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INFLUENCE OF THE MSP-RELATED PROCUREMENT ON FARM HARVEST PRICES OF PADDY AND WHEAT IN INDIA

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ABSTRACT

This study investigates the impact of the Minimum Support Price (MSP) system on farm harvest prices (FHPs) for paddy and wheat in India. As a government intervention aimed at stabilizing agricultural markets and safeguarding farmers against price volatility, the MSP establishes a price floor for designated crops prior to planting, thereby guaranteeing a minimum price for farmers' produce. Our research assesses the effectiveness of the MSP in influencing FHPs for paddy and wheat across key producing states from 2002 to 2021. Utilizing a comprehensive dataset, we employ a panel model to analyze the relationship between MSP-related procurement volumes and FHPs, while controlling for variables such as production costs, market prices, and overall production levels. The results indicate that government procurement under the MSP significantly enhances FHPs for both crops, highlighting the crucial role of such interventions in improving farmers' incomes. In light of these findings, we recommend expanding MSP-based procurement to encompass a wider array of crops and regions.

Keywords: Agricultural policy, Government procurement, Market price, Fixed effect, Random effect, Panel data

The role of government in shaping the dynamics of the agricultural sector, particularly in developing countries, is a critical focus within agricultural economics literature (Gupta, 1980; Kanza and Vitale, 2015). Government interventions significantly influence both the pricing and production of agricultural products, with profound implications for farmers' incomes and the affordability of agricultural commodities for consumers. Among the various strategies employed to support agricultural sectors, India's Minimum Support Price (MSP) system stands out as a noteworthy policy intervention aimed at ensuring remunerative prices for farmers. Introduced in 1966, the MSP system was designed to provide a guaranteed price floor for select agricultural commodities, thereby shielding farmers from market fluctuations and ensuring a degree of income security (Chand, 2008; Parikh and Singh, 2007; Mehta *et al.*, 2020; Srinivasa *et al.*, 2023). Following directives from the central government, an assurance price is announced prior to the sowing season for each designated crop, guiding planting decisions and securing an economic safety net for agricultural producers (Chand, 2008; Deshpande, 2008; Aditya *et al.*, 2017; Das, 2020). Currently, the MSP covers 22 crops, including staples such as paddy and wheat, as well as oilseeds and fibers like groundnut and cotton, illustrating the policy's broad scope (Ministry of Agriculture and Farmers Welfare, 2024). This pre-emptive pricing mechanism operates on the principle that if market prices fall below the MSP threshold, government agencies will intervene to procure the affected crops at predetermined rates, thus stabilizing incomes for the agricultural community (Deshpande, 2003). Although the MSP applies to over 20 crops, its practical impact in terms of procurement volumes is primarily observed in paddy and wheat (Das, 2020; Chand, 2003; Deshpande, 2008; Bhardwaj *et al*., 2021). Recent government initiatives to procure pulses indicate an intent to diversify procurement practices; however, the volumes remain significantly lower compared to those of paddy and wheat (Ali *et al.*, 2012; Singh *et al.*, 2015).

This intervention, however, relies heavily on the effectiveness of government procurement processes, which significantly influence the MSP system's ability to enhance farmer-trader dynamics and, ultimately, the Farm Harvest Price (FHP)—the price received by farmers for their produce directly at the farm gate, excluding transportation to market venues (Srinivasa *et al*., 2023). As noted, the primary objective of the MSP is to support farmers by ensuring a minimum profit for their harvests, regardless of market fluctuations (Mehta *et al*., 2020). This system aims to provide farmers with a degree of financial stability and encourage their continued engagement in agricultural activities. Consequently, the MSP serves as a vital market signal for farmers in determining the FHP at the farm gate (Vasant and Sukhatme, 1983; Srinivasa *et al*., 2023; Thakare *et al*., 2024).

Keeping in view this background, our research examines the substantive effects of the MSP system on the Farm Harvest Prices (FHPs) of paddy and

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wheat. Through this study, we aim to contribute to the existing body of knowledge regarding governmental policy interventions in agriculture by closely analyzing the MSP system's capacity to influence farm harvest prices in India. By focusing specifically on paddy and wheat, we seek to provide insights into the operational effectiveness of the MSP system. This inquiry is crucial not only for understanding the intricacies of agricultural policy in India but also for informing future policy formulations aimed at enhancing the welfare of the agricultural sector.

The paper is organized into four distinct sections. The first section serves as the introduction, outlining the foundational context, objectives, and overall significance of the study, thereby setting the stage for the subsequent in-depth exploration. The second section delves into the research methodology, providing a comprehensive exposition of the models, materials, and methods employed in the investigation. Following this, the paper presents and critically examines the empirical findings, integrating the results with existing literature to discuss their implications and relevance. The final section is dedicated to conclusions and policy implications.

The literature on MSP and procurement operations in India is extensive. The novelty of this study lies in its utilization of a substantial state-level panel dataset to examine the impact of procurement operations on farm harvest prices across various regions of India.

METHODOLOGY

This study is based on secondary data compiled from key sources, including the Food Corporation of India (FCI), a statutory body under the Ministry of Consumer Affairs, Food and Public Distribution; the Directorate of Economics and Statistics within the Department of Agriculture and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare; the Agmarknet Portal[1], managed by the same ministry, which provides real-time data on market prices and arrivals; and the Handbook of Statistics on the Indian Economy, published annually by the Reserve Bank of India (RBI). These data sources are deemed authentic and reliable due to their governmental oversight and rigorous data collection methodologies. The FCI, as a statutory entity, ensures the accuracy and precision of data related to food distribution and stocks. The Directorate of Economics and Statistics and the Agmarknet Portal, overseen by the Ministry of Agriculture and Farmers' Welfare, guarantee systematic data collection and regular updates. Furthermore, the Handbook of Statistics on the Indian Economy, published by the RBI, is highly regarded for its thorough compilation and meticulous analysis of economic data.

In the case of paddy, two Minimum Support Prices (MSPs) are announced: one for common-grade paddy and another for Grade A paddy. Our analysis focuses on common-grade paddy due to the availability of relevant data. We collected data on all necessary variables for 12 Indian states—Andhra Pradesh, Assam, Chhattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal. For wheat, data were gathered from 6 states: Bihar, Haryana, Madhya Pradesh, Punjab, Rajasthan, and Uttar Pradesh. These states are major producers of their respective crops and are the largest contributors to government procurement under the MSP system, accounting for over 95 percent of both production and procurement in these regions. The time frame for the analysis spans from 2002 to 2021, based on data availability. The state-wise weighted farm harvest price (FHP) for each crop was obtained from the Directorate of Economics and Statistics, Department of Agriculture and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Government of India. Various cost concepts are utilized in Indian agriculture; specifically, the Commission of Agricultural Costs and Prices uses the cost of production (A2+FL) when recommending MSP rates. The A2 component includes all expenses incurred by farmers for purchasing inputs such as chemicals, fertilizers, seeds, and hired labour for crop production, while FL represents the implicit cost of family labour (Press Information Bureau, 2020; Directorate of Economics and Statistics, 2022). Data on the cost of production (A2+FL) were collected from the Directorate of Economics and Statistics. State-wise market price data were represented by the state-weighted wholesale market price collected from the Agmarknet portal, which provides daily wholesale market prices (modal prices) and corresponding quantities sold. From this data, we calculated the annual and state-wise weighted wholesale prices. Additionally, the quantities procured by government agencies under the MSP system were sourced from the Ministry of Agriculture and Farmers' Welfare and the Ministry of Consumer Affairs, Food and Public Distribution, Government of India. The MSP rates, state-wise production figures for each crop, and annual rainfall data were obtained from the Handbook

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The Agmarknet portal is a Government of India initiative that provides comprehensive agricultural marketing information. It connects agricultural markets, state marketing boards, and relevant organizations. The portal offers static data on market infrastructure and promotion, and dynamic data on daily commodity prices and arrivals. Over 2000 varieties and 300 commodities' daily market prices are reported by various wholesale markets across the country, helping farmers, traders, and other stakeholders access critical market information.
https://agmarknet.gov.in/

of Statistics on the Indian Economy, published annually by the Reserve Bank of India (RBI). Following the bifurcation of Andhra Pradesh and Telangana in 2014, the paddy production figures for Andhra Pradesh post-2014 reflect the combined output of both states. The values for FHP, market price, cost of production (COP), and annual rainfall in Andhra Pradesh after 2014 are calculated as simple averages of both states' values, as the data show no significant variation.

Model

In the context of this study, the Farm Harvest Price (FHP) is designated as the dependent variable within our model, focusing on the impact of Minimum Support Price (MSP)-related procurement activities on farm harvest prices. The primary independent variable of interest is the percentage of total crop production in a state that is procured by government agencies under the MSP framework for a given year. Keeping in view its theoretical significance, the MSP rate for a farm is an essential factor influencing FHP. It is crucial to acknowledge that FHP is affected by a multitude of demand- and supply-side factors. For instance, an increase in production costs can lead farmers to demand higher prices for their crops. Similarly, when the market price of agricultural goods rises, procuring agents at the farm gate are likely to offer higher prices, making the market price another independent variable in our analysis. Additionally, an increase in total production is expected to depress FHP, as a greater supply typically leads to lower prices. To account for weather-related impacts, we incorporate data on annual rainfall as an additional control variable in our model.

Farm Harvest Price = f (quantity procured under the MSP system, MSP of crop, cost of production, market price, total production, annual rainfall)

The explanatory variables and their expected direction of impact on the dependent variable are outlined in Table 1.

Multicollinearity assessment

Prior to the formulation of the empirical model, we conducted a multicollinearity assessment via the variance inflation factor (VIF) because of the likelihood of intervariable correlations.

In the wheat model, we observed a high correlation between the MSP rate and market price variables, with both exhibiting Variance Inflation Factor (VIF) values exceeding the threshold of 10. As a result, the MSP variable was excluded from the wheat empirical model to ensure robust coefficient estimation. To further validate our findings, we conducted a sensitivity analysis by alternatively excluding the market price variable. Notably, after removing one variable from each equation, the VIF values for all remaining variables fell below the acceptable threshold of 10. In contrast, the VIF values for all variables in the paddy model consistently remained below 10, indicating an absence of significant multicollinearity. Table 1 summarizes the VIF results for both the wheat model (before and after adjustment) and the paddy model.

Methods

Given the structure of the dataset, the models must be further specified as panel models with the help of suffices i and t.

$$\text{Farm Harvest Price}_{it} = \alpha_0 + \alpha_1 (\text{Quantity procured under MSP system})_{it} + \alpha_2 (\text{MSP of Crop})_{it} + \alpha_3 (\text{Cost of production})_{it} + \alpha_4 (\text{Market price})_{it} + \alpha_5 (\text{Total production})_{it} + \alpha_6 (\text{Annual rainfall})_{it} + U_{it} \quad \text{...(ii)}$$

where,

α_0 is the intercept term,

$\alpha_1, \alpha_2 \ldots \alpha_6$ are the coefficient terms of the respective variables,

U_{it} is the error term

The suffix t ranges from 1 to 21, starting at 1 for 2002 and ending at 21 for the year 2022.

'i' ranges from 1--12 for rice for the 12 states included for the analysis of rice FHP and from 1--6 for wheat for the 6 states included for the analysis of the FHP of wheat.

Table 1. Expected sign of the coefficients of explanatory variables

Variable	Variable Description	Expected Sign
Procurement	Quantity Procurement at MSP	+
MSP	MSP of Crop	+
COP	Cost of Production (A2+FL)	+
Market Price	Weighted Wholesale Market Price	+
Production	Total Production	-
Rainfall	Annual Rainfall	+/-

Table 2. Variance Inflation Factor (VIF) analysis for wheat and paddy models

Variable	Model 1 (Paddy): VIF	VIF (Wheat) Before adjustment	Model 2 (Wheat): VIF after removing MSP	Model 3 (Wheat): VIF after removing PRICE
Procurement	1.52	2.01	1.77	2.00
MSP	7.23	43.49	-	8.19
COP	2.47	7.57	7.08	7.09
Market Price	6.24	41.21	7.76	-
Production	1.3	1.21	1.08	1.05
Rainfall	1.51	1.48	1.4	1.28
Mean VIF	3.38	16.16	3.82	3.95

Source: Authors' calculations

Model selection and Hausman test

A Hausman test was conducted to determine whether the fixed effects (FE) or random effects (RE) model is more suitable for estimating the panel regressions. This statistical test helps assess the consistency of estimators under both models, guiding the choice of the appropriate methodology for our analysis.

The Hausman test results indicate that the fixed effects model is preferred for Wheat Model 1 (*p* value = 0.00), signifying a significant correlation between the random effects and the regressors. On the other hand, the random effects model is favoured for Wheat Model 2 (*p* value = 0.99) and the Paddy Model (*p* value = 0.46), suggesting that there is no significant correlation between the random effects and the regressors in these two models.

Thus, the empirical models are specified as follows:

For Paddy

Model 1,

Farm Harvest Price$_{it}$ = α_0 + α_1 (Quantity procured under MSP system)$_{it}$ + α_2 (MSP of crop)$_{it}$ + α_3 (Cost of production)$_{it}$ + α_4 (Market price)$_{it}$ + α_5 (Total production)$_{it}$ + α_6 (Annual rainfall)$_{it}$ + μ_i + U$_{it}$

For Wheat

Model 2,

Farm Harvest Price$_{it}$ = α_0 + α_1 (Quantity procured under MSP system)$_{it}$ + α_2 (Cost of production)$_{it}$ + α_3 (Market price)$_{it}$ + α_4 (Total production)$_{it}$ + α_5 (Annual rainfall)$_{it}$ + U$_{it}$

Model 3,

Farm Harvest Price$_{it}$ = α_0 + α_1 (Quantity procured under the MSP system)$_{it}$ + α_2 (MSP of crop)$_{it}$ + α_3 (Cost of production)$_{it}$ + α_4 (Total production)$_{it}$ + α_5 (Annual rainfall)$_{it}$ + μ_i + U$_{it}$

Where, μ_i is the random effect associated with each state i capturing the unobserved, state-specific effects that are constant over time but vary across states.

Cross-section dependence test

Cross-sectional dependence tests are crucial in panel data analysis as they identify correlations between units. Ignoring these correlations can lead to inefficient and biased estimates. Such tests enhance our understanding of spillovers and common shocks, thereby improving the robustness of econometric models (Pesaran, 2004; Breusch and Pagan, 1980; Friedman, 1937).

For Model 1, the high *p* values from both the Breusch–Pagan LM test and the Pesaran CD test support the retention of the null hypothesis of no cross-sectional dependence. In contrast, the Pesaran scaled LM test indicates a *p* value of 0.0000, suggesting the presence of dependence. Despite this discrepancy, the overall consensus from the tests allows us to retain

Table 3. Hausman test result

Model	Test statistics	*P* value	Preferred Model
Model 1 (Paddy)	5.603559	0.46	Random Effect
Model 2 (Wheat)	68.94483	0.00	Fixed Effect
Model 3 (Wheat)	0.127923	0.99	Random Effect

Source: Authors' calculations

Table 4. Cross section dependence test results

Test	Model 1 (Paddy)			Model 2 (Wheat)			Model 3 (Wheat)		
	Statistics	*df*	*P* values	Statistics	*df*	*P* values	Statistics	*df*	*P* values
Breush- pagan LM	12.55179	66	1.0000	11.16597	15	0.7407	12.29308	15	0.6567
Pesaran Scaled LM	-4.652070		0.0000	-0.699995		0.4839	-0.494214		0.6212
Pesaran CD	0.103041		0.9179	0.675312		0.4995	0.750696		0.4528

Source: Authors' calculations

the null hypothesis, indicating an absence of cross-sectional dependence within the residuals of Model 1. Many researchers (Hansen, 1999; Wooldridge, 2010; Greene, 2012; Phillips and Moon, 1999) argue that the results of the Breusch–Pagan LM test are preferable in panel data analysis when the number of time periods exceeds the number of cross-sectional entities, further confirming the absence of cross-sectional dependence.

In the cases of Model 2 and Model 3, which involve six cross-sections across 20 time periods, all three tests consistently indicate nonrejection of the null hypothesis. The high *p* values suggest an independent structure of the residuals, with no detectable cross-sectional correlations. Consequently, correction for cross-sectional dependence is not necessary in the estimation of any of the models.

RESULTS AND DISCUSSION

Correspondence between FHP and MSP-procurement

Before presenting the results of the panel data regression, it was essential to examine the relationship between the Farm Harvest Price (FHP) and our key explanatory variable, "extent of procurement under MSP." This relationship is illustrated through the trend lines shown in Figures 1 and 2.

The trend line analysis of state-wide data from 2002 to 2021 for Farm Harvest Price (FHP) and the percentage of paddy procurement at the Minimum Support Price (MSP) reveals complex dynamics and notable fluctuations. Overall, the FHP exhibits a steady increase over time, punctuated by significant spikes in specific years. In contrast, the percentage of total production procured fluctuates more dramatically, with sharp increases and decreases in certain periods. Punjab and Haryana consistently report the highest paddy procurement percentages, averaging over 80% and 60%, respectively, reflecting their high production rates. Notably, Punjab exceeded 100% in paddy procurement in 2020, indicating that the quantity procured surpassed the state's production. This anomaly is attributed to the "revolving door" strategy, as described by Kaushik Basu (Basu, 2011), which involves reintroducing purchased paddy into the system to artificially inflate procurement figures. Additionally, the illicit influx of paddy from neighboring states to take advantage of effective procurement practices exacerbates this issue (Chaba, 2020). States such as Andhra Pradesh, Chhattisgarh, Odisha, and Tamil Nadu fall into the medium procurement category, with average procurement rates ranging from 10% to 40%. For instance, Andhra Pradesh peaked at 49.26% in 2008, while Chhattisgarh exhibited steady procurement with a peak of 31.55% in 2010. In contrast, low-procuring states—those with averages below 10%—include Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Uttar Pradesh, and West Bengal. However, Uttar Pradesh and Bihar saw significant increases during this period, peaking at 15.48% and 15.67%, respectively. Karnataka and Maharashtra remained low-procuring states, although they experienced slight peaks toward the end of the period, with Karnataka reaching 5.68% and Maharashtra 5.08% in 2021. Between 2004 and 2007, many states experienced a decline in paddy procurement percentages compared to previous years, primarily due to lower MSPs relative to market prices. This discrepancy led private traders to aggressively purchase from producers, thereby diminishing the need for government procurement. However, from 2008 onwards, procurement percentages began to rise across most states. This shift was prompted by precarious buffer stock positions due to reduced stockpiles from foreign market sales and low procurement despite favourable production from 2005 to 2008. In response, the government increased MSP rates and enhanced procurement infrastructure (Nair and Eapen, 2013). In 2021, several states, including Andhra Pradesh, Haryana, Odisha, Punjab, Tamil Nadu, West Bengal, and Maharashtra, reported lower procurement percentages than in the previous year. This significant fluctuation can be attributed to the government's increased procurement under the Pradhan Mantri Garib Kalyan Yojana (PMGKY) in response to the COVID-19 pandemic, which aimed to provide 5 kg of food grains to 80 crore people at no cost. Consequently, market prices rose in comparison to the MSP or aligned with it, leading farmers to prefer selling in the open market, thereby reducing government procurement at MSP in 2021 (Parashar, 2024).

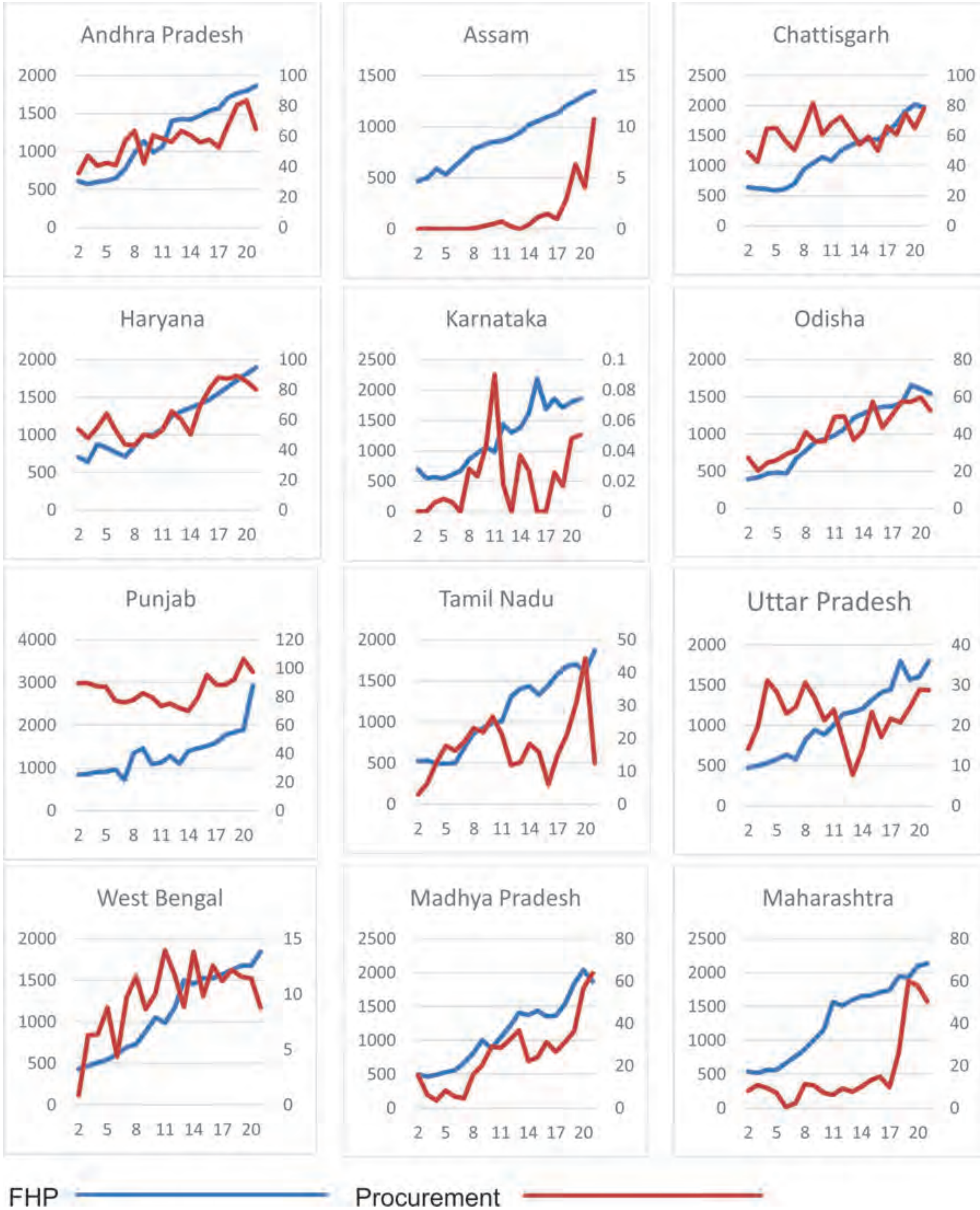

Fig. 1. FHP and MSP procurement of total production of rice (2002-2021)

Across all states, the Farm Harvest Price (FHP) exhibits a steady upward trend from 2002 to 2021, while the trend in the percentage of procurement is more variable. States such as Haryana and Punjab maintain high and stable procurement percentages, positively influencing both the stability and increase of FHP. On the other hand, Bihar consistently shows very low procurement percentages throughout the period, with only occasional peaks. Similar to the trends observed in paddy procurement, most major wheat-procuring states experienced a decline in their procurement percentages from 2004 to 2007. During this time, producers often preferred selling to private buyers, as market prices were higher or comparable to the MSP (Saini and Gulati, 2017). However, from 2008 onwards, wheat procurement percentages rose across

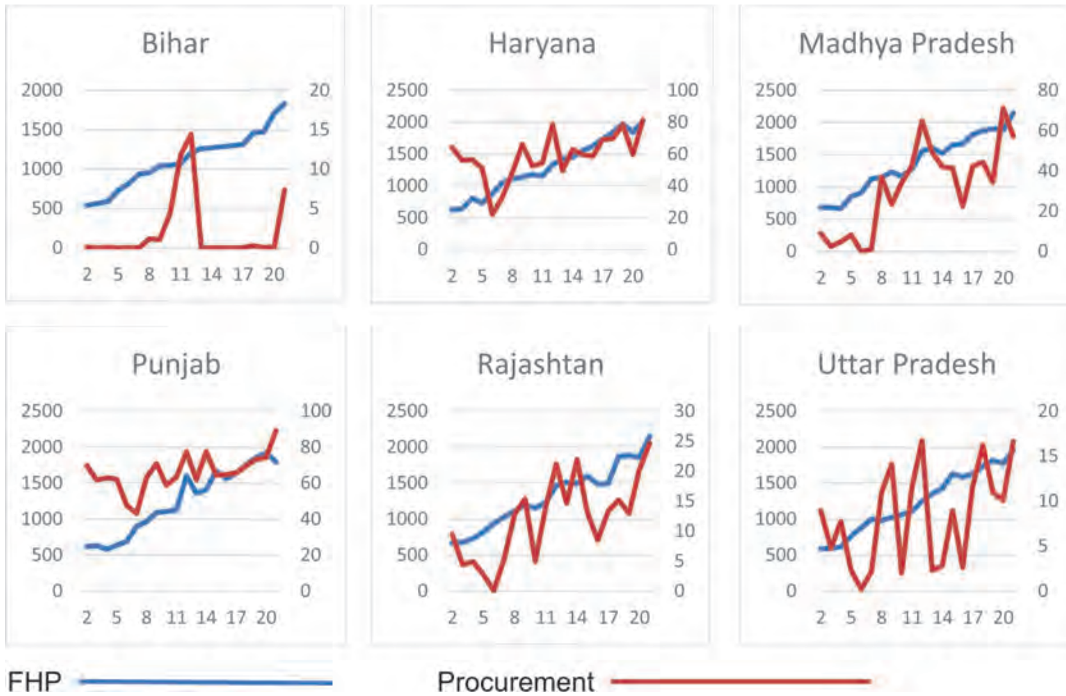

Fig. 2. FHP and MSP procurement of total production of wheat (2002-2021)

most states, driven by critical buffer stock shortages resulting from diminished stockpiles due to foreign market sales and low procurement levels despite strong production between 2005-06 and 2007-08. In response, the government increased the MSP rate and improved procurement infrastructure (Nair and Eapen, 2013). The percentage of procurement rose in most states during the COVID-19 pandemic, facilitated by the provision of an additional 5 kg of food grains under the Pradhan Mantri Garib Kalyan Yojana (PMGKAY). Despite an increase in market prices during this period, the government raised the MSP to encourage higher procurement, especially since wheat is predominantly sourced from key states like Punjab, Haryana, and Madhya Pradesh. In Bihar, a sudden drop in procurement percentage from 14% in 2012 to nearly zero the following year can be attributed to severe flooding in 2013, 2014, 2016, and 2017, which shifted procurement activities to states such as Punjab, Haryana, and Madhya Pradesh. This shift occurred alongside diminished support from the procurement agency following the repeal of the Agricultural Produce Market Act (APMS) in 2006 (Hoda *et al.*, 2021). In Madhya Pradesh, state-led incentives have enhanced the procurement process. Notably, in 2008, ahead of assembly elections, the government announced a ₹100 bonus on top of the raised MSP, bringing the procurement price to ₹1,100—the highest in the country—thereby rapidly expanding procurement operations in major wheat-producing areas. In 2020, in response to the COVID-19 pandemic, the government aimed to procure an additional 100 lakh metric tonnes of wheat compared to the previous year, organizing logistics for storage and procurement beginning on April 15 to address increased needs amid economic disruptions (Krishnamurthy, 2012; Sally, 2020). The procurement percentages in Rajasthan and Uttar Pradesh also display considerable variability. In Rajasthan, procurement percentages fluctuate significantly, with notable peaks of 21.17% in 2012 and 24.67% in 2021. In contrast, Uttar Pradesh maintains a low proportion of procurement, with its percentage swinging considerably—peaking at 22.67% in 2015 and falling to 16.61% in 2021.

Despite the imperfect nature of the correspondences, it is evident that there has been a general positive covariation between Farm Harvest Price (FHP) and the extent of procurement under the Minimum Support Price (MSP). This observation supports the decision to designate procurement under MSP as the key independent variable in the specified regression models.

Our study analyzes a panel dataset comprising 240 observations of paddy over a span of 20 years across 12 Indian states. The average Farm Harvest Price (FHP) for paddy is 1,151.48 units, with a wide range from 396 to 2,934 units, highlighting the substantial variability in prices that farmers receive for their harvests across different states and time periods. The high standard deviation of 471.39 units further highlights the volatility in harvest prices, reflecting significant variations in economic and market conditions across states. The

Table 5. Descriptive statistics of all concerned variables of regression of farm harvest price (FHP) of paddy

Variable	Observation	Mean	Std Dev	Min	Max
FHP	240	1151.48	471.38	396.00	29240
Procurement	240	33.42	28.58	0.00	106.30
MSP	240	1164.40	468.15	530.00	1940.00
COP	240	806.33	449.06	26.55	3295.11
Market Price	240	1247.57	545.80	434.88	2813.38
Production	240	73.36	45.00	10.31	201.89
Rainfall	240	1117.06	484.06	301.30	2578.50

Source: Authors' calculations

procurement range varies dramatically, extending from zero procurement to 106.3% of production, indicating pronounced discrepancies in procurement operations among states over the years. Notably, states like Assam recorded no paddy procurement by government agencies in the years 2002, 2004, 2006, 2007, and 2013, while Karnataka showed similar patterns in 2002, 2003, 2016, and 2017. In contrast, Punjab, Haryana, and Andhra Pradesh consistently emerge as significant contributors to national procurement totals (Food Corporation of India, 2024).

Our study further examines a panel dataset encompassing 20 years with 120 observations on wheat across six Indian states. The average Farm Harvest Price (FHP) for wheat is ₹1,265.34 per quintal, reflecting significant economic disparities among the states, with a standard deviation of ₹433.10. The FHP ranges from a minimum of ₹539 to a maximum of ₹2,147, highlighting the varied market conditions across states over time. The procurement range varies dramatically, from no procurement to nearly 90% of total production in certain states, highlighting stark differences in procurement practices and volumes throughout the examined period. Notably, Bihar experienced years without any wheat procurement (2006, 2013, 2016), in sharp contrast to Punjab and Haryana, which consistently made substantial contributions to national procurement volumes (Food Corporation of India, 2024).

The regression analysis of Model 1 for paddy, which examines the impact of procurement quantity under the Minimum Support Price (MSP) system on the dependent variable Farm Harvest Price (FHP), reveals noteworthy findings. The coefficient for procurement is 1.711858 with a *p* value of 0.022, indicating a substantial positive effect on FHP. This suggests that as procurement under the MSP system increases, FHP is expected to rise significantly, holding other variables constant. Additionally, other control variables, such as cost of production and market price, also exhibit significant positive relationships with FHP, highlighting their crucial roles in determining prices. On the other hand, the variable for production does not demonstrate a statistically significant effect, indicating its limited influence on FHP within this model.

The model exhibits a robust overall fit, characterized by high R^2 values (within = 0.92, between = 0.42, overall = 0.89), which indicate strong explanatory power for the variance in Farm Harvest Price (FHP). The significant Wald chi-square statistic (2698.26 with a *p* value of 0.0000) further confirms the collective impact of the independent variables on FHP. These results emphasize the critical role of procurement under the Minimum Support Price (MSP) system in enhancing FHP, suggesting that policies or strategies aimed at increasing procurement could lead to substantial improvements in FHP outcomes.

Table 6. Descriptive statistics of all concerned variables of regression of farm harvest price (FHP) of wheat

Variable	Observation	Mean	Std Dev	Min	Max
FHP	120	1265.342	433.0967	539	2147
Procurement	120	29.72221	27.60196	0	89.21125
MSP	120	1293.35	459.9633	620	2015
COP	120	590.9942	216.7461	289.22	1140.08
Market Price	120	1264.377	441.5885	594.0274	2130
Production	120	134.1875	81.35836	32.39	355.066
Rainfall	120	752.7796	355.6867	175.6	2372.9

Source: Authors' calculations

Table 7. Random effect regression result of farm harvest price of paddy

Variable	Coefficient	*P*>|z|	Model Diagnostic
Procurement	1.711858** (0.7493685)	0.022	R^2 values within=0.9233 between=0.4263 overall=0.8906
MSP	0.7617313*** (0.0585138)	0.000	
COP	0.0989023*** (0.0396835)	0.013	
Market Price	0.0884133** (0.0458958)	0.054	sigma_u=101.75011 sigma_e=130.42566 rho=0.378347
Production	-0.4262666 (0.5648163)	0.450	Wald chi^2(5)=2701.71*** *Prob > chi^2*=0.0000
Rainfall	-0.0159319 (0.0344974)	0.644	
Constant	66.32738 (56.35535)	0.239	

Figures within parentheses are respective standard errors
*** and ** indicate significance at $p \leq 0.01$ and $p \leq 0.05$, respectively
Source: Authors' calculations

In the analysis of the Farm Harvest Price (FHP) for wheat, Models 2 and 3 are constructed using the same panel dataset but differ in their treatment of potentially collinear variables: market price and Minimum Support Price (MSP). Model 2 (Fixed Effects) excludes MSP to mitigate collinearity and focuses on market price, while Model 3 (Random Effects) includes MSP and omits market price. Both models affirm the positive and significant impact of procurement on FHP, demonstrating that higher procurement levels consistently lead to

Table 8. Regression result of farm harvest price of wheat

Variable	Model 2 (Fixed Effect)		Model 3 (Random Effect)	
	Coefficient	*P*>|t|	Coefficient	*P*>|z|
Procurement	2.143235** (0.950332)	0.026	2.219762*** (0.760155)	0.003
MSP	-	-	0.812769*** (0.051233)	0.000
COP	0.3489917*** (0.115463)	0.003	0.1584173 (0.100155)	0.114
Market Price	0.7168808*** (0.060052)	0.000	-	-
Production	1.028708** (0.437710)	0.021	-0.0137354 (0.353371)	0.969
Rainfall	-0.0335976 (0.042265)	0.428	-0.009014 (0.034332)	0.793
Constant	-23.76819 (47.95155)	0.621	63.25699 (79.85187)	0.428

Model Diagnostic

Model 2 (FE)			Model 3 (RE)		
R^2 values within = 0.9495 between = 0.0145 overall = 0.9015	sigma_u = 105.7604 sigma_e = 99.95928 rho = 0.528176	F (5,109) = 410.04*** Prob > F= 0.0000	R^2 values within = 0.9635 between= 0.1449 overall = 0.9347	sigma_u= 171.7661 sigma_e = 85.039347 rho = 0.8031404	Wald chi^2(5) = 2975.53*** Prob > chi^2 = 0.0000

Note: 1. Figures within () are respective standard errors. 2. *** and ** indicate significance at .01 and .05 level, respectively
Source: Authors' calculation

increased FHP. This consistency across models reinforces the importance of procurement in influencing FHP in the wheat sector.

In Model 2, market price exhibits a strong positive effect, highlighting the influence of market dynamics on Farm Harvest Price (FHP). While the cost of production (COP) and production are also significant, their impacts are comparatively smaller. Rainfall does not show a significant effect, indicating a minimal direct influence on FHP. On the other hand, Model 3 identifies MSP as a significant positive driver of FHP, highlighting the role of government price support in stabilizing or increasing wheat prices. In this model, COP and production are not significant, suggesting that their effects are diminished when MSP is included. This dual-model approach enhances robustness by demonstrating that the relationship between procurement and FHP remains consistent across different specifications. Thus, it reinforces the importance of procurement as a critical factor in determining wheat prices, regardless of whether market dynamics or support prices are considered in the analysis.

The practical significance of the statistical results in terms of farmers' livelihoods is that MSP-based procurement has effectively ensured remunerative prices for growers of rice and wheat in regions where public procurement has been actively implemented. By shielding farmers from the uncertainties of free market pricing, MSP-based procurement has fulfilled its intended purpose. This finding aligns with recent protests by farmers in India advocating for legislation that mandates adherence to the MSP system (Mohanty, 2021; Kunal, 2024).

CONCLUSION

In conclusion, this research highlights the critical role of MSP-based procurement in safeguarding farm incomes by ensuring enhanced farm harvest prices for rice and wheat. The implications of these findings are significant for policy formulation, particularly in the context of the government's commitment to fostering farmers' economic stability. Expanding the procurement program to encompass a broader range of crops aligns with overarching agricultural policies and can address regional disparities in procurement access. To achieve equitable distribution of benefits, it is essential to extend procurement initiatives to farmers in diverse and less accessible areas, thereby promoting inclusive agricultural growth.

However, the broader implementation of procurement processes will necessitate substantial investments in infrastructure, particularly in storage and transportation logistics. While strengthening and expanding the procurement system is vital, it is equally important to acknowledge the environmental and fiscal challenges associated with MSP-based procurement, as highlighted in the literature (Chand, 2003; Singh and Sidhu, 2004; Landes and Gulati, 2004; Deodhar and Kelkar, 2024). Therefore, while reforms in the agricultural sector are essential and long overdue, any proposed changes should be comprehensive, addressing various concerns while retaining MSP-based procurement as a key element of the government's agricultural policy framework. This balanced approach will ensure the sustainability and resilience of India's agricultural sector, ultimately benefiting farmers and the economy as a whole.

LITERATURE CITED

Aditya K S, Subash S P, Praveen K V, Nithyashree M L, Bhuvana N and Sharma A 2017. Awareness about minimum support price and its impact on diversification decision of farmers in India. *Asia Pac Policy Stud* **4**(3): 514-26. https://doi.org/10.1002/app5.197

Ali S Z, Sidhu R S and Vatta K 2012. Effectiveness of minimum support price policy for paddy in India with a case study of Punjab. *Agric Econ Res Rev* **25**(2): 231-42.

Basu K 2011. India's foodgrains policy: An economic theory perspective. *Econ Polit Wkly* 37-45.

Breusch T S and Pagan A R 1980. The Lagrange Multiplier Test and its applications to model specification in econometrics. *Rev Econ Stud* **47**(1): 239-53. https://doi.org/10.2307/2297111

Bhardwaj R, Sohu R S and Dhaliwal I 2021. Millets for crop diversification: Punjab perspective. *Agric Res J* **58**(4): 750-58. DOI: 10.5958/2395-146X.2021.00107.1

Chaba A A 2020. Why Punjab mandis are procuring more paddy than state produces. *The Indian Express*. Available online: https://indianexpress.com/article/explained/why-punjab-mandis-are-procuring-more-paddy-than-state-produces-6793845/

Chand R 2003. Minimum support price in agriculture: Changing requirements. *Econ Polit Wkly* 3027-28.

Chand R 2008. MSP and other interventions in wheat market: Are they contributing to the buffer stock cycles and market destabilization. Available online: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=8f7684d824efae1fe41bcdc5d754a3e6d96d8a7f

Das R 2020. Minimum support price in India: What determines farmers' access? *Agric Econ Res Rev* **33**(1): 61-69.

Deshpande R S 2003. Impact of minimum support prices on the agricultural economy. Agricultural development and rural transformation unit, Institute of Social and Economic Change, Nagarbhavi, Bangalore, India, 115p. http://203.200.22.244/40%20Impact%20of%20MSP%20on%20Agr.%20Eco%20Conso%20Rep.pdf

Deshpande R S (Ed.) 2008. Impact of minimum support prices on the agricultural economy. In: *Glimpses of Indian Agriculture*, Ministry of Agriculture & Academic

Foundation, New Delhi.

Deodhar S Y and Kelkar V 2024. Making a new beginning on farm reforms. *Econ Polit Wkly* **59**(16): 34-42.

Directorate of Economics and Statistics 2022. Cost studies (CS). Ministry of Agriculture and Farmers Welfare, Government of India. Available online: https://desagri.gov.in/divisions-cell/cost-studies-cs/

Friedman M 1937. The use of ranks to avoid the assumption of normality implicit in the analysis of variance. *J Am Stat Assoc* **32**(200): 675-701.

Food Corporation of India 2024. Statistical data (rice). Available online: https://fci.gov.in/headquarter/statistical-data/rice

Food Corporation of India 2024. Statistical data (wheat). Available online: https://fci.gov.in/headquarter/statistical-data/wheat

Greene W H 2012. *Econometric Analysis*. 7th edn. Upper Saddle River, NJ: Prentice Hall.

Gupta G S 1980. Agricultural price policy and farm incomes. *Econ Polit Wkly*: A123-A131.

Hansen B E 1999. Threshold effects in non-dynamic panels: Estimation, testing, and inference. *J Econometrics* **93**(2): 345-68.

Hoda A, Gulati A, Jose S and Rajkhowa P 2021. Sources and drivers of agricultural growth in Bihar. *Revitalizing Indian Agriculture and Boosting Farmer Incomes*: 211-46.

Kanza P and Vitale J 2015. Agriculture in developing countries and the role of government: Economic perspectives. AAEA & WAEA Joint Annual Meeting, 26-28 July 2015, San Francisco, Number 205362.

Krishnamurthy M 2012. States of wheat: The changing dynamics of public procurement in Madhya Pradesh. *Econ Polit Wkly*: 72-83.

Landes R and Gulati A 2004. Farm sector performance and reform agenda. *Econ Polit Wkly*: 3911-19.

Kunal K 2024. Explained: The sticking points in government-farmers talks. *India Today*. Available online: https://www.indiatoday.in/india/story/farmers-protest-explained-delhi-chalo-march-demands-of-msp-haryana-shambhu-border-2502221-2024-02-14

Mehta V P, Malik D P and Kumar R 2020. Impact of agricultural price policy on major food crops in Haryana. *Econ Affairs* **65**(2): 267-74.

Ministry of Agriculture & Farmers Welfare 2024. Minimum Support Price for various crops. Available online: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2003184

Mohanty K 2021. Explained: What is the guaranteed MSP demand for which farmer groups are gearing up to continue stir. *News18.com*. Available online: https://www.news18.com/news/explainers/explained-what-is-the-guaranteed-msp-demand-for-which-farmer-groups-are-gearing-up-to-continue-stir-4472513.html

Nair S R and Eapen L M 2013. Agrarian performance and food price inflation in India: Insights and lessons from pre-and post-economic liberalisation experiences. Indian Institute of Management, Kozhikode, No. IIMK/WPS/115/ECO/2013/01, 19p.

Parashar B K 2024. Paddy procurement at MSP in UP falls short of target claims farmers prefer open market. *Hindustan Times*. Available online: https://www.hindustantimes.com/cities/lucknow-news/paddy-procurement-at-msp-up-falls-short-of-target-claims-farmers-prefer-open-market-101707932516025.html

Parikh J and Singh C 2007. Extension of MSP: Fiscal and welfare implications-A Study for the Planning Commission [of India], Integrated Research and Action for Development (IRADe), 62p. http://dx.doi.org/10.13140/RG.2.1.4473.2322

Pesaran M H 2004. General diagnostic tests for cross section dependence in panels. *IZA Discussion Paper No.* 1240, 41p. https://dx.doi.org/10.2139/ssrn.572504

Phillips P C B and Moon H R 1999. Linear regression limit theory for nonstationary panel data. *Econometrica* **67**(5): 1057-1111.

Press Information Bureau 2020. Calculation of MSP. Ministry of Agriculture & Farmers Welfare. Available online: https://pib.gov.in/PressReleasePage.aspx?PRID=1605054

Saini S and Gulati A 2017. Price distortions in Indian agriculture, International Bank for Reconstruction and Development/The World Bank, Washington DC, 110p. https://icrier.org/pdf/Price_Distortions_in_Indian_Agriculture_2017.pdf

Sally M 2020. Madhya Pradesh leads the way in wheat procurement, followed by Punjab. *The Economic Times*. Available online: https://economictimes.indiatimes.com/news/economy/agriculture/madhya-pradesh-leads-the-way-in-wheat-procurement-followed-bypunjab/articleshow/76270968.cms

Singh J and Sidhu R S 2004. Factors in declining crop diversification: Case study of Punjab. *Econ Polit Wkly*: 5607-10.

Singh R, Mehta U S, Shukla G and Singh N K 2015. Minimum support price and farmers' income. CUTS International. https://cuts-ccier.org/pdf/Minimum_Support_Price_and_Farmers_Income.pdf

Srinivasa A K, Praveen K V, Padmaja S S, Nithyashree M L and Jha G K 2023. Does a farmer's knowledge of minimum support price (MSP) affect the farm-gate price? Evidence from India. *J Econ Dev* **25**(4): 302-16.

Thakare A B, Shende N V and Bhopale A A 2024. Impact of agricultural price policy on farm harvest and wholesale prices of legumes in Maharashtra. *J Food Legumes* **37**(1):101-08. DOI: 10.59797/jfl.v37.i1.183

Vasant A and Sukhatme 1983. Farm prices in India and abroad: Implications for production. *Econ Dev Cult Change* **32**(1): 169-82. http://www.jstor.org/stable/1153428

Wooldridge J M 2010. *Econometric Analysis of Cross Section and Panel Data*. Second Edition. Cambridge, MA: MIT Press, Cambridge, Massachusetts, London, 735p. https://jrvargas.wordpress.com/wp-content/uploads/2011/01/wooldridge_j-_2002_econometric_analysis_of_cross_section_and_panel_data.pdf