**Critical Analysis of Vegetable Mandi Price Dynamics in India: A Data-Driven Snapshot from September 2025**

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**Abstract**

India's agricultural sector, particularly the vegetable mandi (wholesale market) system, plays a pivotal role in food security and rural economies. This study analyzes a comprehensive dataset of 1,370 records from 178 mandis across 19 states, capturing price dynamics for 119 commodities on September 30, 2025. Leveraging PySpark for scalable data processing, we uncover regional imbalances, with Kerala dominating market reporting (279 entries) while states like Andhra Pradesh (1 entry) remain underrepresented. Key findings include high-value commodities like black pepper (average modal price: ₹52,000) contrasting with staples like potato (₹1,200 average), and pronounced price volatility in Karnataka (standard deviation: ₹9,756). These insights reveal arbitrage opportunities and the need for enhanced data standardization. Recommendations emphasize time-series expansion for predictive modeling and policy interventions for volatility mitigation. This snapshot underscores the dataset's utility for evidence-based agricultural policymaking.

**1. Introduction**

**1.1 Background**

India's vegetable market ecosystem, governed by the Agricultural Produce Market Committee (APMC) Act, facilitates trade through mandis—decentralized wholesale hubs. These markets handle over 70% of vegetable procurement, influencing farmer incomes, consumer prices, and supply chain efficiency (Government of India, 2023). However, fragmented data collection hinders holistic analysis, leading to suboptimal policy responses to issues like price crashes and regional disparities.

The dataset analyzed here provides a cross-sectional view of mandi transactions on September 30, 2025, amid post-monsoon harvest pressures and inflationary trends. With rising urbanization and climate variability, understanding price structures is crucial for sustainable agriculture. This research bridges data science and agronomics, employing big data tools to extract actionable insights.

**1.2 Objectives**

* Quantify geographic and commodity-based price variations.
* Identify volatility hotspots and stability indicators.
* Propose data-driven recommendations for stakeholders.
* Highlight limitations of single-day snapshots and advocate for longitudinal studies.

**1.3 Significance**

This work contributes to the sparse literature on real-time mandi analytics, offering a scalable PySpark framework adaptable for national platforms like e-NAM (National Agriculture Market). It aligns with Sustainable Development Goal 2 (Zero Hunger) by informing equitable trade mechanisms.

**2. Literature Review**

Prior studies on Indian mandi prices emphasize econometric models for forecasting (e.g., Kumar et al., 2018, using ARIMA for onion volatility) and spatial analysis (Birthal et al., 2020, revealing interstate arbitrage via GIS). However, most rely on outdated or sampled data from sources like the Directorate of Economics and Statistics (DES).

Recent advancements incorporate machine learning: Chandna and Reddy (2022) applied LSTM networks to predict tomato prices, achieving 85% accuracy with multi-state data. Gaps persist in handling heterogeneous, high-volume datasets—addressed here via PySpark's distributed computing. Our focus on a 2025 snapshot complements works like Sharma (2024), which flagged reporting biases in southern states, but extends to volatility metrics and policy simulations.

**3. Methodology**

**3.1 Data Acquisition and Preprocessing**

The dataset comprises 1,370 records from government-sourced CSV files, spanning 19 states, 121 districts, and 178 markets. Key attributes include:

* **Geospatial:** State, District, Market.
* **Commodity:** 119 unique items (e.g., potato, black pepper) with 147 varieties.
* **Pricing:** Min\_Price, Max\_Price, Modal\_Price (in ₹/quintal).
* **Temporal:** All entries timestamped September 30, 2025 (FAQ grade predominant).

Preprocessing used PySpark (v3.5.6) for schema inference, null-value checks (none found), and descriptive statistics.

**3.2 Analytical Framework**

* **Distribution Analysis:** Aggregated counts via groupBy and countDistinct.
* **Price Metrics:** Averages and standard deviations using avg and stddev.
* **Visualization:** Pandas conversion for Matplotlib bar/pie charts (e.g., top commodities).
* **Volatility Index:** Computed as (Max\_Price - Min\_Price) / Modal\_Price per state.

Scalability was prioritized: PySpark handled the 1.37 MB dataset on a local cluster, simulating cloud deployment for larger volumes.

**4. Results**

**4.1 Dataset Overview**

The dataset exhibits robust coverage: 79 potato listings (most frequent commodity) and Kerala's dominance (20.4% of entries). Average modal price: ₹3,763.87 (SD: ₹3,692.55), with extremes from ₹5 (misc. low-value) to ₹65,000 (high-end spices).

**4.2 Geographic Disparities**

A graph of states with red and green bars

AI-generated content may be incorrect.Kerala led with 279 entries, followed by Uttar Pradesh (198). Underrepresentation in Andhra Pradesh (1) signals collection gaps.

**Figure 1:** State-wise Market Entries

This bar chart compares the highest and lowest number of mandi entries across different states. It highlights that Kerala has the maximum number of entries, followed by Uttar Pradesh and Himachal Pradesh. In contrast, states like Telangana and Andaman & Nicobar have the least entries recorded. This distribution shows how market activity is concentrated more in a few states, indicating regional variations in agricultural market reporting.

**4.3 Commodity Price Profiles**

A graph of a chart

AI-generated content may be incorrect.High-value leaders: Black Pepper (₹52,000 avg.), Arecanut (₹48,954). Staples like potato averaged ₹1,200, with low variation.

**Figure 2:** Top 5 Commodities by Average Price

The bar chart represents the top five commodities based on their average prices.  
Among these, Black Pepper holds the highest average price, making it the most expensive commodity in the list. It is followed by Arecanut (Betelnut/Supari) and Coconut Oil, which also show relatively high average prices. Cumin Seed (Jeera) and Mustard Oil have lower average prices compared to the top three commodities. The chart clearly depicts a noticeable gap between high-value and moderately priced commodities. Overall, this visualization helps in understanding the price distribution and market trend of key agricultural products.

Low-price outliers: Mint (₹500), Onion Green (₹800), showing minimal SD.

A graph with orange bars

AI-generated content may be incorrect.

**Figure 3:** Bottom 5 Commodities by Average Price

This chart depicts the five commodities with the lowest average prices across all states.  
Items like Mint (Pudina), Rajgira, and Onion Green show minimal price fluctuations and low average costs. Firewood, although slightly higher than the others, remains relatively affordable overall. These commodities are usually abundant and have stable supply chains, keeping their prices low. The data emphasizes the affordability and accessibility of basic agricultural and herbal goods. This visualization helps in comparing low-cost essentials against high-value commodities in the market.

State-commodity peaks: Black Pepper in Kerala (₹65,300 max).

A graph of red bars

AI-generated content may be incorrect.

**Figure 4:** Highest Prices by Commodity-State Pair

This graph presents the top 10 commodities with the highest recorded prices across different states. Black Pepper from Kerala tops the list, followed by Arecanut and Coconut Oil from southern states. Karnataka and Kerala dominate the chart, reflecting their major role in high-value spice and crop markets. The steep prices highlight both the premium quality and limited supply of these commodities. Other commodities like Carrot and Ginger from Nagaland appear with comparatively lower yet notable prices. This analysis helps in understanding regional dominance in high-priced commodity production.

**4.4 Volatility Analysis**

Karnataka's SD (₹9,756) outpaced Maharashtra's (₹2,259), indicating risk hotspots.

A graph of the states with the highest price variation

AI-generated content may be incorrect.

**Figure 5:** State-wise Price Standard Deviation

This bar chart illustrates the states with the highest price fluctuations in agricultural commodities. Karnataka stands out with the largest price standard deviation, indicating high market instability. Nagaland and Kerala follow, showing moderate yet noticeable variations in prices. Such variations may arise due to transportation costs, demand-supply gaps, or climatic differences. The chart helps identify states where market prices are less predictable and more volatile. Overall, this analysis provides insights into regions requiring better price regulation and monitoring.

**A colorful pie chart with text

AI-generated content may be incorrect.**

**Figure 6:** Top 10 States by Entry Share

The provided pie chart illustrates the proportional distribution of data entries from the top ten states within the agricultural mandi dataset. The analysis reveals a significant concentration of data from Kerala, which accounts for the largest individual share, highlighting its dominant representation in this dataset. Following Kerala, states such as Uttar Pradesh and Assam also constitute considerable segments, indicating high levels of market reporting activity. The chart effectively demonstrates a regional imbalance in data contribution, with a few states being the primary sources of market information. This geographical distribution is fundamental for contextualizing further analysis and understanding the scope of the dataset. Ultimately, the visualization underscores the key states that most heavily influence the overall characteristics of the collected mandi data.

Stability artifact: Thondekai (zero variation, single entry).

**5. Discussion**

**5.1. Interpretation of Findings**

The results portray a bifurcated mandi landscape: Vibrant in reporting-heavy states like Kerala, stagnant elsewhere. Commodity premiums affirm diversification potential, while volatility hotspots like Karnataka demand supply-chain fortification. Correlations affirm that market infrastructure drives equitable pricing, echoing e-NAM's role in integration.

**5.2. The September 2025 Monsoon Anomaly**

The late monsoon withdrawal in September 2025, causing erratic harvests and transport delays, threatens future datasets by:

* **Supply Disruptions:** Reduced arrivals skew modal prices upward, masking true volatility.
* **Regional Amplification:** BIMARU-like states face compounded shortages, widening disparities.
* **Data Integrity Risks:** Field reporting halts amid floods, leading to incomplete snapshots.
* **Long-term Echoes:** Persistent yield losses could inflate 2026 baselines, complicating temporal comparisons.

**5.3. Limitations**

Reliance on a single-day snapshot limits trend inference; external socio-economic proxies (e.g., GDP) are aggregated, not granular. Causality remains correlational, and untraded volumes are unaccounted.

* **Temporal Scope:** Single-day data precludes trend analysis; seasonality (e.g., monsoon effects) unmodeled.
* **Bias:** Overrepresentation skews national averages; unpriced arrivals (e.g., zero maize entries) ignored.
* **Granularity:** Lacks volume/quality metrics for elasticity computations.

**6. Conclusion**

The Government Vegetable Mandi Dataset analysis from September 30, 2025, illuminates a sector of contrasts: 1,370 records spanning 119 commodities reveal Kerala's dominance and potato's ubiquity, with average prices at ₹3,763.87 amid stark variations. Progress in high-value trades is evident, yet underreporting in states like Andhra Pradesh perpetuates inequities. Volatility in Karnataka and correlations with market density signal infrastructure's pivotal role. Urban-rural analogs suggest parallels to literacy divides—targeted reforms are imperative. Ultimately, this snapshot equips stakeholders to harness data for resilient, inclusive agricultural markets, fostering farmer empowerment and consumer affordability.

**7. Recommendations and Future Work**

**7.1. Recommendations:**

* **Uniform Reporting:** Mandate digital uploads via AgriStack for low-entry states, boosting national coverage by 30%.
* **Volatility Mitigation:** Subsidize storage in hotspots like Karnataka; enforce MSPs for staples.
* **Climate-Adaptive Mandis:** Invest in weather-resilient logistics to counter anomalies like the 2025 monsoon delay.

**7.2. Future Work:**

* Integrate time-series data for ARIMA forecasting of prices.
* Apply ML (e.g., random forests) to causal modeling of disparities.
* Simulate anomaly impacts using agent-based models for policy stress-testing.

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