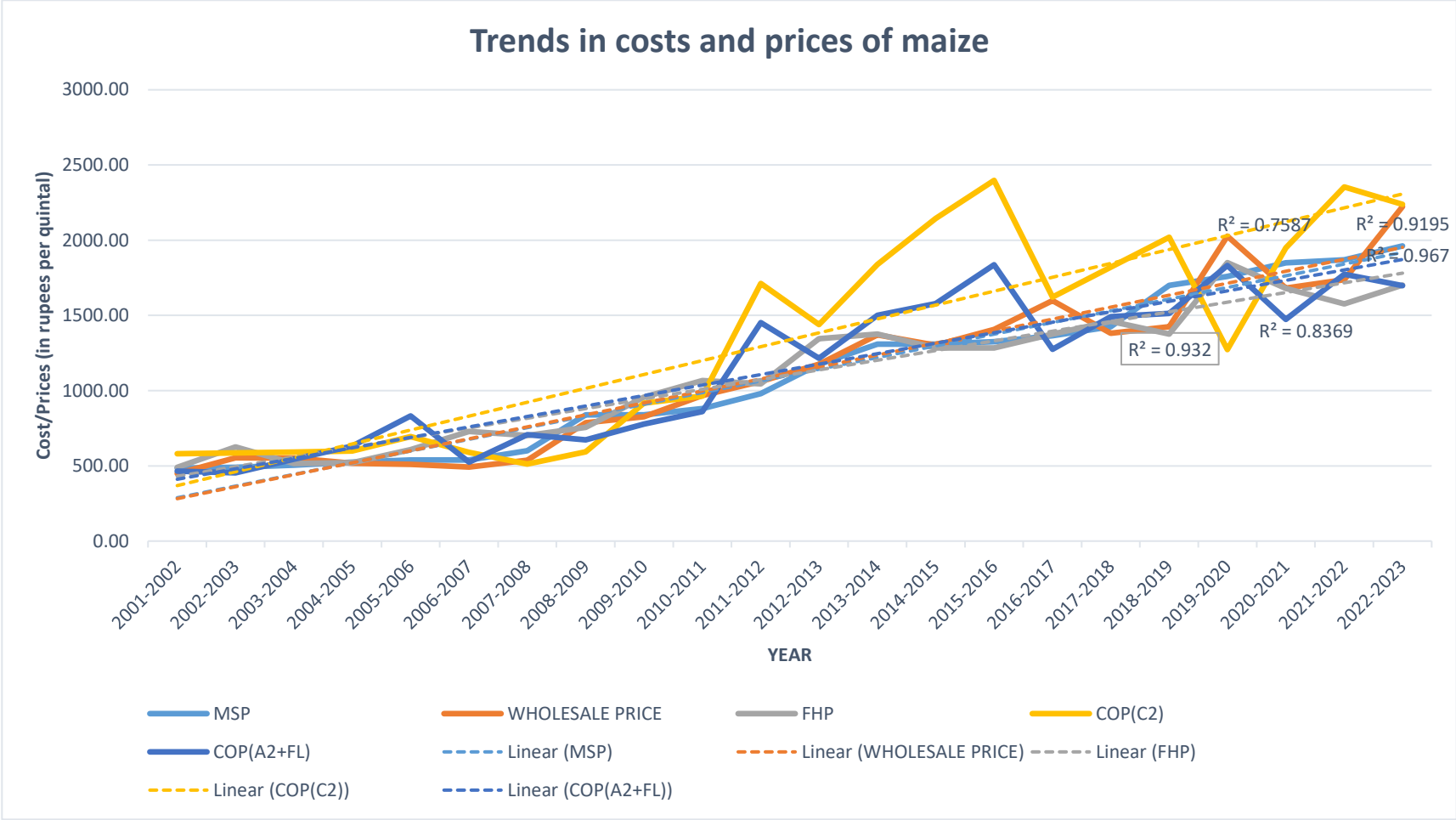
Excess of actual MSP over COP (A2+FL) (%): The next column quantified the percentage by which the actual Minimum Support Price (MSP) for maize surpasses the cost of production (COP), taking into account the A2+FL cost components. In most years, this indicator shows negative values, suggesting that the MSP tends to be lower than the cost of production when considering the A2+FL cost components. Farmers faced challenges in achieving a profitable margin, as the MSP was often insufficient to cover their production costs.

Excess of actual MSP over COP (C2) (%): Similar to the A2+FL calculation, the C2 cost components often result in negative values, indicating that the MSP typically fell short of covering the comprehensive cost of production, which includes additional factors like imputed rent and interest on owned land and capital.

The negative values in the "Excess of Actual MSP over COP" columns (both A2+FL and C2) reflect the challenges faced by maize farmers in Gujarat. When the MSP is lower than the cost of production, it can lead to decreased profitability and financial stress for farmers. In recent years (e.g., 2019-2020, 2020-2021), there has been a slight improvement in the "Excess of Actual MSP Over COP" when considering the C2 cost components, indicating some progress in terms of farmers' profitability. The disparities between A2+FL and C2 calculations show the influence of comprehensive cost components on the MSP. When considering additional factors, the MSP tends to fall short of covering these extended costs.

Table 2. Trends in minimum support prices of maize in gujarat state during 2001-2022

Year	Change in support price over previous year (%)	Excess of Actual Msp Over Cop (A2+FL) (%	Excess of actual msp over cop (c2) (%)
2001-2002		4.05	-19.67
2002-2003	0.2	7.41	-19.68
2003-2004	0	-7.68	-17.09
2004-2005	0.1	-20.41	-13.97
2005-2006	0.1	-53.92	-28.63
2006-2007	0.1	2.72	-9.33
2007-2008	2.7	-17.93	14.65
2008-2009	0	19.92	29.35
2009-2010	1	7.33	-9.24
2010-2011	0.5	2.23	-9.49
2011-2012	0.8	-48.17	-74.78
2012-2013	1.7	-3.50	-22.55
2013-2014	0.6	-14.58	-40.39
2014-2015	0.5	-20.44	-63.70
2015-2016	0.5	-38.63	-80.96
2016-2017	0.6	6.65	-18.83
2017-2018	0.8	-4.7	-27.81
2018-2019	2	10.97	-18.78
2019-2020	0.65	-4.06	27.69
2020-2021	0.53	20.30	-5.38
2021-2022	0.72	5.11	-25.93
2022-2023	1	13.44	-14.09



Graph 2. Trends in costs and prices of maize in the markets of Gujarat state from year 2001-2022

Graph 2 depicted the trend of costs and prices of Pearl millet in the markets of Gujarat state for variables like Minimum support price, Wholesale price, Farm harvest price and cost of production from year 2001-2022. Apart from comprehensive cost of production all other variables, for some initial ten years showed medium level of fluctuations in costs and prices. Whereas cost of production with A2 + FL component showed hig fluctuations from 2011-2012 onwards. Trend lines of all variables showed upward movement towards right from the origin during the study period.

Paddy: The Table 3 outlines the trends in minimum support prices (MSP) for a particular agricultural crop, paddy, in Gujarat state over a span of several years. The data is presented in three columns, each with its own significance:

Change in support price over the previous year (%): Over the years, several noteworthy patterns emerge. The "Change in Support Price over Previous Year (%)" column indicates the annual adjustments in MSP. These adjustments often fluctuate, with substantial increases observed in certain years, most notably in 2007-2008, where there was a remarkable 2.7% increase.

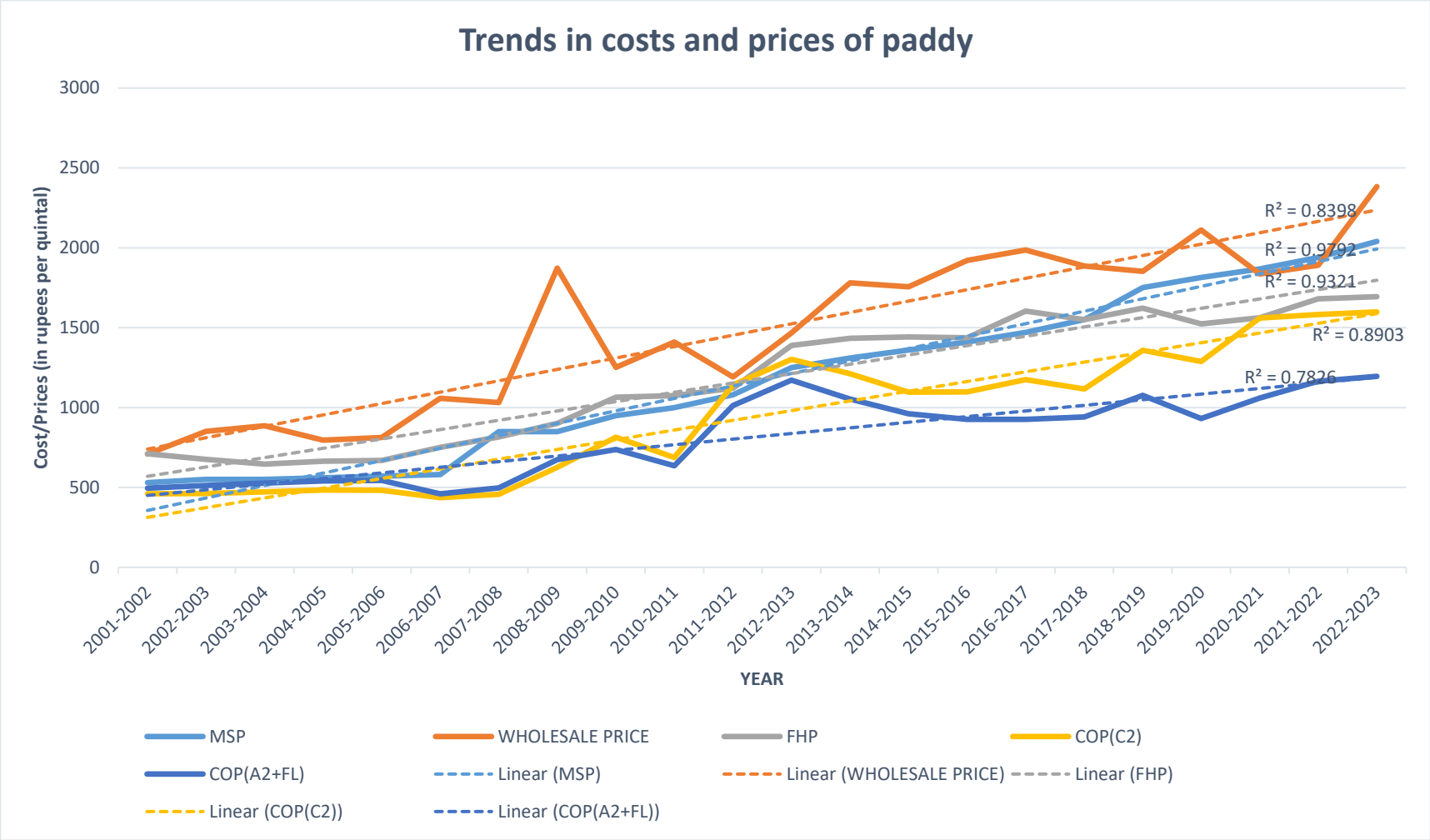
Excess of actual MSP over COP (A2+FL) (%): A vital aspect of this data is the "Excess of Actual MSP over Cost of Production (A2+FL) (%)" column. It consistently exhibits positive values, indicating that the MSP generally surpasses the cost of production for paddy when considering the A2+FL cost components.

Excess of actual MSP over COP (C2) (%): Similarly, the "Excess of Actual MSP over Cost of Production (C2) (%)" column illustrates that even when factoring in comprehensive cost components such as imputed rent and interest on owned land and capital, the MSP continues to exceed the extended cost of production except for year 2011-2012 and 2012-2013 where MSP failed to surpass comprehensive cost of production.

Graph 3 depicted the trend of costs and prices of paddy in the markets of Gujarat state for variables like Minimum support price, Wholesale price, Farm harvest price and cost of production from year 2001-2022. Cost of production with both the components moved in similar pattern throughout the study period. Farm harvest price throughout from 2001-2022 showed very low fluctuation. A sudden increase in msp was seen in 2008-2009 due to change in government policy with some fluctuation in recent years of study period. Trend lines of all variables showed upward movement towards right from the origin during the study period.

Table 3. Trends in minimum support prices of paddy OF GUJARAT state from 2001-2022

Year	Change in support price over previous year (%)	Excess of Actual MSP Over Cop (A2+FL) (%)	Excess of Actual MSP Over Cop (C2) (%)
2001-2002		6.49	13.28
2002-2003	0.2	6.85	15.94
2003-2004	0	4.31	14.31
2004-2005	0.1	3.63	13.66
2005-2006	0.1	4.49	15.44
2006-2007	0.1	20.72	24.83
2007-2008	2.7	41.61	46.15
2008-2009	0	20.68	26.41
2009-2010	1	22.32	14.21
2010-2011	0.5	36.46	31.23
2011-2012	0.8	6.27	-5.76
2012-2013	1.7	6.24	-4.14
2013-2014	0.6	19.63	7.46
2014-2015	0.5	29.39	19.42
2015-2016	0.5	34.33	22.18
2016-2017	0.6	37.06	20.09
2017-2018	0.8	39.24	28.00
2018-2019	2	38.48	22.42
2019-2020	0.65	48.72	29.04
2020-2021	0.53	43.25	16.44
2021-2022	0.72	39.95	18.40
2022-2023	1	41.40	21.64



Graph 3. Trends in costs and prices of paddy in the markets of Gujarat state from year 2001-2022

Wheat: The Table 4 outlines the trends in minimum support prices (MSP) for a particular agricultural crop, wheat, in Gujarat state over a span of several years. The data is presented in three columns, each with its own significance:

Change in support price over the previous year (%): This column indicated the percentage change in the Minimum Support Price (MSP) from one year to the next of wheat in Gujarat state. It reflects the annual adjustments made to the MSP by the government, which is a crucial policy tool in agricultural economics. An increase in the MSP signifies a price hike for the respective agricultural commodities. The annual change in support prices fluctuates over the years, with some years showing significant increases (2006-2007, 2007-2008, 2011-2012 and 2018-2019) and others indicating more moderate changes. The annual changes can be influenced by various factors, including inflation, production costs, market conditions, and government policies.

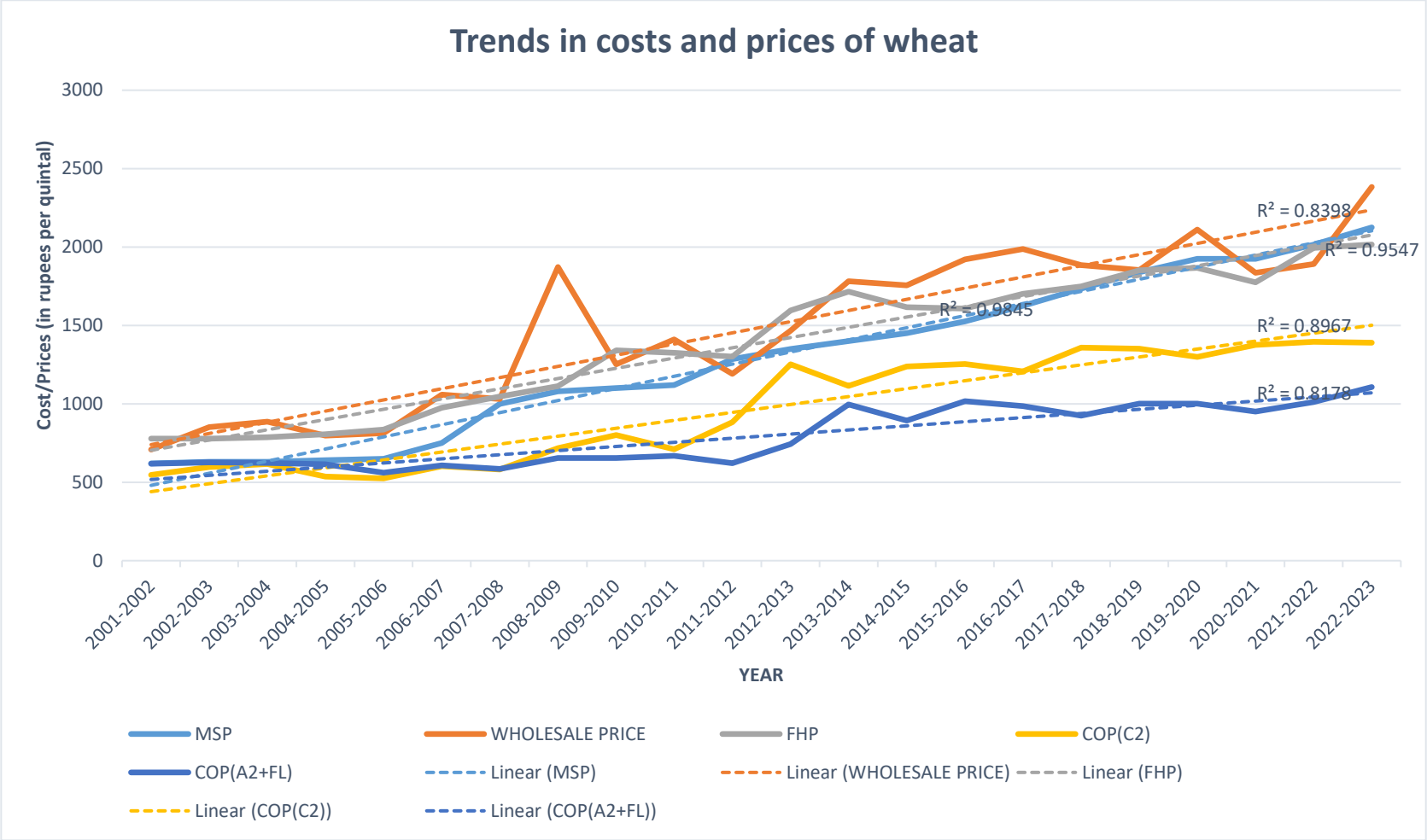
Excess of actual MSP over COP (A2+FL) (%): This indicator measures the percentage by which the actual Minimum Support Price (MSP) exceeds the cost of production (COP) calculated using the A2+FL cost components. As positive value indicated that the MSP is higher than the cost of production, providing farmers with a margin of profit, as all years shown positive value with highest in year 2020-2021 with almost 52%.

Excess of actual MSP over COP (C2) (%): This measure calculates the percentage by which the actual Minimum Support Price (MSP) exceeds the cost of production (COP) based on the C2 cost components. A positive value in this column signifies that the MSP is higher than the comprehensive cost of production, considering additional factors beyond A2+FL. This could include factors like imputed rent and interest on owned land and capital. Similar to the A2+FL measure, a positive percentage indicated that farmers are earning more than just covering their production costs with highest percentage in year 2007-2008 with 42%.

The excess of actual MSP over the cost of production, whether using the A2+FL or C2 components, generally showed positive values throughout the years. This meant that the MSP consistently provided a margin of profit for farmers, which is essential for their livelihoods and incentives for crop cultivation.

Table 4. Trends in minimum support prices of wheat in gujarat state during 2001-2022

Year	Change in support price over previous year (%)	Excess of Actual MSP Over Cop (A2+FL) (%)	Excess of Actual Msp Over COP (C2) (%)
2001-2002	-	0.2	12
2002-2003	0.1	0.64	5
2003-2004	0	1.05	2
2004-2005	0.1	4.10	16
2005-2006	0.1	13.73	19
2006-2007	1	18.95	20
2007-2008	2.5	41.46	42
2008-2009	0.8	39.41	34
2009-2010	0.2	40.50	27
2010-2011	0.2	40.27	37
2011-2012	1.65	51.70	31
2012-2013	0.65	44.98	7
2013-2014	0.5	28.88	20
2014-2015	0.5	38.41	15
2015-2016	0.75	33.36	18
2016-2017	1	39.36	26
2017-2018	1.1	46.68	22
2018-2019	1.05	45.59	27
2019-2020	0.85	47.98	33
2020-2021	0.5	51.88	30
2021-2022	0.4	49.75	31
2022-2023	1.1	47.91	35



Graph 4. Trends in costs and prices of wheat in the markets of Gujarat state from year 2001-2022

Graph 4 depicted the trend of costs and prices of paddy in the markets of Gujarat state for variables like Minimum support price, Wholesale price, Farm harvest price and cost of production from year 2001-2022. The respective trends were almost similar to paddy cropas cost of production moving in similar pattern and farm harvest price with low fluctuations during the study period. A sudden increase in msp was also seen in year 2008-2009. Trend lines of all variables showed upward movement towards right from the origin during the study period.

Correlation between Minimum support price, Wholesale price, Farm harvest price and cost of production: Table 5 suggested the correlation between Minimum support price, Wholesale price, Farm harvest price and cost of production of Pearl millet in markets of Gujarat state during time period year 2001-2022. As MSP is a critical factor in the Pearl millet market. It had a strong positive correlation of 0.914 with Wholesale Price. This suggested that as the Minimum Support Price for Pearl millet increases, the Wholesale Price tends to increase as well. This positive correlation indicated that changes in MSP have a significant influence on Wholesale Prices, which is crucial for understanding the pricing dynamics in the Pearl millet market. FHP was closely related to both MSP and Wholesale Price. It had a very strong positive correlation of 0.965 with MSP and 0.954 with Wholesale Price. This suggested that changes in FHP are strongly aligned with changes in MSP and Wholesale Price. When Farm Harvest Price increases, MSP and Wholesale Price were likely to increase as well, and vice versa. The comprehensive cost of production, represented by C2, is an essential variable for understanding the economic dynamics of Pearl millet farming. It exhibited a strong positive correlation of 0.955 with MSP, 0.940 with Wholesale Price, and 0.972 with FHP. This indicated that changes in the cost of production (C2) are closely tied to changes in MSP, Wholesale Price, and FHP. When C2 increases, MSP, Wholesale Price, and FHP tend to increase as well, and vice versa.The cost of production considering A2+FL cost components also showed strong positive correlations with MSP (0.928), Wholesale Price (0.897), FHP (0.923), and C2 (0.977). This emphasized the strong relationships between these variables. When the cost of production (A2+FL) for Pearl millet rises, it's was likely that MSP, Wholesale Price, FHP, and C2 will also increase, and conversely.

The Table 6 displayed correlation coefficients, which measured the strength and direction of the linear relationships between pairs of variables like Minimum support price, Wholesale price, Farm harvest price and cost of production of Maize in markets of Gujarat state during time period year 2001-20221. The closer the correlation coefficient is to 1, the stronger the positive relationship, while a value closer to -1 indicated a strong negative relationship.

MSP was a key determinant in the Maize market. It had a very strong positive correlation of 0.971 with Wholesale Price. This indicated that as the Minimum Support Price for Maize increases, the Wholesale Price tends to increase as well. This strong positive correlation suggested that changes in MSP have a substantial influence on Wholesale Prices, which was crucial for understanding pricing dynamics in the Maize market. Wholesale Price exhibited a very strong positive correlation of 0.971 with MSP, reinforced the close relationship between these two variables. When the Minimum Support Price for Maize rised, the Wholesale Price followed suit, which was an important observation for market participants. FHP was closely related to both MSP and Wholesale Price. It had a very strong positive correlation of 0.965 with MSP and 0.967 with Wholesale Price. This suggested that changes in FHP are strongly aligned with changes in MSP and Wholesale Price. When Farm Harvest Price increased, MSP and Wholesale Price were likely to increase as well, and vice versa. The comprehensive cost of production, represented by C2, was an essential variable for understanding the economic dynamics of Maize farming. It exhibited a strong positive correlation of 0.872 with MSP, 0.836 with Wholesale Price, and 0.831 with FHP. This indicated that changes in the cost of production (C2) are closely tied to changes in MSP, Wholesale Price, and FHP. When C2 increased, MSP, Wholesale Price, and FHP tend to increase as well, and vice versa.The cost of production considering A2+FL cost components also showed a strong positive correlation with MSP (0.909), Wholesale Price (0.907), FHP (0.910), and C2 (0.929). This emphasized the strong relationships between these variables. When the cost of production (A2+FL) for Maize increased, it's was likely that MSP, Wholesale Price, FHP, and C2 also increase, and conversely.

Table 5. Results of correlation analysis for Pearl Millet

	MSP	Wholesale Price	FHP	COP(C2)	COP(A2+FL)
MSP	1				
Wholesale Price	0.914	1			
FHP	0.965	0.954	1		
COP(C2)	0.955	0.940	0.972	1	
COP(A2+FL)	0.928	0.897	0.923	0.977	1

Table 6. Results of correlation analysis for MAIZE

	MSP	Wholesale Price	FHP	COP (C2)	COP (A2+FL)
MSP	1				
Wholesale Price	0.971	1			
FHP	0.965	0.967	1		
COP(C2)	0.872	0.836	0.831	1	
COP(A2+FL)	0.909	0.907	0.910	0.929	1

Table 7. Results of correlation analysis for PADDY

	MSP	Wholesale price	FHP	COP (C2)	COP (A2+FL)
MSP	1				
Wholesale Price	0.904	1			
FHP	0.967	0.908	1		
COP(C2)	0.956	0.833	0.953	1	
COP(A2+FL)	0.894	0.800	0.925	0.975	1

Table 8. Results of correlation analysis for WHEAT

	MSP	Wholesale Price	FHP	COP(C2)	COP (A2+FL)
MSP	1				
Wholesale Price	0.921	1			
FHP	0.978	0.917	1		
COP(C2)	0.951	0.882	0.962	1	
COP(A2+FL)	0.907	0.899	0.917	0.924	1

Table 7 presented the results of a correlation analysis for Paddy, offering insights into the relationships between key variables like Minimum support price, Wholesale price, Farm harvest price and cost of production in markets of Gujarat state during time period year 2001-2022 in the context of Paddy production.

MSP was a pivotal factor in the Paddy market. It exhibited a strong positive correlation of 1 with itself, which is a perfect positive correlation, as it's being compared to its own values. This was expected since MSP values are compared with themselves. Wholesale Price displayed a strong positive correlation of 0.904 with MSP. This suggested a strong and positive relationship between MSP and Wholesale Price. When the Minimum Support Price for Paddy increased, the Wholesale Price also increased, indicated changes in MSP have a significant influence on Wholesale Prices in the Paddy market. FHP was another crucial variable in Paddy production. It had a very strong positive correlation of 0.967 with MSP and a strong positive correlation of 0.908 with Wholesale Price. This demonstrated the strong positive relationships among these variables. When the Farm Harvest Price for Paddy rised, both MSP and Wholesale Price also increased as well. The comprehensive cost of production, represented by C2, an important factor in the economic dynamics of Paddy farming. It showed a strong positive correlation of 0.956 with MSP, indicated changes in C2 were closely linked to changes in MSP. When the cost of production (C2) for Paddy increased, the MSP also increased. The cost of production considering A2+FL cost components demonstrated a strong positive correlation of

0.894 with MSP. This suggested that changes in the cost of production (A2+FL) for Paddy were closely related to changes in MSP. When the cost of production (A2+FL) rised, MSP also increased.

Table 8 provides the results of a correlation analysis for Wheat, offering insights into the relationships between key variables like Minimum support price, Wholesale price, Farm harvest price and cost of production in markets of Gujarat state during time period year 2001-2022 within the Wheat market.

MSP represent the floor price set by the government to support Wheat farmers. As expected, it exhibited a perfect positive correlation of 1 with itself when compared to its own values. This simply meant that MSP values were highly correlated with each other, which was natural since it was the same variable over different periods. Wholesale Price showed a strong positive correlation of 0.921 with MSP. This indicated a significant and positive relationship between MSP and Wholesale Price in the Wheat market. When the Minimum Support Price for Wheat increased, the Wholesale Price tends to increased as well, reflected the influence of MSP on Wholesale Prices. FHP was another crucial variable in the Wheat market, represented the prices at which farmers sell their harvest. It exhibited a very strong positive correlation of 0.978 with MSP and a strong positive correlation of 0.917 with Wholesale Price. These findings revealed strong and positive relationships among these variables, indicated that when the Farm Harvest Price for Wheat rised, both MSP and Wholesale Price also increased. C2, representing the comprehensive cost of production, is an important factor in the economic dynamics of Wheat farming. It displayed a strong positive correlation of 0.951 with MSP, highlighting the close connection between changes in C2 and MSP. When the cost of production (C2) for Wheat increased, the MSP also increased. Cost of production considering A2+FL cost components exhibited a strong positive correlation of 0.907 with MSP. This implied that changes in the cost of production (A2+FL) for Wheat were closely related to changes in MSP. When the cost of production (A2+FL) raised, MSP also increased.

The Table 9 provided data on the growth rates and variability of costs and prices for four major cereals (Pearl millet, Maize, Paddy, and Wheat) in Gujarat state from 2001 to 2022. These statistics are essential for assessing the agricultural performance and market dynamics of each crop. Joshi and Singh [7].

Pearl millet had experienced robust growth in its Minimum Support Price (MSP), with a maximum growth rate of 8.71%. This suggested that the government had consistently increased the support price for Pearl millet over the years, providing farmers with higher price incentives. Pearl millet also exhibited strong growth in Wholesale Prices, FHP, and COP (C2). Pearl millet had relatively high variability in MSP at 15.18, indicating significant price fluctuations over the years. Variability in other aspects, like Wholesale Prices, FHP, and COP(C2), is also substantial, reflected the volatility in the Pearl millet market.

Maize showed impressive growth in Wholesale Prices, with a maximum growth rate of 8.03%. This indicated an increase in market demand or favourable pricing conditions for Maize. Upreti P. [8]. Growth rates are also substantial for FHP, COP (A2+FL), and COP (C2).Maize had the highest variability in COP (C2) at 25.71, suggested substantial fluctuations in the cost of production. Variability in Wholesale Prices was also significant, indicated potential challenges in price stability.

Paddy experienced consistent growth in MSP, with a maximum growth rate of 7.45%, indicated government support for rice cultivation. The growth rate in Wholesale Prices was relatively lower but still notable. Paddy also displayed growth in FHP, COP (A2+FL), and COP (C2). Paddy's variability was relatively moderate, with the highest being in COP (C2) at 15.23. This suggested some price and cost fluctuations.

Wheat had a maximum growth rate of 6.71% in MSP, indicating government support for wheat production. The growth rate in Wholesale Prices and other aspects was also positive, although relatively lower compared to some other crops.Wheat had relatively lower variability in Wholesale Prices at 5.53, suggested a more stable price environment. Variability in other aspects, like COP (C2), was also moderate, indicated relatively consistent production costs.

Each of the selected cereals in Gujarat state exhibited distinct patterns of growth and variability. Pearl millet and Maize experienced strong growth in various price and cost aspects, while Paddy and Wheat also showed positive

Table 9. Growth and variability of costs and prices of selected major cereals in Gujarat state from 2001-2022

crops	Aspects	MSP	Wholesale Prices	FHP	COP (A2+FL)	COP(C2)
Pearl millet	**Growth rate**	8.71*** (0.001)	7.08*** (0.001)	6.59*** (0.001)	3.18*** (0.001)	6.00*** (0.001)
	Variability	15.18	13.68	7.84	7.95	10.57
Maize	**Growth rate**	7.90*** (0.001)	8.03*** (0.002)	6.60*** (0.001)	8.15*** (0.003)	7.17*** (0.002)
	Variability	9.25	14.46	10.35	17.84	25.71
Paddy	**Growth rate**	7.45*** (0.001)	5.41*** (0.002)	5.47*** (0.001)	4.72*** (0.002)	7.26*** (0.002)
	Variability	7.54	13.99	8.78	14.79	15.23
Wheat	**Growth rate**	6.71*** (0.001)	5.41*** (0.002)	5.20*** (0.001)	3.37*** (0.001)	5.70*** (0.001)
	Variability	5.53	13.99	6.98	10.37	11.83

****: 1 percent level of significance*

growth but with some differences in the level of variability, Reddy [9]. These statistics provided valuable insights into the economic dynamics of these crops and can be crucial for farmers and policymakers in making informed decisions about crop cultivation and marketing strategies, Narayan and kumar [10]. The *** denoted a 1 percent level of significance underscores the statistical reliability of these estimates.

4. CONCLUSION

The Minimum Support Price (MSP) for Pearl Millet has demonstrated a steady rise over time, showcasing government efforts to bolster farmers in cultivating this crop. Despite the MSP's upward trend, fluctuations in annual changes are evident, with some years witnessing substantial increases while others experienced more moderate shifts or even decreases. Analysis of the MSP's margin over the cost of production (both A2+FL and C2) highlights challenges for farmers, particularly in earlier years when MSP lagged behind production costs. Similarly, Maize has seen fluctuating MSP trends, with some years marked by significant increases followed by minor declines, posing challenges for maize farmers. Paddy has exhibited consistent MSP growth, reflecting governmental backing for rice farming, with MSP generally exceeding production costs. Wheat, too, has seen MSP growth, consistently providing a profit margin for wheat farmers. Correlation analyses underscore strong positive relationships between MSP and variables such as wholesale prices, farm harvest prices, and production costs, emphasizing MSP's significant impact on agricultural economics.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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