

Cotton Cultivation Decisions: An Empirical Study of Acreage Elasticity

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ABSTRACT

The study aimed to analyse the acreage response of cotton cultivation in Rajkot district using the Nerlovian adjustment lag model, with the objective of identifying key factors influencing farmers' decisions on area allocation. A quantitative research design was employed using 15 years of time-series data, and the model incorporated variables such as competing crop area, past prices, past yields, price risk, yield risk, and rainfall. Results showed that the model had high explanatory power with an R^2 of 0.8520, explaining 85.2% of the variation in cotton acreage. The intercept (523,203.16) was statistically significant at the 5% level ($p = 0.016$). The area under groundnut exerted a negative effect (-0.39152, $p = 0.12$), suggesting competition with cotton. Past price (-3.76806, $p = 0.18$), past yield (-12.71739, $p = 0.30$), price risk (33.9989, $p = 0.43$), and rainfall (-8.78208, $p = 0.71$) were all found to be statistically non-significant. In contrast, yield risk emerged as the most influential factor with a large negative coefficient (-62,980.84) and was statistically significant at the 5% level ($p = 0.03$), indicating that higher yield variability strongly discouraged farmers from allocating more land to cotton cultivation. The study concluded that while most explanatory variables did not significantly impact cotton acreage, yield risk played a critical role in influencing farmers' decisions, highlighting the need for improved agronomic practices, technological support, and effective risk management measures to reduce yield uncertainty and stabilize cotton production in the region.

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Keywords: Cotton, Acreage response, Nerlovian adjustment lag model, Rajkot

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1. INTRODUCTION

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Cotton remains a cornerstone of agricultural economies across the globe, particularly in countries like India where it plays a vital role in rural livelihoods, industrial supply chains, and export earnings. As a cash crop with significant economic importance, the decisions farmers make regarding cotton cultivation especially the allocation of land or acreage are influenced by a complex interplay of market signals, policy interventions, climatic conditions, and resource availability (Godara et al., 2015; Agarwal et al., 2023). India's cotton production has shown mixed trends in recent years. National output declined slightly from 336.60 lakh bales in 2022-23 to 325.22 lakh bales in 2023-24, indicating a modest contraction in growth. In contrast, Gujarat's cotton production has steadily increased, rising from 87.95 lakh bales in 2022-23 to 90.57 lakh bales in 2023-24, reflecting a positive growth trajectory (Divya, 2024; Oganja et al., 2024a; Bani et al. 2025; Ghadiya & Maheta, 2018). This upward trend in Gujarat is attributed to improved productivity, which surged from 139 kg/hectare in 1960 to 589 kg/hectare in 2024, driven by hybrid seed adoption and farmer-centric policies. Gujarat stands as the undisputed leader in cotton production within India, contributing a substantial share to both the country's total output and its global export footprint (Bharodia et al. 2025).

34 The state's dominance is reflected in its expansive cultivation area and its impressive
35 production figures in recent years. In addition to genetic advancements, farmers in Gujarat
36 have embraced a suite of modern agronomic practices. Techniques like drip irrigation have
37 optimized water use efficiency (Rohit et al., 2015; Prajapati et al., 2018; Parmar et al., 2024),
38 while integrated pest management and precision farming have helped maintain ecological
39 balance and reduce input costs (Oganja et al., 2024b; Kumar et al., 2024a). These
40 innovations are supported by a strong network of agricultural extension services, research
41 institutions, and government initiatives that promote sustainable and profitable farming
42 (Sathish et al., 2022; Pithiya et al., 2024b; Kumar et al., 2024b). Policies such as the
43 Minimum Support Price (MSP) scheme and procurement operations by the Cotton
44 Corporation of India (CCI) provide financial stability and market assurance to growers,
45 encouraging continued investment in cotton cultivation (Nariya et al., 2024). Beyond its
46 agricultural significance, Gujarat's cotton sector is deeply intertwined with the state's
47 industrial and socio-economic fabric. It supplies raw material to a thriving textile industry,
48 generates employment across rural and urban areas, and sustains the livelihoods of millions
49 of farming families. As such, cotton is not merely a crop in Gujarat it is a strategic asset that
50 underpins the state's economic resilience and global competitiveness in textiles. Rajkot
51 district in Gujarat is a significant cotton-growing region. Farmers here are increasingly
52 adopting sustainable practices under initiatives like the Better Cotton Initiative (BCI), which
53 promotes eco-friendly cultivation and improved livelihoods (Sathish et al., 2019; Pithiya et
54 al., 2024a). Cotton farming faces several constraints including high water requirements,
55 vulnerability to pests like bollworms, and dependence on chemical inputs. Additionally,
56 fluctuating market prices and climate variability can impact yield and farmer income
57 (Ghangale et al., 2018; Vennila et al., 2018; Nakum et al., 2024b).

58 Understanding the elasticity of acreage response to various economic and non-economic
59 factors is crucial for policymakers, agronomists, and stakeholders in the cotton value chain
60 (Kormla et al., 2015; Katariya et al., 2016; Sulthana et al., 2019; Vasoya et al., 2024; Nakum et
61 al., 2024a). Acreage elasticity, in particular, reflects the sensitivity of farmers' planting
62 decisions to changes in prices, input costs, and other incentives. This empirical study aims
63 to quantify and analyse the determinants of acreage allocation for cotton cultivation,
64 shedding light on how farmers respond to changing economic environments in Rajkot
65 district. By employing econometric models and time-series data, this research investigates
66 the extent to which cotton acreage decisions are influenced by price expectations,
67 government support mechanisms, and competing crop profitability. The findings are
68 expected to offer insights into the behavioral patterns of farmers and contribute to more
69 informed agricultural policy design, especially in Rajkot district where cotton is a dominant
70 crop.

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72 **2. MATERIAL AND METHODS**

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74 **2.1 Source of data**

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76 This study was conducted in the year 2025. The study was based on secondary data
77 collected for the period of 15 years from 2010 to 2024. The annual data for related to
78 hectareage and yield was collected from Directorate of Agriculture, Gujarat state,
79 Gandhinagar (DAG). The data pertaining to farm harvest prices was collected from
80 Directorate of Economics and Statistics, DAC & FW, Ministry of Agriculture and Farmers
81 Welfare, Gol, New Delhi. The data related to rainfall was collected for the month of sowing
82 and total annual rainfall.

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84 2.2 Selection of competing crop

85 Selection of competing crops was done on the basis of its total area, sowing season and/or
 86 the magnitude as well as direction of correlation between the areas of these crops. In Rajkot,
 87 district groundnut was selected as competing crop.

88 2.3 Nerlovian adjustment lagged mode

89 This model was applied to examine the acreage response of cotton crop during the 2025.
 90 Cotton acreage was regressed on lagged cotton acreage, lagged cotton price, lagged cotton
 91 yield, price risk, yield risk and pre-sowing rainfall in the selected district area. Using
 92 Nerlovian Adjustment Lag model (Nerlove, 1958) as a basic framework, the form of equation
 93 for the acreage response function is specified as follows for Nerlovian Adjustment Lag
 94 model:

$$95 \quad A_t = a + b_1 A_{t-1} + b_2 RP_{t-1} + b_3 AG_{t-1} + b_4 RY_{t-1} + b_5 PR + b_6 YR + b_7 RF_t + U_t$$

96 Where,

97 a = Intercept

98 A_t = Area in hectares under the crop (Cotton)

99 A_{t-1} = Area in hectares under the crop in the year t-1 (Cotton)

100 AG_{t-1} = Area in hectares under the crop in the year t-1 (Groundnut)

101 b_1 to b_7 = Regression co-efficient

102 RP_{t-1} = Price of crop in year t-1 (Rs/qrtl)

103 RY_{t-1} = Yield of crop in year t-1 (Kg/ha)

104 PR = Price risk measured in terms of standard deviation

105 YR = Yield risk measured in terms of standard deviation

106 RF_t = Total rainfall (mm) in the year t

107 U_t = Random error term

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109 3. RESULTS AND DISCUSSION

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111 To analyze the factors influencing farmers' decisions regarding land allocation for cotton
 112 cultivation, the Nerlovian adjustment lag model was applied using a time-series dataset
 113 consisting of 15 observations. This model is particularly suited for capturing the dynamic
 114 nature of agricultural decision-making, where past behavior and economic variables
 115 influence current choices. The model yielded a high explanatory power, with an R^2 value of
 116 0.8520, indicating that 85.2% of the variation in the area allocated to cotton could be
 117 explained by the independent variables included in the analysis. This strong fit underscores
 118 the relevance of the selected factors in shaping farmers' planting decisions.

119 The intercept of the model, valued at 523,203.16, was statistically significant at the 5% level
 120 ($p = 0.016$), suggesting a solid foundational level of cotton cultivation area even in the
 121 absence of other influencing variables. Among the explanatory variables, the area under
 122 cotton cultivation in the previous period showed a positive coefficient (0.16463), implying that
 123 farmers tend to maintain or slightly increase cotton acreage over time, possibly due to
 124 habitual cropping patterns or infrastructural investments. However, this relationship was not
 125 statistically significant ($p = 0.47$), indicating that inertia alone may not be a strong predictor of
 126 future allocation. In contrast, the area under groundnut cultivation exhibited a negative
 127 coefficient (-0.39152), approaching statistical significance ($p = 0.12$). This suggests a
 128 potential competitive relationship between cotton and groundnut, where an increase in
 129 groundnut acreage may lead to a reduction in cotton area, likely due to resource constraints
 130 or comparative profitability. Such insights are crucial for policymakers and agricultural
 131 planners aiming to balance crop diversification with optimal land use.

132 Economic indicators such as the lagged price of cotton (-3.76806; $p = 0.18$) and previous
 133 year's yield (-12.71739; $p = 0.30$) both had negative but statistically insignificant effects,
 134 implying that past market performance did not strongly influence current planting decisions.
 135 This suggests that farmers in the study region may not rely heavily on past price trends or
 136 yield outcomes when planning their crop area, possibly due to limited access to market
 137 intelligence or a lack of trust in price stability. Price risk, measured by the standard deviation
 138 of cotton prices, had a positive coefficient (33.9989), suggesting that volatility might
 139 encourage planting, yet its impact was not statistically validated ($p = 0.43$) but hinting that
 140 some farmers might perceive volatility as an opportunity for higher returns. However, its lack
 141 of statistical significance indicates that this perception is not widespread or influential enough
 142 to drive planting decisions. In contrast, Yield risk was identified as the most influential factor
 143 affecting farmers' decisions on cotton area allocation, as evidenced by its significantly
 144 negative coefficient of -62,980.84 and a p-value of 0.03. This statistical significance
 145 underscores the strong deterrent effect that uncertainty in crop yield has on farmers'
 146 willingness to commit land to cotton cultivation. The magnitude of the coefficient suggests
 147 that even moderate increases in yield variability can lead to substantial reductions in the
 148 area planted with cotton. This finding reflects the deep vulnerability of farmers to production
 149 shocks, such as pest outbreaks, erratic weather, or soil degradation, which can severely
 150 impact harvest outcomes. Given their limited capacity to absorb such risks, farmers tend to
 151 adopt a cautious approach, preferring crops with more predictable returns. The aversion to
 152 yield risk highlights the need for targeted interventions—such as improved access to crop
 153 insurance, adoption of resilient seed varieties, and enhanced extension services—to mitigate
 154 uncertainty and build confidence among growers. Addressing yield volatility is therefore
 155 essential not only for stabilizing cotton production but also for supporting the economic
 156 security of farming communities. Rainfall had a minor negative effect (-8.78208; $p = 0.71$),
 157 but it was statistically insignificant effect, possibly due to irrigation coverage or variability in
 158 rainfall patterns.

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 160 Overall, the analysis revealed that while several variables influenced cotton area allocation,
 161 yield risk was the most decisive and statistically significant factor shaping farmers' choices
 162 during the study period. Given these insights, policy interventions should prioritize reducing
 163 yield uncertainty to encourage cotton cultivation. This could include promoting climate-
 164 resilient seed varieties, expanding access to crop insurance, and improving extension
 165 services that offer timely agronomic advice. Additionally, enhancing farmers' access to
 166 reliable market information and forecasting tools could help them make more informed
 167 decisions, potentially increasing their responsiveness to price signals. By addressing both
 168 production and information risks, stakeholders can foster a more stable and confident
 169 environment for cotton growers.

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 171 **Table 1. Acreage response of Cotton crop in Rajkot district**

Variables	Coefficient	P Value
Intercept	523203.16	0.016**
Area in hectares under the Cotton crop (ha)	0.16463	0.47 ^{NS}
Area in hectares under the Ground nut crop (ha)	-0.39152	0.12 ^{NS}
Price of crop in year t-1(Rs/qttl)	-3.76806	0.18 ^{NS}
Price of crop in year t-1 (qttl/ha)	-12.71739	0.30 ^{NS}
Price risk (Standard deviation)	33.9989	0.43 ^{NS}
Yield risk (Standard deviation)	-62980.84	0.03**
Rainfall (mm)	-8.78208	0.71 ^{NS}
R ² = 0.8520		
n = 15		

d.f. = 14

172 *NS = Non-significant, ** Significant at 5 per cent level*

173 **4. CONCLUSION**

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175 The Nerlovian adjustment lag model revealed that 85.2% of the variation in cotton cultivation
 176 area in Rajkot district could be attributed to the selected explanatory variables,
 177 demonstrating strong predictive capability. Although the area under cotton showed a positive
 178 association with future allocation, the effect was statistically insignificant, indicating limited
 179 influence. In contrast, the area under groundnut exerted a negative impact, suggesting a
 180 competitive relationship between the two crops for land resources. Other factors such as
 181 past cotton prices, previous yields, and rainfall did not significantly affect farmers' decisions
 182 on area allocation. Notably, yield risk emerged as the most influential determinant, with a
 183 substantial and statistically significant negative effect. This finding highlights that greater
 184 uncertainty in crop yield strongly discourages farmers from dedicating land to cotton, making
 185 yield risk the dominant factor shaping acreage decisions in the region.
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201 **REFERENCES**

202

- 203 Agarwal, D, Shitap, M. S. & Patel, D. V. (2023). Study on hectareage response of cotton
 204 crop in the Amreli district of Gujarat. *International Journal of Statistics and Applied*
 205 *Mathematics*, 8(5), 153-156.
- 206 Bani, R. J., Maheta, H. Y., Bharodia, C. R., & Kumar, K. (2025). Identification of mutation
 207 point and trend in export of Indian groundnut. *Journal of Agriculture and Ecology*
 208 *Research International*, 26(5), 24-31.
- 209 Bharodia, C. R., Lakhani, C. D., Maheta, H. Y. & Kumar, K. (2025). Market integration and
 210 price transmission in fruits price export from India. *Plant Archives*, 25(Special
 211 Issue), 627-632.
- 212 Divya, S. (2024). Gujarat remains top in India's cotton production and exports. *The Indian*
 213 *Textile Journal*. Available at < [https://indiantextilejournal.com/gujarat-remains-top-](https://indiantextilejournal.com/gujarat-remains-top-in-indias-cotton-production-and-exports/)
 214 [in-indias-cotton-production-and-exports/](https://indiantextilejournal.com/gujarat-remains-top-in-indias-cotton-production-and-exports/)>.
- 215 Ghadiya, M. & Maheta, H. Y. (2018). Trend of area, production and productivity of groundnut
 216 in Gujarat. *AGRES – An International e. Journal*, 7(3), 355-360.
- 217 Ghangale, S. N., Maheta, H. Y., & Khunt, K. A. (2018). Constraints faced by the farmers in
 218 relation to organic fertilizers. *International Journal of Agriculture Sciences*, 10(17),
 219 7102-7103.
- 220 Godara, A. S., Poonia, U., Bishnoi, D. K. & Prakash, S. (2015). Prices acreage response of
 221 American cotton in Haryana. *Indian J. Agric. Res.*, 49 (2), 142-147.

- 222 Katariya, B. B., Maheta, H. Y., Kalsariya, R., Khorajiya, M., & Chaudhari, V. P. (2016). A
223 study on marketing of milk in Junagadh district of Gujarat. *Advances in Life*
224 *Sciences*, 5(1), 239-246.
- 225 Kormla, G. S., Maheta, H. Y., Kumar, K., Bharodia, C., & Chaudhari, V. (2015). Impact of
226 ICT on the supply chain management of seed companies. *Trends in Biosciences*,
227 8(10), 2675-2678.
- 228 Kumar, N., Maheta, H. Y., Kumar, K., & Bharodia, C. R. (2024a). Perception towards plant
229 growth regulators among vegetable growers in Junagadh district of Gujarat, India.
230 *Asian Journal of Advanced Agricultural Research*, 24(8), 93-101. DOI:
231 <https://doi.org/10.9734/ajaar/2024/v24i8539>
- 232 Kumar, N., Maheta, H. Y., Kumar, K., & Bharodia, C. R. (2024b). Discriminant analysis of
233 plant growth regulators among vegetable growers in Junagadh district of Gujarat,
234 India. *Asian Research Journal of Agriculture*, 17(4), 88-99. DOI:
235 <https://doi.org/10.9734/arja/2024/v17i4503>
- 236 Nakum, M. M., Patel, R. M., Kotvaliya, N. A., & Gohil, M. B. (2024a). An analysis of
237 marketing status of Bt cotton seed in Devbhumi Dwarka district, Gujarat, India.
238 *Asian Journal of Agricultural Extension, Economics & Sociology*, 42(12), 21–
239 26. <https://doi.org/10.9734/ajaees/2024/v42i122624>
- 240 Nakum, M. M., Patel, R. M., Kotvaliya, N. A., & Gohil, M. B. (2024b). Analysis of constraints
241 faced in the Bt cotton seed market in Devbhumi Dwarka district. *Asian Research*
242 *Journal of Agriculture*, 17(4), 844–848. <https://doi.org/10.9734/arja/2024/v17i4594>.
- 243 Nariya, Y. H., Bharodia, C. R., Maheta, H. Y., Kumar, K., Patel, D. J., & Kumar, N. (2024).
244 Constraints faced by bt cotton seed companies in Gujarat: A comprehensive
245 analysis. *Asian Journal of Research in Agriculture and Forestry*, 10(4), 223-230.
246 DOI: <https://doi.org/10.9734/ajraf/2024/v10i4331>.
- 247 Nerlove, M. (1958). Dynamics of supply estimation of farmers response to price. John
248 Hopkins Press, Baltimore.
- 249 Oganja, Y. H., Maheta, H. Y., Kumar, K., & Bharodia, C. R. (2024a). Identification of
250 mutation point and trend analysis of area, production, and yield of wheat crop in
251 Gujarat, India. *Asian Research Journal of Agriculture*, 17(4), 150-156. DOI:
252 <https://doi.org/10.9734/arja/2024/v17i4510>
- 253 Oganja, Y. H., Maheta, H. Y., Kumar, K., & Bharodia, C. R. (2024b). Factors influencing
254 farmers' purchase intention toward insecticides of Rajkot district, India. *Archives of*
255 *Current Research International*, 24(8), 67-74. DOI:
256 <https://doi.org/10.9734/acri/2024/v24i8849>
- 257 Parmar, A. B., Bharodia, C. R., Maheta, H. Y., & Kumar, K. (2024). Assessment of farmer's
258 attitude towards drip and traditional irrigation system in Junagadh district, Gujarat.
259 *Asian Journal of Advanced Agricultural Research*, 24(10), 53-59. DOI:
260 <https://doi.org/10.9734/ajaar/2024/v24i10556>
- 261 Pithiya, K. N., Maheta, H. Y., Kumar, K., & Bharodia, C. R. (2024a). Adoption of bio-pesticide
262 among the farmers through internet usage in Junagadh district of Gujarat.
263 *International Journal of Bio-resource and Stress Management*, 15(12), 1-7. DOI:
264 <https://doi.org/10.23910/1.2024.5664>
- 265 Pithiya, K. N., Maheta, H. Y., Bharodia, C. R., & Kumar, K. (2024b). Bridging the gap:
266 Factors influencing farmers' willingness and behaviour in biopesticide application.
267 *Journal of Agriculture and Ecology Research International*, 25(5), 1-6. DOI:
268 <https://doi.org/10.9734/jaeri/2024/v25i5623>.
- 269 Prajapati, G. V., Subbaiah, R., Vithlani, N. S., Maheta, H. Y., Makwana, J. J. & Patel, P. V.
270 (2018). Conjunctive stimulus of irrigation regimes frequency and mulching on bt.
271 Cotton. *Innovative Farming*, 3(2), 51-54.
- 272 Rohit, B. R., Maheta, H. Y., Khorajiya, M. H., & Chaudhari, V. P. (2015). Current status,
273 potential and economics of micro irrigation system in Sabarkantha district of
274 Gujarat. *Trends in Biosciences*, 8(9), 2446-2454.

- 275 Sathish, K. M., Maheta, H. Y., Kumar, K., Bharodia, C. R., & Srinivas, M. (2019). Factors
276 affecting the adoption of water soluble fertilizers by banana growers in Trichy
277 district, Tamil Nadu. *International Journal of Agriculture Sciences*, 11(12), 8645-
278 8646.
- 279 Sathish, K. M., Maheta, H. Y., Lad, Y. A., & Mahera, A. B. (2022). Factors influencing
280 banana growers to purchase water soluble fertilizers in Trichy district, Tamil Nadu.
281 *British Journal of Marketing Studies*, 10(4), 55-63.
- 282 Sulthana, R., Kumar, K., Maheta, H., Bharodia, C., & Doke, V. Y. (2019). Marketing
283 distribution channel of tomato at Madanapalle block of Chittoor district in Andhra
284 Pradesh. *International Journal of Agriculture Sciences*, 11(15), 8841-8843.
- 285 Vasoya, P. R., Maheta, H. Y., Bharodia, C. R., & Kumar, K. (2024). Analysis of marketing
286 channels, price spread, and costs of wheat in Junagadh district of Gujarat, India.
287 *Asian Journal of Advanced Agricultural Research*, 24(9), 68-74. DOI:
288 <https://doi.org/10.9734/ajaar/2024/v24i9547>
- 289 Vennila, M., Lakhlani, C. D., & Maheta, H. Y. (2018). Constraints faced by the groundnut
290 farmers in adoption of organic fertilizers. *AGRES - An International e-Journal*, 7(2),
291 220-225.
292
293
294