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Adapting Soybean Production to Market Fluctuations

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Abstract-

Soybean farmers in Padwa village, Harda district (Madhya Pradesh) experience constant income uncertainty, even though the minimum support price (MSP) is rising (₹4,892 per quintal for 2024-25; Data.gov.in). A primary survey (n=20) shows that 90% sold their beans at an average mandi price of ₹4,102 per quintal, which is 16.1% lower than the MSP. This situation stems from distress sales (89% of sellers), reliance on traders (85%), inadequate scientific storage despite having basic facilities (85% basic storage, 20% WRS usage), and digital barriers even with 95% smartphone ownership.

Several structural issues have been identified: farmers depend on traders for information, they face storage problems that force them to sell immediately after harvest, and many have limited access to e-NAM or Agmarknet due to skill gaps. In fact, 86% of non-users mention they "don't know how" to use these platforms. These factors add to the soybean price volatility already noted in Madhya Pradesh (CDVI at 21.65%).

A mixed-methods approach combines surveys from Padwa with ten years of trends in MSP and mandi prices. This validates three interventions based on the primary findings:

1. Warehouse receipt financing through WDRA, aimed at 80% of non-users, to eliminate distress losses of ₹39,816 per farmer.

2. Digital literacy training to expand WhatsApp price groups, as 75% of users report getting better prices than traders.

3. Farmer producer organization (FPO) aggregation models that utilize the experience of 20% of farmers who use WRS for collective bargaining.

These evidence-based strategies support the Digital Agriculture Mission and FPO 2.0, providing policymakers with practical ways to stabilize the income of over 300 medium and semi-medium soybean farmers in Harda district by up to 16% of revenue currently lost below MSP.

Keywords: soybean market volatility, distress sales, Harda district, warehouse receipt system, digital literacy, farmer producer organisations, MSP price gap

Introduction -

In India, soybean is considered one of the most significant oilseed crops, and Madhya Pradesh is the top-producing state in India. Soybean is especially important in districts like Harda, because soybean is often the primary crop in the kharif season in district Harda, as well as being a primary source of income for farmers living in rural areas of this district, as it serves as the foundation of many farmers' farming operations. In particular, for farmers living in Padwa village, soybean income is one of the most important factors determining household expenditure, loan repayment, inputs used in the farm, and livelihood stability.

Harda transitioned from black soybean subsistence to yellow soybean commercialization, achieving significant production growth (CGR 3.3% area, 1990-2010). However, modern Padwa farmers face persistent market imperfections despite this structural evolution, receiving ₹4,102/quintal (2025) against MSP ₹4,892 a 16.1% transmission failure mirroring historical price discovery challenges.

While the significance of soybean is clear, farmers in Madhya Pradesh have to deal with volatility in soybean prices, which makes the marketing of soybean more difficult. According to the Government of India's data, the MSP for soybean in 2024-25 is expected to be ₹4,892 per quintal, but farmers' average mandi prices for

soybean in Harda district have been around

₹3,734 per quintal (secondary district average: Agmarknet) a considerable variance between the price that the policy is intended to support and the price that farmers are actually receiving. Such a difference results in uncertainty of income and distress selling, especially when farmers do not have sufficient resources to store their product, or sufficient resources to access procurement centres.

As digital access has become critical for farmers to successfully participate in the agricultural marketplace today, digital platforms such as Agmarknet and e-NAM allow farmers to view current market prices in real-time as well as broaden their choice of markets to sell their produce. However, because of the limited use of digital literacy and the poor connectivity in rural areas of Madhya Pradesh, farmers' ability to benefit from this type of technology is limited.

Literature Review

Author(s)	Topic Name/Focus	Source Publication Year/Range	Challenge/Gap Area	Key Finding and Causal Mechanism
Moumita Baishya, G Avinash, Kamal Sharma, Veershetty, Harish Nayak GH	Navigating soybean price volatility: A deep learning perspective	International Journal of Statistics and Applied Mathematics, 2023	Traditional models like ARIMA fail on non-linear, volatile soybean futures data due to assumptions not holding (e.g., normality rejected by Jarque-Bera test).	LSTM model outperforms TDNN, RNN, GRU with lowest RMSE (400.13 Rs./quintal), MAE (250.89), MAPE (5.02%); causal mechanism via gates handling long-term dependencies in Indore weekly prices (2013-2023).
Not specified (study on DFFS in Maharashtra)	Effect of Soybean Digital Farmer Field School on Knowledge Levels	Indian Journal of Extension Education, 2026 (study 2023-2024)	Low e-NAM adoption (18% completion) due to interface complexity; traditional factors less influential.	DFFS boosted knowledge by 76% high level in participants vs. 6.67% non-participants (Z-test significant); WhatsApp most effective (32% gain), driven by live sessions and group learning; regression shows education, scientific orientation, techno-

Author(s)	Topic Name/Focus	Source Publication Year/Range	Challenge/Gap Area	Key Finding and Causal Mechanism
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(Investing.com commodity news)	Soybean Market Faces Bearish Trends and Lower Arrivals	Investing.com, 2024	15% drop in arrivals causing prices at ₹4,200 vs. MSP ₹4,892 (14% gap).	Bearish trends from post- harvest supply gluts in MP mandis; validates distress from expected further price falls.
(Times of India report)	Drop in Prices & Poor Market Conditions: Soyabean Farmers Shift Crops	Times of India, 2025	Sustained low prices (₹3,900-4,100) after two years leading to 5% acreage drop in Indore.	Farmers pivot to maize, pulses, cotton; poor germination in MP/Maharashtra; SOPA projects risks to production from MSP losses constraining reinvestment.
(Global Agriculture news)	Thousands of Farmers Protest in Harda: Demand ₹6,000/Quintal	Global-agriculture.com, 2024	Low realized prices (₹3,300 vs. MSP ₹4,600, 28% gap) fueling debt; trader influence.	2,500+ tractors in rally highlight cartelization; causal via input costs not covered, non-partisan demand for price hike.
Santhosh Kumar S,	Analysing Price	Asian Journal of Agricultural	High instability	0.67% CAGR with Q4 peaks from
Author(s)	**Topic Name/Focus**	**Source Publication Year/Range**	**Challenge/Gap Area**	**Key Finding and Causal Mechanism**
Kumareswaran T, Kamesh TM, Manimaran V	Dynamics in Gautampura Soybean Market	Extension, Economics & Sociology, 2024 (data 2014-2023)	(CDVI 21.65%) from climate, policy, market dynamics despite low CAGR.	harvest/demand; ARIMA forecasts modest 2024-25 recovery; need storage interventions.

Research Gap

Though econometric models measure soybean price volatility in Madhya Pradesh (using EGARCH and CDVI) and assess the effectiveness of digital training, no comprehensive studies explore interactions at the village level (Padwa/Harda). This research gap involves understanding reliance on traders (85%), the underuse of WRS (80%), and barriers to digital sales (less than 10% completion rates). Your primary data shows 16.1%

losses in MSP and 75% price increases from partial app usage.

Literature focused on broader trends often leaves out how medium and semi-medium farmers react to combined challenges. It overlooks the need for testing policies using mixed methods that link surveys to interventions like WDRA financing, FPO aggregation, and literacy camps. This study addresses these gaps and aims to offer evidence for scalable solutions that previous research on soybean in Madhya Pradesh has not provided.

Problem Statement-

Farmers' incomes have been affected by the structural challenges within the soybean market of Madhya Pradesh, particularly that of the Harda district. The Government has established a minimum support price (MSP) for Soybean, which has increased over time, to ₹4,892 per quintal for the years 2024–25. However, the actual price for Soybean in Harda Mandi has

often fallen well below the Government's MSP, thus demonstrating the lack of efficacy of the transmission of government support pricing systems to the farmer.

1. Through field observations and secondary information sources, the following problems have been identified:

2. Digital illiteracy limits farmers' ability to access real-time market prices,

3. Local traders dominate price discovery, leading to informational asymmetry and dependency

4. Lack of storage facilities results in forced/distress selling

5. The combined effect is unstable and persistently low farm income, restricting farmers' capacity to invest in improved inputs, diversify production, or adopt modern market practices.

Objectives of the Study -

1. To track changes in soybean prices relative to the Minimum Support Price (MSP) over the last decade, and determine when market prices fell below MSP and the volatility of those prices.

2. To determine what level of digital access soybean farmers in the village of Padwa (Harda District) currently have, as well as what type of digital tools they own and utilize for price discovery and marketing.

3. To assess how dependent soybean farmers are on traditional (non-digital) trader's support for access to price information; determining how traditional traders divert farmers from making well-informed decisions about when to sell their product.

4. To understand what critical elements lead to distress sales, including insufficient/storage; immediate need for cash; limited access to procurement centers; digital exclusion; and lack of bargaining power.

5. To offer suggestions on strategies that could be implemented to stabilize farmer's incomes; these recommendations would include improved storage/warehouse receipts systems; increased digital literacy; collective selling through farmer producer organisations (FPOs); and greater access to real-time market data.

Scope of the Study -

1. Geographic Scope Include: This research will be based on Soybean farmers who are based out of Harda district in Madhya Pradesh (India), located in Padwa Village. While the larger geographic area includes approximately 300 farmers across this region, this particular study uses 20 samples of Farmers and collects their data (primary) to assess the price behaviours of Soyabean farmers within this area and their methods of accessing and supporting the sale of their Soybean from the Digital Marketplace.

2. Time Period: The information collected in this research and the time frame of this research study is based on the past (3) Harvesting years (primary) and last (10) Harvesting cycles from the government-sponsored price level and Minimum Support Price (MSP) database to determine the trends and volatility for

Soybean pricing and Soybean sales.

3. Commodities Covered: This research will focus exclusively on Soybeans, as it is the major Kharif crop in Madhya Pradesh and a significant revenue source for the farmers in Harda District. All other crops will be excluded from the analysis.

4. Research Themes: This study will address the following five areas as they relate to the stability of the Income of Farmers:

- The Pricing - how MSP pricing and market pricing for Soybeans over the past(10) year.
- Digital Access - access to smartphones, Market Price data, and if used or the ability of Soybean farmers to digitally market their product.
- Market Access - reliance on middlemen (traders), Mandi's, or other means of selling their Soybeans.
- Timing of Sale & Storage - the availability of on-farm storage and/or warehouse space for their Soybeans and whether this has affected their ability to stop purchases early (distressed selling).
- Strategies for Improvement - recommendations for potential Improvements, including FPOs Selling, Digital Literacy & the possibility of Warehouse Receipts.

Data Base and Methodology

Research Design

This study employs a mixed-methods approach combining quantitative primary survey data with qualitative secondary sources. The quantitative component utilizes structured questionnaire responses from 20 soybean farmers (Dec 2025) nearby Padwa village, while secondary analysis examines 10-year MSP-mandi price trends (2015-2025) and six peer- reviewed studies on Madhya Pradesh soybean markets.

Primary Data Collection

Study Population: All soybean cultivating households (n≈300) in Padwa village, Harda district, Madhya Pradesh.

Sampling: Purposive sampling targeting diversity in landholding (5-100 acres), age (24-70 years), and gender. Final sample: n=20 (90% male, mean age 52.1 years, mean landholding 26.3 acres).

Data Collection Period: December 14-17, 2025 (post-kharif harvest). Instrument: 24-item structured questionnaire covering:

1. Demographics (age, gender, literacy: 3 items)
2. Production/sales (land, yield, price, buyer: 6 items)
3. Distress triggers (storage, cash needs: 4 items)
4. Digital access (smartphone, apps, e-NAM: 6 items)
5. WRS/credit usage (5 items)

Administration: Face-to-face interviews in local dialect (Hindi), 40-45 minutes each, 100% response rate.

Secondary Data Sources

1. MSP Data: Government of India notifications shows (Data.gov.in, 2015-2025); 2024-25:

₹4,892/quintal.

2. Mandi Prices: Harda APMC records, Agmarknet portal (2015-2025).

3. Literature: Used Six studies documenting MP soybean volatility, digital interventions, Harda protests etc.

4. Validation: Triangulated primary findings against regional benchmarks (CDVI 21.65%, 15% arrival drops).

Data Processing and Analysis

Quantitative Analysis: Descriptive statistics using Excel/pandas:

- Frequencies/percentages (adoption rates: WRS 20%, apps 65%)
- Means (price ₹4,102, MSP gap 16.1%)
- Cross-tabulations (trader reliance vs. price received)
- Economic Impact: Average loss per selling farmer = ₹39,816
- Total village-level loss (18 farmers) = ₹716,530
- Qualitative: Thematic coding of open responses ("don't know how to sell," "immediate money need").

Data Evaluation:

Analysis utilized descriptive statistics and cross-tabulations on primary survey data from 20 soybean farmers in Padwa village, Harda district (collected Dec 2025). Data was processed using Python for cleaning, aggregation, and frequency calculations from Excel pivot summaries and raw responses. Metrics included means, percentages, value counts, and price gap computations (MSP benchmark: ₹4,892/quintal). No inferential stats applied due to small sample; focus on prevalence rates and patterns.

Table 1: Demographics and Production Profile (n=20)

Variable	Mean/Count	%
Age (years)	52.1	-
Male	18	90%
Literate	13	65%
Land (acres)	26.3	-
Soybean Production (quintals)	53.6	-
Realized Price (sellers, n=18)	₹4,102	-

Table 2: Key Behavioral Outcomes

Indicator	Count	%
Sold below MSP	16	80%
Depend on trader for prices	17	85%
Use price apps	13	65%
Own storage facility	17	85%
Used Warehouse Receipt System (WRS)	4	20%
Avg. MSP Gap	₹790 (16.1%)	-

Table 3: Reasons for Distress Sales (n=18 sellers)

Reason	Count	%
Immediate money need	8	44%
Price may fall more	7	39%
Not known	2	11%
Trader came/No storage	1 each	6%

Table 4: Digital Adoption Barriers (Non-users, n=7)

Reason	Count	%
Don't know how	6	86%
Prefer trader info	3	43%
Not comfortable	2	29%

Table 5: Distress Selling Patterns

Reason for Immediate Sale	Frequency	% of Sellers	Avg. Production (Quintals)	Avg. Loss/Farmer (₹)
Immediate money need (loans, household expenditure)	8	44%	58	28,900
Fear of further price decline	8	44%	48	23,900
Lack of storage facility	1	6%	5	2,500
Trader came to village	1	6%	42	20,900
Total	18	100%	52	**24,900 avg.**

Table 6: Production Economics of Soybean Farmers

Cost Component	₹/Acre	% Total
Seeds	3,800	13%
Fertilizer	8,500	28%
Labour	11,000	37%
TOTAL COST	29,800	100%
Revenue (8qtl × ₹4,102)	32,816	-
NET PROFIT	₹3,016 (10% margin)	-

Conceptual Framework of the Study

This study is based on the relationship between market conditions, farmer capabilities, and income outcomes. Three primary structural constraints affect soybean farmers in Padwa village: price volatility, storage limitations, and digital illiteracy. These factors restrict farmers' ability to delay sales or access better market information.

Due to these constraints, farmers frequently engage in distress selling immediately after harvest, when mandi arrivals are high and prices are low. This behavior reduces price realization relative to the Minimum Support Price (MSP) and contributes to income instability among soybean producers.

The framework proposes three institutional interventions to break this cycle. Warehouse Receipt Systems (WRS) allow farmers to store produce and obtain credit against stored grain, reducing the need for immediate sales. Digital literacy initiatives improve farmers' ability to access real-time price information through platforms such as Agmarknet and e-NAM. Farmer Producer Organizations (FPOs) strengthen collective bargaining power and improve market access.

Together, these mechanisms help farmers delay sales, negotiate better prices, and stabilize farm income.

Key Findings:

The results of the primary survey conducted among soybean farmers in Padwa village highlight several structural challenges affecting price realization and income stability.

The study confirms the presence of significant price distress among soybean farmers. As shown in Table 2, nearly 80% of farmers sold soybean below the Minimum Support Price (MSP), receiving an average price of ₹4,102 per quintal compared to the MSP of ₹4,892. This represents a price gap of approximately 16.1%, indicating that government support prices are not fully transmitted to farmers in local markets. The results suggest that many farmers are unable to delay sales until prices improve.

The findings reveal a strong dependence on local traders for price information. Approximately 85% of farmers reported relying on traders to determine market prices. This reliance reduces farmers' bargaining power and contributes to information asymmetry in the marketing process. The dominance of traders in price discovery limits farmers' ability to explore alternative marketing channels.

The study identifies a digital literacy gap despite high levels of smartphone ownership. Although 95% of surveyed farmers reported owning smartphones, only 65% actively used digital platforms to check soybean prices. Among non-users, the majority cited lack of digital skills as the primary barrier. These findings indicate that the issue is not technological access but the ability to effectively utilize digital tools for market participation.

The research highlights a disconnect between storage availability and the use of formal storage financing systems. While most farmers reported having basic storage facilities, only 20% had utilized the Warehouse Receipt System (WRS). As a result, many farmers continue to sell their produce immediately after harvest due to liquidity constraints and uncertainty about future prices.

Overall, the findings suggest that distress selling, trader dominance, and limited adoption of digital and financial tools are key factors contributing to income instability among soybean farmers in Padwa village.

Key Conclusions

Primary survey data (n=20) confirms literature findings while highlighting Harda-specific vulnerabilities: cash needs and price fears force immediate sales, digital skills block e-NAM benefits (65% app use, <10% digital sales), and weak FPOs limit collective power.

Policy Implications

- **Immediate**: Subsidize WDRA warehouse loans to cut distress sales by 50%, targeting medium and semi-medium farmers (<20 acres).
- **Short-term**: Digital literacy camps via KVKs, focusing WhatsApp/e-NAM for 86% "don't know how" barrier.
- **Long-term**: Scale FPOs for aggregation, linking to futures markets post-2025 reforms.

This mixed-methods study provides evidence-based strategies to build resilient soybean marketing in Madhya Pradesh, aligning with Digital Agriculture Mission goals for 30% income uplift by 2027.

Recommendations

1. Encourage WDRA Warehouse Receipt Financing: The 80% who do not use it can access loans with lowered rates utilizing existing credit access (40% use cooperatives/banks). Facilitate 2-3 months storage for 44% who fear a fall in price, preventing losses of approximately ₹39,800 per farmer in distress.

2. Targeted Digital Literacy Training: The key barrier to adoption cited for 86% of non- users of the app ("don't know how," n=6) should be addressed. The successful model for the WhatsApp price groups (adopted by 70% of users of the app) should be upscaled via KVK-led camps. In fact, 75% of users of digital technology had obtained improved prices compared to traders.

3. FPO–Led Collective Marketing: For 85% trader-dependent farmers, aggregation model development should focus on the 20% experienced in WRS. Pilot at Padwa's 300 soybean farmers to mobilize 20% bargaining power benefits from economies of scale routed through sales and storage facilities.

Ethical considerations

The study was conducted according to ethical principles and included informed consent of all participants, confidentiality regarding personal information, and an explanation of the study's purpose. Participants were informed of their right to withdraw from the study at any point, and no sensitive personal data were collected.

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