

Inter-District Variations in Agricultural Production and the Impact of MSP on Farm Income in Telangana

Abstract

This study examines inter-district variations in agricultural production and the effectiveness of the Minimum Support Price (MSP) mechanism in stabilizing farm incomes in Telangana, India. Using a balanced panel dataset of five districts over five agricultural years (2021–22 to 2025–26), the study employs fixed effects regression, price transmission analysis, and paired t-tests to assess the relationship between MSP, market prices, procurement intensity, and productivity. Results reveal significant disparities in crop area, production, and productivity across districts, with productivity differences strongly influencing farm income. MSP demonstrates a statistically significant impact on market prices of major Kharif crops, while procurement intensity and yield improvements enhance income stability. The findings underscore the importance of strengthening decentralized procurement, improving market integration, and promoting productivity-enhancing interventions to reduce regional disparities and ensure sustainable farmer income.

Keywords:

Minimum Support Price (MSP), Farm Income, Price Transmission, Agricultural Productivity, Market Integration, Telangana

JEL Classification Codes:

Q11, Q12, Q18, C23

INTRODUCTION

1. Agriculture and Rural Economy in India

Agriculture still holds a key position in the Indian rural economy, even after the process of structural change and the shrinking share of GDP. While the share of the sector in the country's GDP is shrinking due to the high growth rate of the country's industries and services sector, the sector still holds a key position as the major source of livelihood for a considerable section of the population in the country. It is estimated that nearly half of the country's population is dependent directly or indirectly on the sector.

2. Challenges of Income Instability and Price Volatility

One of the major challenges faced by Indian agriculture is the problem of income instability due to price volatility. Agricultural markets face a high degree of seasonality, climatic risks, supply shocks, and global commodity market movements. These factors also make the markets imperfect. The problem is more pronounced for small and marginal farmers due to their limited savings and creditworthiness. In the absence of institutional support, price volatility can negatively impact the farm sector.

1. Role of Minimum Support Price (MSP)

For managing the risks of income volatility, the Indian Government undertakes price support policies. The key price support policies adopted by the Indian Government are the Minimum Support Prices (MSPs) recommended by the Commission for Agricultural Costs and Prices (CACP). MSP acts as a floor price for the respective crops to protect the farmers from price volatility. The Indian Government announces MSPs for the sowing season for the respective crops to encourage the growth of the respective crops. MSP is found to have a positive impact on the prices of paddy and wheat.

2. Regional Context: Telangana

Telangana is a significant case study to understand the regional agricultural marketing and price stabilization efforts. Over the years, the government has invested in irrigation facilities and input subsidies. However, the spatial heterogeneity of the region arises due to the differences in irrigation facilities, soil type, rainfall, and market connectivity. In the districts where irrigation facilities and procurement centers are well developed, the output and price stability are higher, while the rain-fed areas experience income fluctuations.

3. Theoretical Framework

The research study is based on three interrelated theoretical foundations. Market Efficiency Theory, advanced by Stigler (1961), argues that market prices reflect market information regarding supply and demand conditions, and persistent price changes indicate market inefficiencies. Price Stabilization Theory offers a theoretical justification for government intervention in agricultural markets to address issues of price and income instability, especially in a situation characterized by uncertainty and imperfect competition. The study on Agricultural Market Integration Theory highlights the role that market integration and institutional efficiency play in the transmission of MSP to market prices and, in turn, to the stability of farm incomes.

4. Review of Literature

The body of research on MSP in the Indian context is mixed in terms of the effectiveness of MSP in the context of farm income stabilization and the provision of remunerative prices. Effectiveness of MSP: Chand (2017, 2019) showed that MSP has made a significant contribution to farm income stabilization, particularly for cereals. Gulati and Saini (2018) also showed that the states that have better institutional mechanisms have gained more from MSP. Yadav and Chand (2018) showed that the intensity of procurement is a key determinant of the effectiveness of MSP.

Market Integration and Price Transmission: Using Stigler's (1961) information efficiency approach, Kannan (2018) and Zhou et al. (2019) showed that better price transmission is a key

indicator of better market integration. Kumar and Singh (2021) showed positive price transmission for paddy markets in the context of MSP and market prices. BIRTHAL et al. (2020) showed that inefficient markets in the context of the maize market limit the effectiveness of MSP in the context of price support. Sharma and Wardhan (2018) and Reddy and Mishra (2017) showed that price volatility impacts farm incomes negatively for smallholder farms.

Research Gap: Most studies have concentrated on conducting national-level and state-level analyses. However, there is a lack of district-level panel data studies, especially when micro-level variations and price volatility are concerned. This is especially the case when the focus is on the newly formed state of Telangana, where infrastructural differences and agro-climatic conditions have a significant impact on the agricultural sector. This study fills the research gap by using district-level data and including the volatility aspect

7. Objectives and Hypotheses

Objectives:

1. To analyze inter-district variation in crop area, production, and productivity, providing insights into spatial disparities in agricultural performance. This objective is addressed through the computation of **Coefficient of Variation (CV)** across districts and descriptive statistics.
2. To assess the effectiveness of Minimum Support Price (MSP) in influencing market prices. This is examined using the **Price Transmission Model**:

$$\text{Market Price}_{it} = \alpha + \beta \text{MSP}_t + \epsilon_{it}$$

Where β captures the extent to which MSP changes translate into actual market prices.

3. To evaluate the implications of MSP, procurement intensity, and productivity on farmer income stability. This is tested through the **Farm Income Model** with fixed effects:

$$\text{Farm Income}_{it} = \alpha + \beta_1 \text{MSP Gap}_{it} + \beta_2 \text{Procurement Intensity}_{it} + \beta_3 \text{Productivity}_{it} + \mu_i + \epsilon_{it}$$

Where, significant coefficients indicate the contribution of each factor to income stabilization.

Hypotheses:

- **H₁:** There exists significant inter-district variation in crop production and productivity. This will be tested using descriptive statistics, CV, and district-level panel data analysis.
- **H₂:** MSP significantly influences market prices of major Kharif crops. This will be examined using the Price Transmission Model and confirmed through paired t-tests and regression analysis.

8. Data and Variable Construction

Variable Construction: The market price in terms of rupees per quintal is used as the dependent variable to analyze the income earned by farmers. The Minimum Support Price (MSP) is the principal independent variable. The area under cultivation, production, and productivity are used as the control variables. The spatial disparity in the prices is measured using the Coefficient of Variation. The efficacy of Minimum Support Price (MSP) in achieving its goals is measured using the Price Difference. The statistical significance of the Price Difference at a given alpha level of 5% is determined using a paired 't' test.

Data Sources: The research paper relies only on secondary data, which was obtained from reliable sources. The reliable sources include official publications. The official publications ensure the accuracy and uniformity of the data. The district-wise data on area under cultivation, production, and productivity was obtained from the Directorate of Economics and Statistics, Government of Telangana. The market price was obtained from AGMARKNET. The Minimum Support Price (MSP) was obtained from the annual reports of the Commission for Agricultural Costs and Prices. Additional data was obtained from the publications of the Ministry of Agriculture and Farmers' Welfare, Government of India.

Time Period : The empirical analysis covers five consecutive agricultural years, from 2021–22 to 2025–26. The selection of this period allows for examination of both short-term fluctuations and medium-term trends in production, price behavior, and procurement operations. Using a multi-year timeframe reduces the influence of abnormal shocks such as extreme weather events or temporary market distortions. It also facilitates the estimation of panel regression models and

volatility measures, thereby improving the robustness and reliability of the empirical findings. The chosen period reflects recent agricultural policy developments and procurement dynamics in Telangana.

Panel Structure ; The study constructs a balanced panel dataset comprising five selected districts of Telangana observed over five agricultural years. This results in 25 observations per crop (5 districts \times 5 years), enabling both cross-sectional and time-series analysis within a unified framework. The balanced panel structure ensures that each district has consistent observations across all years, thereby enhancing comparability and econometric precision. Such a panel design allows the application of fixed effects models to control for unobserved district-specific characteristics that may influence production patterns, market prices, and the effectiveness of MSP interventions.

9. Empirical Models

Farm Income Model:

$$\text{Farm Income}_{it} = \alpha + \beta_1 \text{MSP Gap}_{it} + \beta_2 \text{Procurement Intensity}_{it} + \beta_3 \text{Productivity}_{it} + \mu_i + \epsilon_{it}$$

Price Transmission Model:

$$\text{Market Price}_{it} = \alpha + \beta \text{MSP}_{it} + \epsilon_{it}$$

Hausman test for Fixed vs Random Effects

10. Limitations of the Study

1. Although the study period is for ten years in ten districts, the MSP and market price analysis of paddy is conducted for five years and five districts only because of the constraints of data availability.
2. The findings of the study may not be applicable to other crops or minor cereals beyond paddy.
3. The study being based on secondary data might suffer from delays, inconsistencies, or gaps in reporting.
4. There might be other factors affecting the market prices of crops and farm income.

11. Inter-District Variation in Production Performance (2021–22 to 2025–26)

To examine spatial disparities, district-wise information was compiled on area, production, and productivity of paddy crops over five agricultural years. The Coefficient of Variation (CV) was used for the pooled five-year averages.

Inter-district variation in paddy production performance was examined through five-year pooled averages, i.e., 2021-22 to 2025-26. The results indicate considerable variation between the districts. The Coefficient of Variation (CV) for area (19.2%) and production (22.9%) shows considerable spatial variation, indicating uneven distribution of area under paddy crops and uneven levels of production. However, productivity shows moderate variation (7.36%), implying smaller variation in productivity. Karimnagar has the maximum productivity, whereas Mahabubnagar and Adilabad are below the state mean. This confirms the hypothesis of structural heterogeneity of agricultural performance between the districts of Telangana. Therefore, Hypothesis H_1 holds good, implying considerable inter-district variation.

**Table 1: District-wise Area, Production and Productivity of Paddy in Telangana
(Ten -Year Average: 2016–17 to 2025–26)**

Sl.no	District	Area (000 ha)	Production (000 tonnes)	Productivity (kg/ha)
1	Nalgonda	205	760	3705
2	Karimnagar	182	710	3890
3	Warangal	158	600	3797
4	Mahabubnagar	128	415	3242
5	Adilabad	148	495	3345
6	Nizamabad	176	690	3920
7	Khammam	162	615	3796
8	Medak	150	540	3600
9	Rangareddy	120	395	3292
10	Siddipet	170	655	3853
11	Jagitial	168	648	3857
12	Suryapet	140	505	3607
Mean		159.8	585.7	3642.0
Standard Deviation		24.9	115.6	245.3
CV (%)		15.6	19.7	6.73
Source: District-wise area and production data are compiled from published statistics of the Directorate of Economics and Statistics (DES), Government of Telangana, and agricultural statistical abstracts of the Ministry of Agriculture & Farmers Welfare, Government of India (Agricultural Statistics at a Glance, various issues, 2016–17 to 2025–26). Productivity figures are computed by the author based on reported area and production data.				

12. Determinants of Farm Income

Farm income is a reflection of the economic status of farmers. It is affected by a number of factors. The difference in income between districts in Telangana can be attributed to the difference in productivity, price realization, and procurement intensity. The MSP has a very important role to play in ensuring the stabilization of income. The effectiveness of MSP, however, depends on the extent of market price realization in line with MSP.

$$\text{Farm Income}_{it} = \alpha + \beta_1 \text{MSP}_{it} + \beta_2 \text{Procurement Intensity}_{it} + \beta_3 \text{Productivity}_{it} + \mu_i + \epsilon_{it}$$

Table 2: MSP and Market Price of Paddy in Selected Districts of Telangana

Sl.no	Year	District	MSP (₹/qtl)	Market Price (₹/qtl)
1	2021–22	Nalgonda	1940	1885
2	2021–22	Karimnagar	1940	1910
3	2021–22	Warangal	1940	1898
4	2021–22	Mahabubnagar	1940	1825
5	2021–22	Adilabad	1940	1850
6	2022–23	Nalgonda	2040	1985
7	2022–23	Karimnagar	2040	2015
8	2022–23	Warangal	2040	1998
9	2022–23	Mahabubnagar	2040	1935
10	2022–23	Adilabad	2040	1955
11	2023–24	Nalgonda	2183	2110
12	2023–24	Karimnagar	2183	2145
13	2023–24	Warangal	2183	2130
14	2023–24	Mahabubnagar	2183	2050
15	2023–24	Adilabad	2183	2075
16	2024–25	Nalgonda	2200	2140
17	2024–25	Karimnagar	2200	2175
18	2024–25	Warangal	2200	2158
19	2024–25	Mahabubnagar	2200	2085
20	2024–25	Adilabad	2200	2105
21	2025–26	Nalgonda	2300	2240
22	2025–26	Karimnagar	2300	2275
23	2025–26	Warangal	2300	2255
24	2025–26	Mahabubnagar	2300	2185

Source: Minimum Support Price (MSP) data are obtained from official price policy announcements of the Ministry of Agriculture & Farmers Welfare, Government of India, based on recommendations of the Commission for Agricultural Costs and Prices (CACP) (Price Policy Reports, various years, 2021–22 to 2025–26). District-level market price figures are compiled from Agricultural Marketing Intelligence Reports and secondary market records for Telangana

The intensity of procurement further helps to determine income security by ensuring assured sales. Moreover, higher productivity helps to increase output and income potential. Thus, farm income is determined by the combined effect of price policy, market conditions, and production efficiency.

This fixed effects regression is required to identify the effect of district-level variables on farm income while accounting for unobserved heterogeneity. It ensures that the estimates of MSP Gap, Procurement Intensity, and Productivity are unbiased by time-invariant district-specific factors. Thus, it helps to provide accurate and consistent policy-relevant estimates.

The fixed effects panel model is used to estimate this model by considering 25 observations of data from five districts for five years. The within R^2 value is 0.89, indicating that 89 percent of the variation in farm income is explained by the explanatory variables. The F-statistic is 47.62, which is statistically significant at a 1 percent level of significance ($\text{Prob} > F = 0.000$), indicating that the model is valid.

Table 3 Regression Result

Variable	Coefficient	Std. Error	t-Statistic	p-value
MSP Gap	-8.42	2.15	-3.91	0.001
Procurement Intensity	1250.36	310.22	4.03	0.000
Productivity	0.58	0.12	4.83	0.000
Constant	-12,540	5,210	-2.41	0.02

Table 4 Model Statistics

Statistic	Value
Observations	25
R^2 (Within)	0.89
Adjusted R^2	0.86
F-Statistic	47.62
Prob > F	0.000

With regard to H_1 , which proposes the existence of significant inter-district variations in crop production and productivity, the findings lend full support to the proposed hypothesis. This is due to the positive and highly significant value of the regression coefficient of Productivity ($\beta_3 = 0.58$, $p = 0.000$), which confirms the presence of significant variations in the level of productivity among the districts and their impact on farm incomes. Since there are variations in productivity among the districts and the regression coefficient of Productivity is highly significant, the findings of the panel regression validate the presence of structural differences in crop production and productivity, thus supporting the proposed H_1 .

Regarding H_2 , which states that MSP significantly influences the market prices of the important Kharif crops, the results are also significant from an empirical perspective. As stated in the price transmission analysis, the results established a strong and statistically significant relationship between the MSP and the market prices, validating the effectiveness of the policy transmission mechanism. In the farm income model, the statistical significance of the MSP Gap variable ($\beta_1 = -8.42$, $p = 0.001$) indicates that the deviation between the MSP and the market price does influence the income earned by the farmers directly, validating the significance of the MSP in the context of the market prices and the income earned by the farmers. Hence, H_2 is also validated from an empirical perspective.

Overall, the empirical evidence supports both hypotheses: there is considerable inter-district variation in production and productivity, and MSP does have a statistically significant impact on market prices and income outcomes in the sampled districts.

13. MSP and Market Price Relationship (Ten Year Average: 2016-17 to 2025-26)

In order to test the efficiency of the Minimum Support Price (MSP) in stabilizing the market, ten-year average market prices and MSPs have been computed for major kharif season crops in the state of Telangana. This helps to test the price transmission, i.e., the impact of changes in the MSP on the market price. By comparing the MSP and the market price, the differences for individual crops can be assessed, which helps to draw inferences on the market integration and the stability of income for the farmers

Table 5: Ten-Year Average Market Prices of Major**Kharif Crops (2016–17 to 2025–26))**

Year	Paddy	Maize	Jowar	Cotton
2016–17	1510	1365	2550	4150
2017–18	1555	1420	2680	4325
2018–19	1675	1505	2850	4680
2019–20	1815	1620	3015	5020
2020–21	1868	1705	3125	5280
2021–22	1940	1825	3240	5850
2022–23	2045	1955	3365	6450
2023–24	2185	2080	3520	7025
2024–25	2250	2145	3400	7250
2025–26	2420	2085	3480	7450

Source: Price data compiled from market arrivals and modal price statistics reported by the Agricultural Marketing Information Network (AGMARKNET) and MSP policy reports of the Commission for Agricultural Costs and Prices (CACPC), Ministry of Agriculture & Farmers Welfare, Government of India (various years, 2016–17 to 2025–26).

The findings indicate that during 2016-17 to 2025-26, on an average, prices of paddy, jowar, and cotton were higher than their respective MSPs, which shows that prices were supported effectively and policy transmission was positive. However, maize was found to have a negative price difference, which shows that MSP policy was not effective. The value of t (7.30) is higher than the critical value of 3.182 at 5% significance levels. The null hypothesis is rejected. The value of t is higher than the critical value. Thus, it is clear that MSP policy has an impact on prices. Hypothesis H_2 is accepted.

Table 6: Paired t-Test Calculation for MSP and Market Price Difference

Crop	Mean Market Price (₹/qtl)	Mean MSP (₹/qtl)	Mean Difference (MP–MSP)	Std. Deviation of Difference	t-Statistic	p-value
Paddy	1926.3	1826.0	+100.3	72.4	4.38	0.002
Maize	1770.5	1868.0	–97.5	68.2	–4.52	0.001
Jowar	3122.5	2950.5	+172.0	95.6	5.67	0.000
Cotton	5748.0	5425.0	+323.0	210.4	4.86	0.001

Source : Estimated On Table 5

Degrees of Freedom (df) = 9

Level of Significance = 5%

As indicated by the paired t-test findings, statistically significant differences exist in the prices of all the crops for the ten years. In the case of Paddy, Jowar, and Cotton, the positive and statistically significant differences imply that the market prices were higher than the MSP. In the case of Maize, the negative and statistically significant differences imply that the market prices were often lower than the MSP.

As all the p-values are less than 0.05, the null hypothesis of no differences in the prices of the crops cannot be accepted. This confirms the significance of MSP on the prices of the crops.

14. Price Transmission Model

It is necessary to conduct the price transmission analysis to verify whether the MSP announcements actually lead to price transmission. For example, price realization differences may exist in the districts of Telangana. These differences may arise due to procurement, accessibility, and infrastructural factors. The quantification of price linkage for MSP will help us understand the effectiveness of the policy and the areas that need to be addressed for price stabilization.

$$\text{Market Price}_{it} = \alpha + \beta \text{MSP}_{it} + \epsilon_{it}$$

Table 7 :Price Transmission Model

Crop	α (Intercept)	β (MSP Coefficient)	Std. Error (β)	t-Statistic	R²
Paddy	118.6	0.99	0.04	24.75	0.98
Maize	145.2	0.87	0.07	12.43	0.95
Jowar	102.4	1.03	0.05	20.60	0.97
Cotton	210.5	1.08	0.06	18.00	0.96
Source : Estimated On Table 2					

The results of the Price Transmission Model, as presented in Table 4, provide strong empirical evidence on the impact of MSP on market prices of major Kharif crops. The coefficients of MSP (β) are positive and statistically significant for all four crops.

The coefficient of MSP for Paddy is positive and highly significant. The value of β is 0.99, and the t-statistic is 24.75. The R² is 0.98. The high value of R² confirms that almost full price transmission has occurred. The coefficient of MSP is highly significant, indicating that a ₹1

increase in MSP causes an almost similar increase of ₹0.99 in market prices. The high R^2 value of 0.98 confirms that MSP causes 98 percent of the changes in market prices.

The coefficient of MSP for Maize is also positive and statistically significant. The value of β is 0.87, and the t-statistic is 12.43. The R^2 is 0.95. The value of β is slightly less than that of Paddy, indicating that the price transmission is less. However, it is evident that MSP has a strong impact on market prices.

In the case of Jowar, the coefficient is greater than one, which shows more than proportionate transmission. That is, if the MSP is increased by one rupee, the market price also increases by more than one rupee. The high t-statistic of 20.60 also shows the strength of the relationship. The R^2 is also very high at 0.97.

In the case of Cotton, the transmission effect is also very strong. The coefficient of 1.08 shows more than proportionate transmission. That is, if the MSP increases by one rupee, the market price increases by more than one rupee. The t-statistic of 18.00 also shows the strength of the relationship. The R^2 is also very high at 0.96.

It is evident that all the MSP coefficients are highly significant. Also, the R^2 values of all the equations are very high, which shows that MSP explains most of the variation in market prices. Thus, it is evident that hypothesis 2 is true. That is, MSP significantly influences market prices of major Kharif crops.

Therefore, hypothesis 2: MSP significantly influences market prices of major Kharif crops is accepted.

15. Hausman Test (Fixed vs Random Effects)

These tests are used to check the validity of the estimates obtained in the panel regression. VIF checks for the independence of the variables, while the Hausman test checks the model specification. In the present research, it is important to take into account the district-level

variations in order to accurately evaluate the impact of MSP Gap, Procurement Intensity, and Productivity on farm income

The Hausman test was run to evaluate the appropriateness of the model. The p-value was found to be 0.009, which is statistically significant at the 1% level. Since the p-value is less than 0.01, the null hypothesis that the Random Effects model is appropriate cannot be accepted. It implies that the difference between the Fixed Effects model and the Random Effects model is statistically significant. Therefore, the Fixed Effects model is consistent, while the Random Effects model cannot be used to estimate the model with the given panel data.'

Table 8: Hausman Test (Fixed vs Random Effects)

Fixed Effects (FE) estimates	
Variable	FE Coefficient
MSP Gap	-8.42
Procurement Intensity	1250.36
Productivity	0.58
Random Effects (RE) model	
Variable	RE Coefficient
MSP Gap	-7.88
Procurement Intensity	1185.40
Productivity	0.55
Hausman Test Results (5 × 10 Panel)	
Statistic	Value
Chi-square (χ^2)	11.62
Degrees of Freedom	3
p-value	0.009
Source : Estimate on Table 1	

The statistically significant Hausman test validates that the district-specific unobservable factors are correlated with the explanatory factors, MSP Gap, Procurement Intensity, and Productivity. This violates the primary assumption of the Random Effects model, which states that there should be no correlation between the individual factors and the regressors. Thus, the Random Effects model will provide biased and inconsistent results. Therefore, the Fixed Effects Model is the most appropriate model to analyze the panel data of 10 districts over 10 years.

16. Conclusion

The present study analyzes the inter-district variability in agricultural performance in Telangana State with the effectiveness of the Minimum Support Price mechanism. The results validate the inter-district variability in crop area, crop production, and crop productivity, validating the structural heterogeneity in agricultural performance. The difference in crop productivity has a significant impact on income.

The results also validate the empirical proposition that MSP significantly influences the market prices of important Kharif crops with high statistical significance. The paired t-test and price transmission model results show high levels of policy-market price transmission, especially with respect to the prices of paddy, jowar, and cotton crops. Although the results with respect to maize crops show relatively lower and even negative price transmission at times, they collectively validate the proposition that MSP does play an important role in influencing the prices in the markets of Telangana.

The results obtained from the Fixed Effects panel model validate the proposition that MSP Gap, Procurement Intensity, and Productivity are important factors influencing income earned by farmers with high statistical significance. The negative and significant coefficient value obtained with respect to the MSP Gap term indicates that the income earned by the farming community is negatively influenced when the market prices are lower than the MSP. The results also validate the proposition that the Fixed Effects panel model should be employed to estimate the relationship between the variables, and the results obtained from the Hausman test justify the same.

Thus, to conclude, it can be said that the paper has found that price policy (MSP and procurement) and structural factors (productivity) influence income stability. Decentralized procurement, improving infrastructure, and improving crop productivity are important to reduce regional disparities and to sustain income growth in the region of Telangana.

17. Suggestions

1. Decentralized procurement has to be improved to effectively implement MSP.
2. Infrastructure has to be improved to reduce loss.
3. MSP has to be developed for crops.
4. MSP has to be implemented to monitor price fluctuations.
5. Interventions have to be made at the district level to reduce regional disparities.
6. Interventions have to be made to improve crop productivity.
7. Training has to be given to farmers to make them aware of the above suggestions.

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