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# Supply Response of Wheat and Cotton Crops in North Gujarat: Evidence from the Nerlovian Supply Response Model

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Agriculture continues to play a pivotal role in the Indian economy by contributing to food security, employment generation and rural livelihoods. In semi-arid regions such as North Gujarat agricultural production is strongly influenced by market signals as well as agro-climatic and technological factors. Among various crops cultivated in this region, wheat and cotton occupy a prominent position due to their economic importance, acreage share and contribution to farm income. Understanding how farmers respond to changes in prices and non-price factors is essential for designing effective agricultural policies and support mechanisms.

Agricultural supply response refers to the manner and extent to which farmers adjust their cropping decisions, acreage allocation and production levels in response to variations in economic incentives, particularly output prices, input availability, rainfall and technological change. Unlike industrial production, agricultural supply adjustment is constrained by biological processes, seasonal cycles and resource limitations. Consequently, farmers often respond to changes gradually rather than instantaneously.

The Nerlovian Supply Response Model, introduced by Marc Nerlove, has been widely used in empirical agricultural economics to study farmers' production behaviour. The model incorporates the concepts of adaptive price expectations and partial adjustment, allowing for a realistic assessment of short-run and long-run responses. By using lagged prices and adjustment coefficients, the model captures the dynamic nature of farmers' decision-making processes.

In the context of Gujarat, empirical evidence on crop-wise supply response remains limited, particularly for major crops such as wheat and cotton in North Gujarat. Given the increasing volatility in prices, climate variability and changing policy environment, it is important to quantify how farmers respond to both price and non-price factors. This study attempts to fill this gap by analysing acreage, production and yield responses of wheat and cotton using the Nerlovian framework.

The present study was undertaken with the following specific objectives:

- To analyse the acreage response of wheat and cotton crops in North Gujarat
- To examine the production response of wheat and cotton to price and non-price factors
- To estimate short-run and long-run elasticities of supply for both crops
- To derive policy-relevant implications based on empirical findings

Nerlove (1958) introduced the partial adjustment and adaptive expectations framework, showing that farmers adjust acreage gradually rather than instantly. The model explains that current production decisions are influenced by past prices and desired acreage, making it a foundational approach in agricultural supply response analysis.

Askari and Cummings (1977) reviewed global supply response studies and found that agricultural supply is price inelastic in the short run but more elastic in the long run. They

highlighted the importance of institutional factors, technology and resource availability in influencing farmers' supply behaviour.

Rao (1989) found that supply response of major crops in India is strongly influenced by non-price factors such as irrigation, rainfall and yield trends. The study showed that price incentives alone are inadequate, with technological progress playing a key role in long-term output growth.

Mythili (2008) analysed crop-wise supply response in Indian agriculture and observed significant variation across crops, with commercial crops like cotton showing higher price elasticity than cereals. The study also confirmed that long-run elasticities are higher than short-run elasticities due to gradual land adjustment.

Birthal et al. (2021) found that farmers' supply behaviour is shaped by prices, climate variability and risk management strategies. The study highlighted that better access to information, technology and institutional support improves farmers' responsiveness to market signals.

## Study Area and Data

The study focuses on North Gujarat a major agricultural region characterised by semi-arid climate and diversified cropping patterns. Secondary time-series data covering the period 2011–12 to 2024–25 were used for analysis. The data included information on area, production, yield, prices, rainfall and technological trends for wheat and cotton.

## Analytical Framework

The Nerlovian Supply Response Model was employed to analyse farmers' responses. The model assumes that farmers form expectations about prices adaptively based on past prices and adjust their actual acreage or production partially towards the desired level.

Three functional forms were estimated:

- Acreage response model
- Production response model
- Yield response model

Lagged dependent variables were included to capture adjustment behaviour, while lagged prices and non-price variables represented expected incentives and constraints.

- Estimation of Elasticities

Short-run elasticities were computed directly from estimated coefficients, whereas long-run elasticities were derived by adjusting short-run coefficients using the coefficient of adjustment. Statistical significance was tested using standard econometric procedures.

## Acreage Response of Wheat and Cotton

The estimated acreage response functions reveal that farmers in North Gujarat respond to both price and non-price variables. Lagged acreage emerged as a significant determinant, confirming the presence of partial adjustment in farmers' decision-making.

For wheat, the impact of lagged prices was positive but relatively modest, indicating limited short-run price responsiveness. This can be attributed to institutional support mechanisms such as MSP and assured procurement, which reduce market uncertainty. Yield trends and technological improvements also played a significant role in influencing wheat acreage.

In contrast, cotton acreage exhibited a stronger response to lagged prices, reflecting its commercial nature and higher exposure to market signals. Rainfall and yield variability were found to significantly influence acreage decisions, highlighting the crop's sensitivity to climatic conditions.

**Table 1.1 Determinants of Acreage Response of Wheat and Cotton in North Gujarat**

| Variable | Wheat (Sign) | Cotton (Sign) |
|---|---|---|
| Lagged acreage | Positive | Positive |
| Lagged price | Positive | Strongly positive |

| | | |
|---|---|---|
| Yield trend | Positive | Significant |
| Rainfall | Moderate | Significant |
| Technology proxy | Positive | Positive |

## Production Response of Wheat and Cotton

Production response analysis indicates that changes in production are influenced not only by acreage adjustments but also by yield-enhancing factors. For wheat, non-price variables such as technological progress and yield trends had a stronger influence on production compared to prices.

Cotton production, however, responded more significantly to price incentives. The elasticity estimates suggest that cotton farmers adjust production levels more effectively in response to favourable prices, although climatic factors continue to play a crucial role.

The inclusion of lagged production terms confirms that farmers do not instantly adjust output levels, supporting the theoretical assumptions of the Nerlovian model.

## Short-Run and Long-Run Elasticities

The estimated elasticities reveal a clear distinction between short-run and long-run responses. For both crops, long-run elasticities were higher than short-run elasticities, indicating that farmers require time to fully adjust their production decisions.

Cotton exhibited higher price elasticity in both the short and long run compared to wheat. This suggests that price-based policy instruments may be more effective in influencing cotton supply than wheat supply. Wheat supply response, on the other hand, is more dependent on technological interventions and productivity improvements.

**Table 1.2 Short-Run and Long-Run Price Elasticities of Wheat and Cotton**

| Crop | Short-Run Elasticity | Long-Run Elasticity |
|---|---|---|
| Wheat | Low to moderate | Moderate |
| Cotton | Moderate | High |

## Role of Non-Price Factors

Non-price factors such as rainfall, yield trends, and technological change were found to be significant across most models. Rainfall variability particularly affected cotton supply, while wheat production benefited more from technological improvements and stable institutional support.

These findings highlight the limitations of relying solely on price incentives to stimulate agricultural supply. A comprehensive policy approach that integrates price support with investments in irrigation, research and extension services is necessary to enhance supply response sustainably.

**Table 1.3 Relative Importance of Price and Non-Price Factors**

| Factor | Wheat | Cotton |
|---|---|---|
| Price incentives | Moderate | High |
| Rainfall | Moderate | High |
| Technology | High | Moderate |
| Yield trend | High | Moderate |

## Policy Implications

Low short-run price elasticity of wheat suggests that price incentives alone are insufficient, making technological support and input availability crucial. Cotton's higher price responsiveness highlights the importance of stable prices, along with irrigation and risk management measures. Strong long-run elasticities emphasize the need for consistent and stable agricultural policies to encourage sustained supply response.

## Conclusion

The study reveals that wheat and cotton farmers in North Gujarat respond to both price and non-price factors, with cotton showing higher price sensitivity and wheat being more influenced by technology and institutional support. Long-run elasticities exceed short-run elasticities, indicating gradual adjustment and highlighting the need for balanced policies combining price incentives with technological and infrastructural support.

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