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Public Procurement of Rice and Wheat and Agricultural Income in Indian States: A Panel Regression Analysis

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ABSTRACT

This study evaluates the effect of India's Minimum Support Price (MSP) procurement system on per-hectare Gross Value Added by Agriculture (GVAAH) using panel data from 14 states for the period 2000 to 2020. Fixed effects results reveal a significant positive correlation between MSP procurement and GVAAH, emphasizing MSP's role in enhancing farm incomes. However, fiscal and logistical constraints limit its scalability. A balanced approach is suggested, integrating essential MSP procurement for food security with private sector participation through contractual farming. This strategy aims to reduce government expenditure, ensure farmer income, and promote sustainable, regionally equitable agricultural growth.

Keywords: Cropping Intensity, Farmer Income, Minimum Support Price, Panel Data
JEL codes: C33, H53, Q11, Q15, Q18

I

INTRODUCTION

The agrarian crisis that struck India in the 1990s marked a pivotal moment in the nation's socio-economic landscape. This period was characterized by a tragic surge in farmer suicides, a distressing manifestation of the financial and psychological toll on rural communities (Bezbaruah & Hassan, 2017). It soon became apparent that this crisis was not an isolated issue but part of a larger, systemic challenge within India's agricultural sector. The relentless economic hardships faced by farmers drew the attention of policymakers and academic scholars alike, sparking widespread discourse and prompting decisive responses aimed at unravelling the root causes and finding sustainable solutions.

In the wake of this escalating crisis, the M.S. Swaminathan Commission was formed, tasked with delving into the structural issues plaguing the agricultural sector and proposing strategic policy recommendations (National Commission on Farmers, 2006). One of the Commission's key findings was the overwhelming debt burden faced by farmers, exacerbated by unstable and insufficient income sources. Recognizing the urgency of the situation, the Indian government responded with initiatives aimed at stabilizing the rural economy and improving the quality of life for farmers. Among the flagship initiatives was the Pradhan Mantri Gram Sadak Yojana (PMGSY), which was launched to improve rural connectivity. Better infrastructure was considered an essential step to facilitate market access for farmers, enabling them to transport their produce more efficiently and potentially gain better prices (Deshmukh, 2019). Another landmark program, the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), was introduced to secure minimum-wage

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employment opportunities for rural labourers. MGNREGA not only provided a financial safety net for vulnerable populations but also indirectly benefited small and marginal farmers by offering an alternative source of income during lean agricultural seasons (Shah *et al.*, 2018; Suman & Devi, 2022). Building upon these efforts, the government under the National Democratic Alliance (NDA) further recognized the need for long-term income security for the farming community. A comprehensive plan was laid out to double farmers' incomes by 2022, incorporating various relief measures, crop insurance schemes, and direct benefit transfers to mitigate the risks associated with agriculture (Ministry of Agriculture & Farmers Welfare, 2022). Central to this plan was the Minimum Support Price (MSP) program, which, though established in the 1960s, became a focal point for recent debates on agricultural income security.

MSP system guarantees a minimum price for specific crops, intended to protect farmers from price crashes in the open market (Deshpande, 2003). Each year, before the sowing season begins, the central government announces a fixed price—known as the Minimum Support Price—for various crops. If, after harvest, the market price of a crop falls below this pre-declared MSP, the government steps in to procure the produce at the assured MSP rate. This mechanism ensures that farmers are protected from distress sales and sudden declines in market prices, thereby providing them with a guaranteed income and promoting agricultural stability (Gupta,1980; Sigh & Bhogal, 2021; Baishya & Bezbaruah, 2024). The MSP procurement system was instrumental in the success of the Green Revolution in transforming the country from a persistent food grain importer to a self-sufficient, food-secure nation (Balasubramanyam & Balasubramanyam, 1986). Although the Minimum Support Price (MSP) is announced for more than 20 crops across the country, in practice, it primarily benefits rice and wheat farmers (Das, 2020; Chand, 2003; Bhardwaj *et al.*, 2021). Procurement of other crops, such as cotton and, more recently, pulses, remains limited. Traditionally, Punjab and Haryana were the leading contributors to the MSP system. However, over time, its coverage has gradually expanded to include more states like Andhra Pradesh, Assam, Bihar, Chhattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal (Government of India, Ministry of Agriculture & Farmers Welfare, 2024)

Recent farmer movements have spotlighted these issues, calling for an expansion of the MSP program to include a broader range of crops and regions (Jana & Manna, 2024). This advocacy underscores a critical demand: fair income for farmers across the nation (Philip, 2022; Kumar, 2024). Farmers argue that a wider MSP coverage would safeguard them from market unpredictability and allow them to make long-term investments in sustainable agricultural practices. However, this expansion is not without consequences. Implementing a universal MSP framework carries substantial fiscal implications, requiring increased government expenditure on procurement, warehousing, and distribution (Chaudhuri, 2024). Environmental concerns also loom large, as an MSP-driven focus on certain crops could lead to over-cultivation, soil degradation, and depletion of water resources, exacerbating existing ecological challenges.

In light of these complexities, a pertinent question arises: Has the existing MSP procurement system effectively contributed to the income enhancement of farmers'? This study embarks on an investigation into the efficacy of the MSP procurement system, focusing on its role in enhancing farmers' incomes. The paper is organized into four distinct sections. The initial segment is dedicated to the introduction, where the foundational context, objectives, and overarching significance of the study are articulated, setting the stage for the in-depth exploration that follows. The paper subsequently explores the research methodology, where a comprehensive exposition of the materials and model employed in the investigation is provided. Following this, the paper transitions to the presentation and critical examination of the empirical findings, integrating the results with the literature to discuss their implications and relevance. The final section of the paper is devoted to conclusions and policy implications.

II

MATERIALS AND MODEL

2.1 Materials

This study relies exclusively on secondary data sources to compile essential agriculture-related variables. Key data on Gross State Value added by agriculture, gross sown area, net sown area, cropping intensity, fertilizer usage per hectare, annual average rainfall, agricultural credit provided by scheduled commercial banks, crop production, and crop-specific cropped area have been obtained from the "*Handbook of Statistics on Indian States"* published annually by the Reserve Bank of India (https://rbi.org.in/Scripts/Publications.aspx?publication=Annual). Procurement data for paddy and wheat at the Minimum Support Price (MSP) is sourced from the Food Corporation of India. Irrigated area statistics, as well as electricity consumption figures, are derived from *Indiastat*, an extensive e-resource for socio-economic statistics on India and its states. Additionally, data on land-holdings (classified by farm size) have been collected from the Agricultural Census Data. The analysis centers on data from 14 prominent agricultural states—Andhra Pradesh, Assam, Bihar, Chhattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. These states were selected due to their substantial contribution to India's paddy and wheat production, collectively accounting for over 95% of national production and nearly 99% of the total procurement for these crops under the MSP system. The study period, 2000–2020, was chosen based on data availability. Post-2014 data for Andhra Pradesh includes Telangana to maintain consistency, as Telangana was carved out of Andhra Pradesh in 2014, ensuring comprehensive and accurate analysis across the timeline.

2.2 Model

In the context of this study, the state-wise and year-wise per-hectare gross value added by agriculture forms the dependent variable. GVAAH is derived by dividing the Gross State Value Addition from Agriculture by the Net Sown Area, representing the average agricultural value added per hectare of cultivated land. The primary independent variable is the percentage of paddy and/or wheat procurement at MSP relative to the total production from a state in a given year. According to the theory, increased MSP procurement raises farm income by providing a reliable minimum price, shielding farmers from volatile market rates. This encourages greater production, ensuring a more predictable income stream and improving financial security, especially in unfavorable market conditions (Sekhar, 2021). Control variables include cropping intensity (CropInt), the share of total cropped area under the marginal and small holding (MarginalNsmall) in a state, average land holding area (AvgHold), irrigation rate (Irrigation), electricity consumption for agricultural purposes in a state (PowerCons), credit disbursement to the agricultural sector (Credit), Fertilizer use per hectare of land in a state and average annual rainfall.

The theoretical perspective of cropping intensity is that higher cropping intensity can elevate per-hectare gross value added by maximizing land productivity through multiple cropping cycles, efficient resource use, and income diversification. This intensified land use boosts agricultural returns, though sustainable practices are essential to prevent soil depletion and ensure long-term productivity and profitability (Singh *et al.*, 2014; Sonia *et al.*, 2022; Kumar *et al.*, 2024). Regarding the impact of marginal and small-size land holdings on farm income, the agricultural researchers are divided into two schools. According to one some marginal and small landholders may achieve high per-hectare GVA through intensive management and efficient resource use, maximizing productivity on limited land (Singh *et al.*, 2014; Meena, 2022; Kumar & Moharaj, 2023). However, others argue that these farms face diseconomies of scale due to limited access to credit, technology, and bulk purchasing power, potentially reducing efficiency and increasing costs (Nayak, 2018; Baruah *et al.*, 2022; Dhillon & Moncur, 2023). The theory of average landholding is that an increase in average landholding size generally increases per-hectare income. Larger landholdings enable economies of scale, allowing for more efficient resource use, mechanization, and better access to credit and technology, which enhance productivity and reduce per-unit costs. This efficiency typically boosts per-hectare income, as larger farms can optimize inputs and increase yields with lower relative expenses (Kareemulla, 2021). Thus the share of cropped area under marginal and small holdings highlights the prevalence of small-scale farming, which often involves intensive cultivation on limited land, sometimes achieving high per-hectare productivity but facing challenges with resource access. In contrast, average landholding size captures the overall scale of farming operations within a state, with larger holdings typically benefitting from economies of scale, mechanization, and greater access to resources. The irrigation rate is defined as the percentage of irrigated area relative to the total cropped area of a state. By ensuring a consistent water supply, increasing yields, permitting multiple cropping, and providing financial incentives to farmers, irrigation expands the area under rice and wheat cultivation (Bhattarai *et al.*, 2001; Hussain & Hanjra, 2004; Pereira *et al.*, 2009; Farooq *et al.*, 2009). The use of fertilizer increases crop output, encouraging farmers to expand cultivation to maximize profit. Increased productivity leads to land-use expansion, which increases the area under crop production and supports sustainable agricultural growth (Tilman *et al.*, 2002; Matson *et al.*, 1997; Cassman *et al.*, 2002). The amount of land used for crops like wheat and paddy is heavily influenced by the annual rainfall. Adequate rainfall supports increased yields, motivating farmers to expand their croplands. Conversely, droughts reduce the availability of water for cultivation, potentially resulting in crop failure and thus decreasing the area under crop production in the subsequent season (Lobell *et al.*, 2013). Electricity consumption enhances per-hectare GVA in agriculture by powering irrigation systems, enabling precise water management, and supporting mechanized tools, which boost productivity. Reliable electricity access reduces dependency on rainfall, stabilizing yields and enabling multiple cropping cycles (Omoju *et al.*, 2020; Kargwal *et al.*, 2022)

GVAAH = f (Procurement, CropInt, MarginalNsmall, AvgHold, Irrigation, PowerCons, Credit, Fertilizer, Rainfall) …………………….(1)

Where,

GVAAH = per-hectare gross value added by agriculture
Procurement = percentage of the total output of paddy and/or wheat procured under the MSP system from a state
CropInt = cropping intensity of the state
MarginalNsmall = percent area of the total cropped area under Marginal and small-holding
AvgHold = average Land Holding size in a state.
Irrigation. = percentage of irrigated area relative to the total cropped area of a state,
PowerCons = per hectare electricity consumption for agricultural purposes,
Credit = per hectare credit disbursement by scheduled commercial banks for agricultural purpose
Fertilizer = amount of fertilizer (NPK) consumption (in Kilo Gram) per hectare of a state,
Rainfall = average annual rainfall (in cm)

TABLE 1. EXPECTED SIGN OF THE COEFFICIENTS OF EXPLANATORY VARIABLES

Variable Name	Variable Description	Expected Sign
Procurement	percentage of paddy and/or wheat procured under the MSP system	+
CropInt	the cropping intensity of the state	+
MarginalNsmall	percent area of total cropped area under Marginal and small holding	+/-
AvgHold	Average land holding	+/-
Irrigation	the percentage of irrigated area relative to the total cropped area of a state	+
PowerCons	per hectare electricity consumption for agricultural purposes	+
Credit	per hectare credit disbursement by scheduled commercial banks for agricultural purpose	+
Fertilizer	amount of fertilizer (NPK) consumption (in Kilo Gram) per hectare of a state,	+
Rainfall	annual average rainfall (in cm)	+/-

2.3 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.

TABLE 2. VARIANCE INFLATION FACTOR (VIF) ANALYSIS FOR WHEAT AND PADDY MODELS

Variable	VIF	VIF (after dropping MarginalNSmall)
Procurement	1.56	1.54
CropInt	3.40	3.96
MarginalNsmall	9.77	-
AvgHold	9.03	2.43
Irrigation	6.98	6.73
PowerCons	4.88	3.97
Credit	2.49	2.14
Fertilizer	4.67	4.56
Rainfall	2.83	2.79
Mean VIF	5.07	3.44

Source: Authors' calculations

A VIF value of 10 or above indicates the presence of severe multicollinearity. Kutner *et al.* (2005), Montgomery *et al.* (2012), and O'Brien (2007) support this threshold, recommending investigation or variable exclusion if surpassed.

As indicated in the VIF table, the variable 'MarginalNsmall' exhibits a VIF value of 9.77, approaching the critical threshold of 10. The inclusion of this variable along with the other explanatory variables leads to a typical multicollinearity-type situation resulting in the non-significance of key explanatory variables. Accordingly, this variable was dropped from the empirical model. Moreover, the explanatory variable 'average size of land holding' also exhibits a very high Variance Inflation Factor (VIF). It is worth noting that both the variables - 'area under marginal and small holding size ' and 'average land holding' underscore the significance of farm size in determining farm income. These two variables inherently share a degree of conceptual overlap. Therefore, excluding one of them theoretically does not result in a meaningful omission.

2.4 Model Selection and Hausman Test

A Hausman test has been conducted to ascertain whether the fixed effect (FE) version or the random effect (RE) version is more appropriate for estimating the panel regressions.

TABLE 3. HASUMAN TEST RESULT

Test statistics	P value	df	Preferred Model
41.49	0.00	8	Fixed Effect

Source: Authors' calculations

The Hausman test indicates that the fixed effects (p = 0.00) is preferred for the empirical model. A fixed effects model controls for unobserved, time-invariant characteristics of each entity, isolating the effects of time-varying variables on the outcome by focusing on changes within each entity over time.

Thus, the empirical model is specified as follows:

$$GVAAH_{it} = \alpha_0 + \alpha_1(\text{Procurement})_{it} + \alpha_2(\text{CropInt})_{it} + \alpha_3(\text{AvgHold})_{it} + \alpha_4(\text{Irrigation})_{it} + \alpha_5(\text{PowerCons})_{it} + \alpha_6(\text{Credit})_{it} + \alpha_7(\text{Fertilizer})_{it} + \alpha_8(\text{Rainfall})_{it} + U_{it} \quad \ldots\ldots (2)$$

Where,

α_0 = intercept term,

$\alpha_1, \alpha_2 \ldots\ldots\ldots \alpha_8$ = coefficient terms of the respective variables,

U_{it} = error term

The suffix t ranges from 1 to 21, starting at 1 for 2000 and ending at 21 for 2020.

'i' ranges from 1-14 for 14 states included in the analysis of per-hectare gross value added by agriculture.

III

RESULTS AND DISCUSSION

3.1 Cross-Section Dependence Test

Cross-sectional dependence tests are essential in panel data analysis to identify correlations between units, which, if ignored, can result in inefficient and biased estimates. These tests help in understanding spillovers and common shocks, enhancing the robustness of econometric models (Pesaran, 2004; Breusch and Pagan, 1980; Friedman, 1937).

TABLE 4. CROSS SECTION DEPENDENCE TEST RESULTS

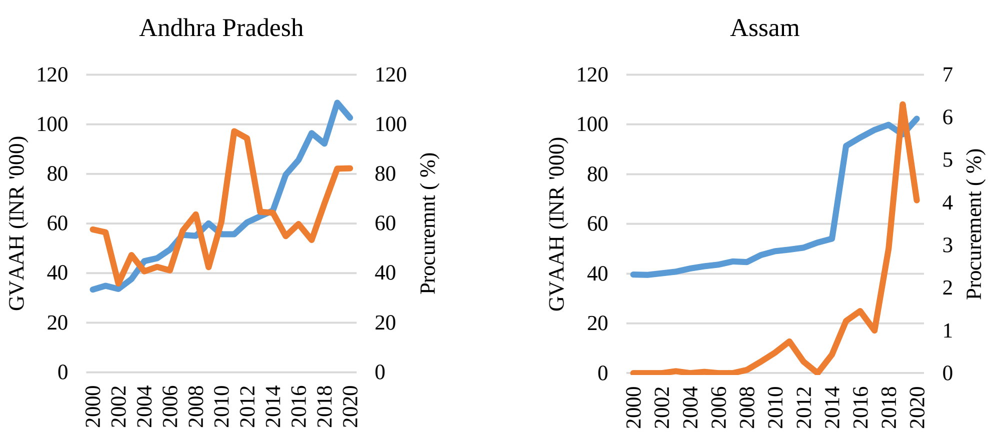
Test	Null Hypothesis (H_0)	Statistics	d.f	P values
Breush-Pagan LM	No cross-sectional dependence (all pairwise correlations are zero)	25.28419		1.0000
Pesaran Scaled LM	No cross-sectional dependence (Scale for large panels)	-4.871180	91	0.0001
Pesaran CD	The average cross-sectional dependence is zero	0.773470		0.4392

Source: Authors' Calculation

The high p values of both the Breusch–Pagan LM test and the Pesaran CD test favour the retention of the null hypothesis of no cross-sectional dependence. Conversely, the Pesaran scaled LM test's p value of 0.0000 suggests the presence of dependence. Despite this anomaly, the majority consensus from the tests allows us not to reject the null hypothesis, pointing to an overall absence of cross-sectional dependence within the residuals of the Model. According to many researchers (Hansen, 1999; Wooldridge, 2010; Greene, 2012; Phillips and Moon, 1999), the result of the Breush–Pagan LM is preferable in panel data analysis when the number of periods is greater than the cross-sectional entity, which confirms the absence of cross-sectional dependence.

3.2 Correspondence between GVAAH and MSP-Procurement

Before the panel data regression results, examining the correspondence between the per hectare gross value added by agriculture and our key explanatory variable 'extent of procurement under MSP' was necessary. The correspondences have been captured through the trend lines presented in Figure 1.



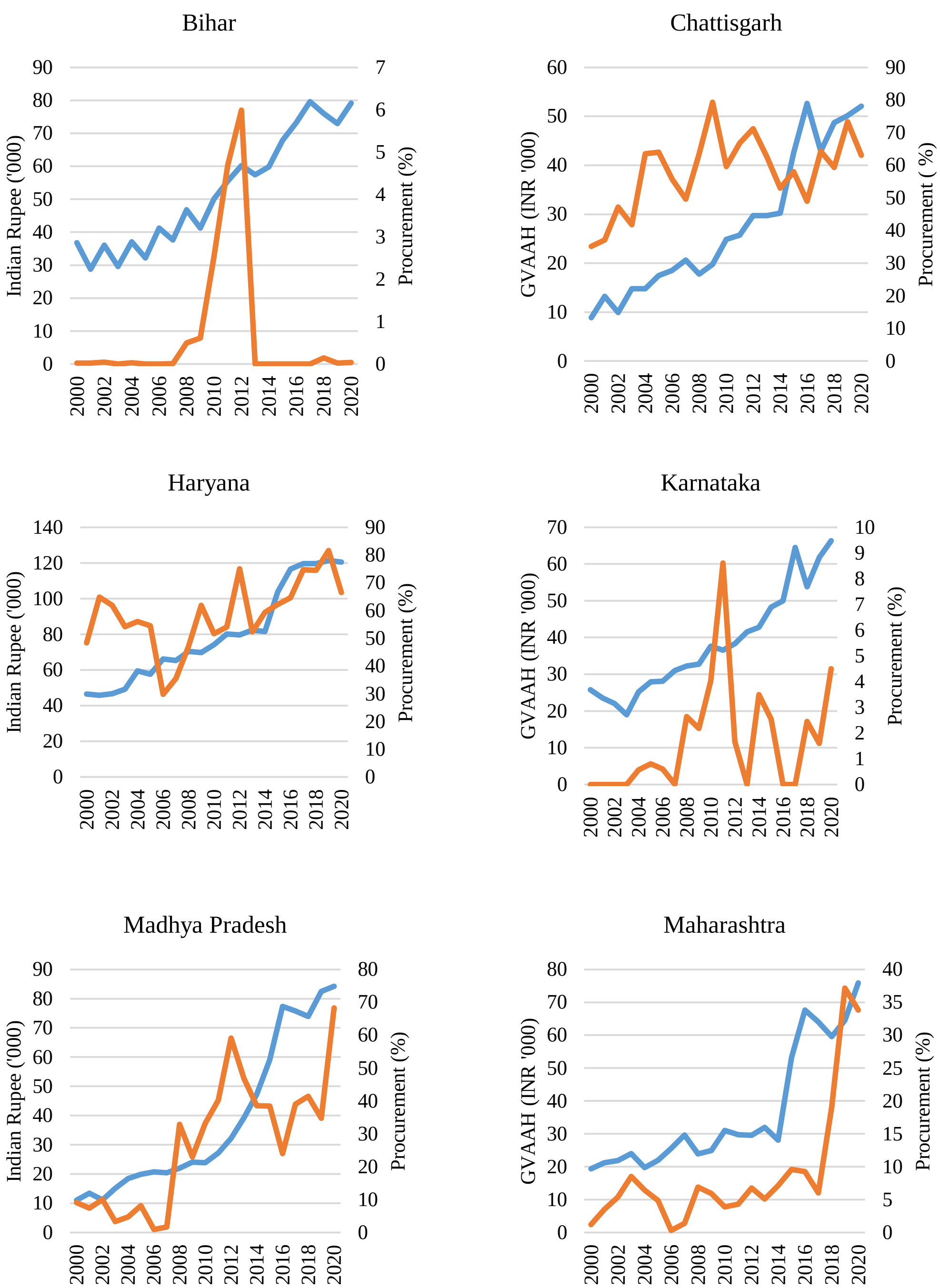

Bihar
Indian Rupee ('000)
Procurement (%)
Chattisgarh
GVAAH (INR '000)
Procurement (%)
Haryana
Indian Rupee ('000)
Procurement (%)
Karnataka
GVAAH (INR '000)
Procurement (%)
Madhya Pradesh
Indian Rupee ('000)
Procurement (%)
Maharashtra
GVAAH (INR '000)
Procurement (%)

Figure 1. GVAAH and MSP procurement of total production (2000-2020) in different states of India

In analyzing the relationship between GVAAH and procurement trends across Indian states, notable state-specific variations are observed. Most states show a gradual increase in GVAAH over time; however, a sudden spike occurred across major agricultural states from 2014 to 2016. This surge is attributed to several factors, including an increase in market prices for agricultural products, higher MSP rates compared to previous years, favorable weather conditions, and government policies such as the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) for irrigation, the Soil Health Card Scheme, and the National Mission for Sustainable Agriculture (NMSA) promoting sustainable practices. The combined effect of these factors significantly boosted productivity (Ghosh *et al.*, 2023; Saxena *et al.*, 2023).

High-procurement states like Punjab and Haryana show a consistent upward trend in GVAAH, with procurement percentages often exceeding 80% for Punjab and around 60% for Haryana. This stability reflects well-established procurement policies and infrastructure, ensuring steady farmer incomes and supporting consistent GVAAH growth. Andhra Pradesh and Chhattisgarh similarly show steady GVAAH growth, sustained by relatively stable procurement patterns. In contrast, states with lower procurement rates, such as Karnataka and Maharashtra, experience steady but minor fluctuations in GVAAH, indicating the limited impact of MSP in these regions. These states generally maintain procurement percentages below 10%, with occasional peaks tied to MSP adjustments. Likewise, Assam, Bihar, Odisha, Uttar Pradesh, and West Bengal display stable but modest GVAAH growth, with procurement rates generally under 10%.

Overall, states with consistent, high procurement benefit significantly from MSP support and robust procurement systems, maintaining stability and higher GVAAH even under variable agricultural conditions. Conversely, low-procurement states remain more vulnerable to external factors, leading to limited MSP impact on GVAAH and slower growth. This varied trend emphasizes the interplay between procurement stability, MSP policies, and regional factors in shaping GVAAH outcomes across India.

Our study analyzes a panel dataset of 294 observations on agricultural productivity variables across multiple states. The GVAAH averages 55,461.22 units, with a substantial range from 8,861.64 to 161,426.9 units, underscoring the variability in per-hectare agricultural returns across regions and time periods. The high standard deviation of 31,184.8 indicates significant fluctuations, likely influenced by economic, environmental, and market conditions.

TABLE 5. DESCRIPTIVE STATISTICS OF VARIABLES IN THE REGRESSION

Variable	Observation	Mean	Std. Dev.	Minimum	Maximum
Dependent					
GVAAH	294	55461.220	31184.800	8861.642	161426.900
Independent					
Procurement	294	26.855	26.636	0.000	97.200
Control					
CropInt	294	144.411	24.724	111.800	193.200
AvgHold	294	1.554	0.938	0.390	4.030
Irrigation	294	45.035	26.038	4.011	98.846
PowerCons	294	723.044	651.737	2.384	2824.239
Credit	294	29659.810	42575.990	590.250	297254.700
Fertilizer	294	129.596	61.672	28.600	278.400
Rainfall	294	1061.266	483.592	175.600	2578.500

Source: Authors' calculations

Procurement levels range from 0 to 97.2%, with an average of 26.86%, reflecting wide disparities in state-level procurement operations over time. States such as Punjab and Haryana consistently exhibit high procurement rates, while others see minimal or sporadic procurement. Specific instances, such as in Assam during the years 2002, 2004, 2006, 2007, and 2013 and in Karnataka during 2002, 2003, 2016, and 2017, recorded no paddy procurement by government agencies. In contrast, states such as Punjab, Haryana, and Andhra Pradesh consistently emerge as significant contributors to national procurement totals (Food Corporation of India, 2024).

The regression analysis for GVAAH reveals key insights into how procurement and other factors influence agricultural income per hectare. Procurement has a significant effect on GVAAH, with a coefficient of 253.40 (p = 0.005), suggesting that government-backed procurement lifts income by providing a minimum price guarantee. This outcome aligns with the theoretical perspective that increased procurement levels reduce income volatility, boosting farm profitability and income per hectare. Similarly, variables like cropping intensity (coefficient = 230.1476), credit (coefficient = 0.3369), and fertilizer use (coefficient = 119.78) positively impact GVAAH at high levels of statistical significance (p = 0.037, p = 0.000, and p = 0.004, respectively). The strong influence of Cropping Intensity underscores its critical role in maximizing land utilization and boosting agricultural productivity.

These findings collectively highlight the importance of financial support, efficient credit systems, optimal input use, and enhanced cropping intensity in maximizing land utilization, improving per-hectare productivity, and boosting overall farm income.

TABLE 6. FIXED EFFECT REGRESSION RESULT OF GVAAH

Variable	Coefficient	P>|t|	Model Diagnostic
Procurement	253.4092*** (90.07997)	0.005	
CropInt	230.1476** (110.2485)	0.037	R^2 values
AvgHold	-26537.80*** (7861.275)	0.000	within =0.6714
Irrigation	207.4314 (192.6082)	0.282	between = 0.3085
PowerCons	3.0664** (4.72861)	0.517	overall = 0.4064
Credit	0.3207*** (0.031063)	0.000	sigma_u = 26103.339
Fertilizer	137.7675*** (35.82495)	0.000	sigma_e = 13137.282
			rho = 0.7978
Rainfall	3.4101 (3.534078)	0.335	F (8,272) = 69.48***
			Prob > F = 0.0000

Source: Author's calculation

Figures within parentheses are the standard errors. *** and ** indicate significance .01 level and .05 level respectively

On the other hand, average land holding shows a significant negative impact on GVAAH (coefficient = -26537.80, p = 0.000), suggesting that smaller land holdings may be associated with more intensive use of resources and higher productivity per hectare. Other variables, such as power consumption, irrigation, and rainfall, did not show statistical significance possibly indicating that these factors have a more indirect or context-dependent impact on agricultural income. It might be surprising to see the insignificant impact of power consumption, irrigation, and rainfall, as they are typically important for agricultural productivity. This could be because, other factors like procurement, cropping intensity, credit availability, and fertilizer use are more dominant, reducing the observed significance of power consumption, irrigation, and rainfall—their marginal impact on productivity may be lower when other key inputs are readily available. The model diagnostics, with an R^2 within value of 0.6714 and a highly significant F-statistic (Prob > F = 0.0000), indicate a strong fit, suggesting that the fixed effects model effectively captures the influence of the key variables on GVAAH across entities over time.

IV

CONCLUSION AND POLICY IMPLICATIONS

The results of this study underscore the role of effective MSP procurement in increasing GVAAH. Evidence from the analysis suggests that assured prices under MSP help farmers secure higher incomes, especially in states with consistent and high procurement levels, such as Punjab and Haryana. However, states with lower procurement rates experience limited benefits, indicating that a balanced approach to MSP could potentially enhance income and reduce regional disparities. Furthermore, access to financial inputs, particularly credit, and fertilizer, positively influences GVAAH, while larger landholdings demonstrate negative impacts on per-hectare productivity. These findings highlight the importance of financial support mechanisms and resource-efficient practices to sustain farm incomes across varying agricultural conditions.

Considering these insights, some agricultural economists and pressure groups advocate for expanding MSP to cover a broader array of crops (Kumbhar, 2011; Aditya *et al.*, 2017; Parashar, 2021). However, expanding MSP coverage on a large scale introduces substantial fiscal challenges, including increased government expenditure for procurement, storage capacity concerns, and the need to maintain extensive buffer stocks. Such expansion could also distort markets, reduce export competitiveness, and put immense strain on national resources (Chand, 2003; Dev & Rao, 2010; Hareesh, 2018; Deodhar & Kelkar, 2024). Therefore, a balanced and structured approach is necessary.

One practical solution involves maintaining minimal MSP procurement to ensure food security for marginalized communities while encouraging private sector participation to alleviate the government’s responsibilities (Mahapatra & Mahanty, 2018; Kolloju *et al.*, 2024). Contract farming initiatives could play a pivotal role here, with the private sector offering guaranteed minimum prices akin to MSP, thereby stabilizing farmers' incomes without the need for large-scale government intervention and storage costs (Singh & Raj, 2019; Bezbaruah & Khan, 2020; Kaur *et al.*,2021). Through these targeted policies and private partnerships, the government can enhance farmers’ income, and address fiscal constraints sustainably, ensuring both food security and economic resilience for the agricultural sector.

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