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Assessing the Profitability of Cotton Cultivation in Northern Gujarat

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Abstract

Cotton has been a leading cash crops in India since the introduction of Bt technology, ever since farmers in Gujarat shown enthusiastic adoption. The state recorded agricultural growth rate more than double the national average between 2001–02 and 2014–15, a trend largely attributed to the widespread adoption of Bt cotton. This study, conducted in the northern districts of Gujarat viz. Patan and Mehsana, assessed the economics of cotton cultivation by analysing input costs and returns. A detailed analysis in both districts revealed that labour constituted the largest portion of the total cultivation cost. Additionally, expenses related to machinery for land preparation and pesticides were also significant. Mehsana farmers achieved higher net returns of Rs. 80,952.16/ ha with operational costs of Rs. 74,438.58/ha, while Patan farmers had lower returns of Rs. 57,127.22/ha on costs of Rs. 75,451.78/ha. The Benefit-Cost Ratio (BCR) over variable costs was observed to be 2.09 for Mehsana and 1.76 for Patan. The study further observed that, in recent years, cotton is increasingly being adopted by large farmers, as the effectiveness of Bt cotton against bollworms has declined. This trend highlights the need for renewed efforts in pest management and technological advancement to strengthen cotton productivity and help transition India from being a net importer to a net exporter of cotton.

Keywords: Bt Cotton, Cash crop, Economics, Labour cost

JEL Classification: Q12, Q16, Q10

Introduction

Agriculture plays a foundational role in the global economy, serving as a primary source of food, raw materials, and employment. According to the World Bank (2024), agriculture contributes nearly 4 per cent to the global Gross Domestic Product (GDP). However, its significance is far greater in developing and least-developed countries, where it often accounts for 25 per cent or more of national GDP and serves as the main livelihood for a large portion of the population. It also underpins global food security and is critical to reducing poverty, especially in rural areas.

In the case of India, agriculture is not only a key economic sector but also a major driver of socio-economic development. As per the Economic Survey of India (2024), agriculture and allied sectors contribute approximately 18 per cent to the country's GDP and provide employment to about 43 per cent of the total workforce. It supports the livelihoods of over half a billion people, either directly or through allied activities like dairy, fisheries, and agro processing. India's vast agro-ecological diversity allows for the cultivation of a wide range of crops, making it a global leader in the production of rice, wheat, cotton, pulses, and spices. Given its economic, social, and strategic importance, agriculture remains central to India's development agenda, especially in the context of ensuring food security, improving rural incomes, and achieving sustainable growth.

Cash crops have long been central to the evolution of agriculture, trade, and rural economies. Unlike subsistence crops, which are grown primarily for household consumption, cash crops are cultivated for sale in domestic and international markets, providing farmers with income and linking agriculture to broader economic systems. Common cash crops include cotton, sugarcane, tea, coffee, tobacco, oilseeds, and spices, all of which contribute significantly to employment, export revenues, and value-added industries.

Historically, cash crops played a transformative role in shaping colonial trade networks and industrial development. For instance, cotton was a key raw material during the Industrial Revolution, feeding the textile mills of Britain and driving demand for plantation labour in colonized countries (Beckert, 2014). Sugarcane plantations in the Caribbean and South America fuelled the global sugar trade while reinforcing colonial economies. These crops not only influenced economic patterns but also had profound social and

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political consequences, including the expansion of slavery, land alienation, and monoculture-based farming systems.

In the modern context, they remain vital for the economies of many developing countries. Agricultural exports predominantly consisting of cash crops play a major role in generating foreign exchange and boosting GDP, particularly in Sub-Saharan Africa, Southeast Asia, and Latin America. For example, coffee and cocoa are critical exports for countries like Ethiopia and Ghana, respectively (FAO, 2022).

In India, cash crops such as cotton, sugarcane, tea, coffee, oilseeds, and spices are significant both economically and socially. As per the GoI (2023), these crops contribute substantially to India's export earnings, while supporting millions of small and marginal farmers. Cotton alone forms the backbone of India's large textile and garment industry, which is a major employment generator. Similarly, sugarcane sustains a vast agro-industrial network of sugar mills and ethanol production units.

Moreover, these crops encourage agribusiness development, rural employment, and diversification of farm income, especially in regions with suitable agro-climatic conditions. With increasing integration into global value chains, they offer opportunities for farmers to access international markets, adopt improved technologies, and shift toward higher-value agriculture. However, the dependence on cash crops also brings challenges such as price volatility, climate vulnerability, and monoculture risks, underscoring the need for sustainable and diversified cropping systems.

Cotton has held exceptional historical significance as one of the most influential and traded agricultural commodities in the world. Often referred to as "white gold," cotton has shaped the course of global trade, industrialization, and colonial expansion. Its utility as a soft, breathable fibre made it an essential material for textile production across civilizations.

Globally, cotton was a major driver of the Industrial Revolution in the 18th and 19th centuries. The demand for raw cotton surged as mechanized spinning and weaving technologies advanced in Europe, particularly in Britain. According to Beckert (2014), cotton became the foundation of the modern capitalist economy—linking enslaved labour in the American South with industrial manufacturing in Europe and creating the first truly global supply chains. The transatlantic cotton economy not only fuelled massive profits but also reinforced systems of slavery, colonization, and environmental transformation. By the 19th century, cotton had become the world's most important commodity, surpassing even sugar and tea.

Cotton also played a key role in colonial agricultural systems, especially in Africa, the Americas, and Asia, where colonial powers enforced cotton cultivation to serve the needs of European industries. This led to widespread changes in traditional farming systems, often prioritizing cotton over food crops and causing long-term socio-economic and ecological impacts.

In India, cotton has been cultivated for over 5,000 years, making it one of the earliest centres of cotton domestication and textile innovation. The Indus Valley Civilization (circa 3000 BCE) used cotton fibres for spinning and weaving garments, with archaeological findings in sites like Mohenjo-daro indicating sophisticated textile practices. Ancient Indian cotton textiles were highly valued in global trade, particularly in Egypt, Mesopotamia, and later the Roman Empire.

During the medieval and early modern periods, India was a global leader in fine cotton textiles, especially the famed muslins of Bengal and chintz of Gujarat. These products were exported in large volumes through maritime and overland trade routes. However, the British colonial era marked a major shift. The British East India Company imposed policies that deindustrialized Indian textile manufacturing, forcing India to export raw cotton to British mills while importing finished textiles. This resulted in the decline of India's indigenous handloom industry and created a raw-material-export-dependent economy.

Cotton also became a symbol of resistance during India's freedom struggle. Mahatma Gandhi's Swadeshi Movement and the promotion of khadi (hand-spun cotton cloth) encouraged Indians to boycott British textiles and revive domestic weaving. Khadi emerged as a powerful tool for self-reliance and national identity.

Even today, cotton remains central to India's agrarian and industrial landscape. India is one of the largest producers and consumers of cotton globally, supporting millions of farmers and feeding a vast textile industry that is a cornerstone of the national economy.

Cotton is considered one of the most vital commodities worldwide, largely because of its stable role as a primary raw material in the textile sector. Its significance is evident from the fact that cotton is the only commodity addressed separately at the World Trade Organization (WTO), underscoring its critical role in supporting the livelihoods of a large segment of the farming population, particularly in developing and least developed countries (Yadav and Chattopadhyay, 2024). Ensuring fair trade, stable prices, and support for sustainable cotton farming practices is thus vital for global efforts aimed at poverty reduction, food security, and inclusive economic growth. In 2025, India is projected to be the largest cotton producer, with 7.22 million metric tonnes, driven by its extensive cultivation area and Bt cotton adoption. The USA is expected to have the highest yield due to advanced mechanization and efficient practices and will also remain the top exporter, shipping 3.04 million metric tonnes. Meanwhile, China will lead in both consumption

(7.74 MMT) and imports (2.22 MMT), reflecting its dominant textile industry. These projections highlight India's production strength, the USA's export capacity, and China's central role in global cotton demand (ICAC, 2022)

It is one of the most significant cash crops in India and holds the distinction of being among the first crops in the country to undergo genetic modification. India accounts for approximately 25 per cent of the world's total cotton production, highlighting its global importance (Yadav and Chattopadhyay, 2024). In the 2024–25 season, India recorded 11.29 million hectares under cotton cultivation, representing 5.16 per cent of the total cultivated area. The average yield was estimated at 2.38 bales (170 Kg each) per hectare (CAI, 2025). Cotton production in India has risen significantly, increasing from 140 lakh bales in 2001 to 294.25 lakh bales in the 2024-25 season (CIA, 2022; GoI, 2024). The states like Maharashtra, Gujarat, Telangana, Karnataka and Rajasthan are leading state in the cotton cultivation in the country.

The cotton plant belongs to the genus Gossypium, which comprises over 50 species, but only four are domesticated for commercial cultivation. These include two old world species *Gossypium arboreum* and *Gossypium herbaceum*, native to the Indian subcontinent and Africa, respectively—and two New World species *Gossypium hirsutum* and *Gossypium barbadense*, originating in Central and South America. Among them, *Gossypium hirsutum*, commonly known as upland cotton, accounts for nearly 90 per cent of global cotton production due to its high yield and adaptability to diverse climates. *Gossypium barbadense*, known for its extra-long staple fibres, is valued for its superior quality and is cultivated primarily in Egypt, the U.S., and parts of South America.

Gujarat has experienced a notable expansion in cotton cultivation following the introduction of Bt cotton in India. This shift came largely at the expense of foodgrain crops, as farmers increasingly opted for cotton due to its higher profitability and improved yields. As a result, cotton's share in the state's gross cropped area (GCA) rose substantially from 11 per cent during the triennium ending (TE) 1994-95 to 20.6 per cent in TE 2014–15 highlighting a significant structural transformation in Gujarat's cropping pattern (Gulati *et al,* 2021). In 2023-24 state has 2.68 million hectares land under cotton which was 36.58 per cent of total kharif area (GoG, 2024).

Considering these facts, it becomes essential to assess the economics of cotton cultivation to identify the key cost components, evaluate the potential for improving returns over costs, and understand the actual income farmers derive from cotton farming. To address these questions, the present study was undertaken in two districts of North Gujarat, namely Patan and Mehsana, with the objective of estimating the economic viability of cotton cultivation in the region.

Data Sources and Methodology

This study forms part of a broader research initiative aimed at estimating water productivity in crops and livestock by comparing water-saving technologies with conventional irrigation methods. Specifically, this paper focuses on cotton cultivation and draws on primary data collected from farmers during the kharif season of 2024. The sample includes 5 marginal farmers (holding <1 ha), 16 small farmers (1–2 ha), and 30 semi-medium farmers (2–4 ha) and 11 Medium farmers (4-10 ha) from the study area.

The research was conducted in two districts of North Gujarat Patan and Mehsana. A multistage sampling approach was employed. In the first stage, blocks were purposively selected based on the prevalence of water-saving technologies, using secondary data from government sources. In the second stage, villages within these blocks based on highest adoption in the blocks were selected, followed by random selection of farmers.

To fulfil the objectives of the study, descriptive statistical tools such as frequencies, averages, and percentages were used for analysis.

Gross return- It was computed by multiplying the yield per hectare with the price received by farmers for their produce.

Gross returns (Rs./ha) = Yield (quintals/ha) × Price received by farmers (Rs./kg)

Net returns- It was calculated by subtracting the total variable cost per hectare from the gross returns in cotton cultivation.

Net returns (Rs./ha) = Gross returns (Rs./ha) – Total variable cost (Rs./ha)

Benefit-cost ratio over variable cost

The Benefit-Cost ratio (BCR) helps in assessing the profitability of an activity by comparing the benefits gained to the costs incurred. It was also used in this study to evaluate the economic viability of cotton cultivation.

$$BCR = \frac{Gross\ Returns}{Total\ Variable\ Cost}$$

Results and Discussion

Profile of sample household heads

Socio-economic characteristics such as education and landholding size have been widely recognized in various studies as key determinants of a farmer's ability to make risk-oriented decisions, adopt new technologies, optimize the use of available resources and more (Mittal and Mehar, 2015; Kaur *et al,* 2017).

Table 2 presents the socio-economic characteristics of cotton cultivators in the study districts. A close examination reveals that the average age of the household head was

Table 1: Overview of cotton cultivators by district, block, and village (Kharif 2024)

District	Block	Village	Adopters
Patan	Siddhpur	Nagvasan, Lukhasan	31
	Patan	Sariyad, Sampra	
Mehsana	Satlasana	Vaghar, Isakpura	31
	Kheralu	Moti hiravani, Gajipur	
	Total farmers		62

47 years in Patan and 46 years in Mehsana. The average farming experience was 25 years in Patan and 24 years in Mehsana. The average size of holding was 3.34 and 2.81 hectares in Patan and Mehsana, respectively. According to the Agriculture Census 2015–16, the average size of holding was 2.10 and 1.22 hectares in Patan and Mehsana, respectively. (GoG, 2020). In Patan, most cultivators had education up to matriculation (48.39%), followed by those in the illiterate category (19.35%). In contrast, in Mehsana, most cultivators had attained education up to senior secondary level (35.49%), followed by illiterates (29.03%).

Contributors to the total operational cost in cotton cultivation

Table 3 presents the operational costs incurred by farmers in the study districts. The costs are categorized across various components such as land preparation, seed, farmyard manure (FYM), pesticides (including herbicides, insecticides, and fungicides), different types of fertilizers, and labour associated with activities like sowing, weeding, fertilizer application, pesticide spraying, machinery cost incurred for bund raising and intercultural operations. It also includes electricity charges for irrigation and interest on working capital.

In both districts, labour emerged as the largest contributor to total operational costs, accounting for 27.45 per cent in Patan and 35.58 per cent in Mehsana. Similar findings were reported in a study on the cost structure of Bt cotton conducted in South Gujarat (Khichadiya and Makadia, 2020).

Pesticide application (12.24%) and land preparation activities such as ploughing and harrowing (9.97%) were the next major contributors to the total operational cost in Patan. In contrast, Mehsana showed a reverse trend, where land preparation ranked second after labour, contributing 12.98 per cent, followed closely by pesticide application at 12.83 per cent of the total operational cost in cotton cultivation.

The higher electricity cost in Patan district compared to Mehsana was attributed to fixed electricity charges based on the horsepower (HP) of the irrigation pumps. In Patan, due to a deeper water table, farmers were required to use higher HP pumps to extract water, resulting in increased electricity expenses.

Table 2: Socio-economic characteristics of sample cotton cultivators (Kharif 2024)

Sr. No.	Particulars	Patan	Mehsana	χ^2 Statistics
1)	Average age (yrs.)	47	46	-
2)	Average experience of farming (yrs.)	25	24	
3)	**Education level**			
a)	Illiterate	6 (19.35)	9 (29.03)	5.51 (p=0.239>0.5)
b)	Up to matriculation	15 (48.39)	8 (25.81)	
c)	Up to 10+2	5 (16.13)	11 (35.49)	
d)	Graduate	3 (9.68)	2 (6.45)	
e)	Post-graduate	2 (6.45)	1 (3.22)	
4)	Average size of holding (ha)	3.34	2.81	

Note: - 1) Figures in parentheses indicate percentages to total educated cultivators in respective district
2) χ^2 at 5 df (alpha= 0.05) is 9.48 means there is no significant difference between education level between two districts.

Table 3: Breakdown of operational cost incurred in cotton cultivation (Kharif 2024)

Sr. No.	Particulars	PATAN		MEHSANA	
		Cost (Rs/ ha)	Share (%)	Cost (Rs/ ha)	Share (%)
1)	Land preparation (ploughing, harrowing)	7519.47	9.97	9658.68	12.98
2)	Seed	2643.53	3.50	2456.42	3.30
3)	FYM	6934.29	9.19	5051.12	6.79
4)	Pesticides	9232.76	12.24	9549.3	12.83
5)	**Fertilizers**				
a)	Urea	1266.68	1.68	1913.41	2.57
b)	DAP	5482.63	7.27	6418.09	8.62
c)	12:32:16	4444.18	5.89		
6)	**Labour cost**				
a)	Field preparation	1119.19	1.48	1459.5	1.96
b)	Sowing	1483.81	1.97	1553.66	2.09
c)	Weeding	4270.08	5.66	8474.52	11.38
d)	Fertilizer application	1120.52	1.49	1518.34	2.04
e)	Pesticide application	828.62	1.10	790.97	1.06
f)	Harvesting	11884.50	15.75	12543.63	16.85
7)	Bund raising	1668.00	2.21	2764.29	3.71
8)	Interculture operation	6759.44	8.96	6672	8.96
9)	Electricity charges	6242.57	8.27	1097.42	1.47
10)	Interest on working capital @ 7% per annum for 6 months	2551.51	3.38	2743.48	3.38
	Variable cost	75451.78		74438.58	

Table 4 presents the returns from cotton cultivation in both study districts. The analysis indicates that Mehsana holds a clear advantage over Patan in terms of profitability from cotton farming. Farmers in Mehsana earned Rs. 80,952.16 per hectare, whereas those in Patan earned Rs. 57,127.22 per hectare. This substantial difference in returns is primarily attributed to higher yields in Mehsana, where farmers harvested 23.12 quintals per hectare compared to 19.63 quintals in Patan. The similar yield was also reported by other study (Khichadiya and Makadia, 2020; Meena, 2017).

Notably, the cost of cultivation and market prices remained largely similar between the two districts. The Benefit-Cost ratio (BCR) over variable costs was also calculated. It was found that Mehsana recorded a BCR of 2.09, indicating that for every one rupee

Table 4: Returns from cotton cultivation (Kharif 2024)

Particulars	Patan	Mehsana
Variable cost (Rs. /Ha)	75454.78	74438.58
Price (Rs/q)	6754.05	6721.05
Yield (q/ha)	19.63	23.12
Gross returns (Rs./Ha)	132582	155390.7
Net returns (Rs. / Ha)	57127.22	80952.16
BCR over variable cost	1.76	2.09

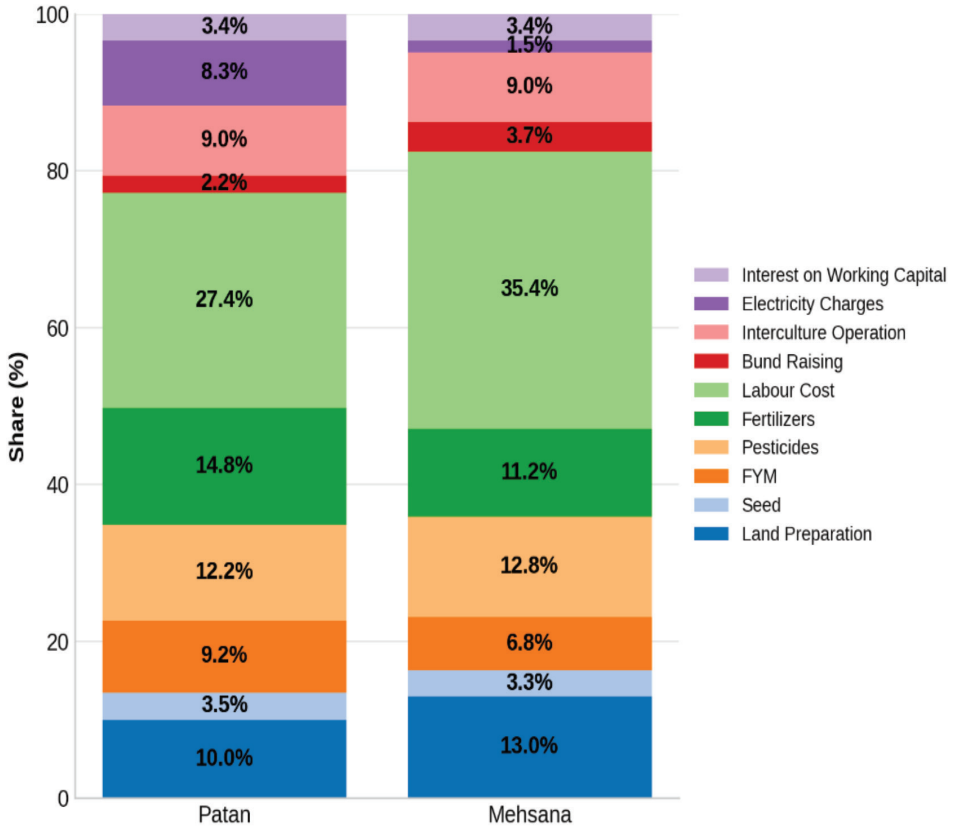

Fig. 1. Contribution of various inputs to total cost of cotton cultivation across selected districts

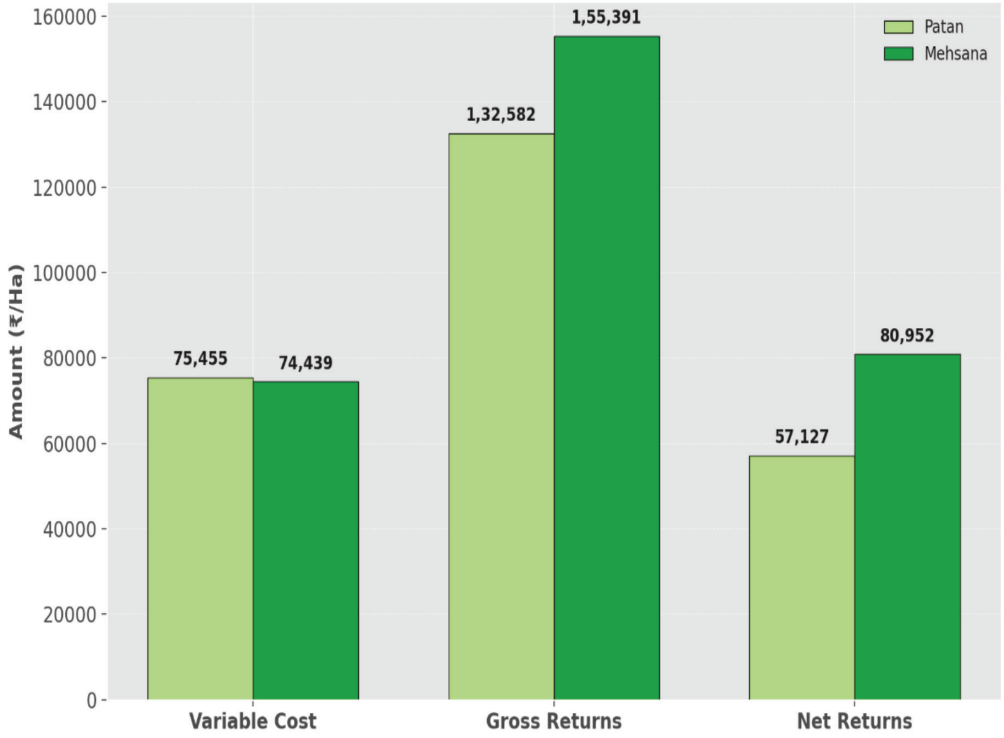

Fig. 2. Comparison of variable cost and returns from cotton cultivation across selected districts

invested in cotton cultivation, farmers earned Rs. 2.09. In comparison, Patan had a BCR of 1.76. The significantly higher yield per hectare in Mehsana was the primary factor contributing to the disparity in BCR between the two districts.

Conclusions and Policy Implications

The economic analysis of cotton cultivation in the northern districts of Gujarat Mehsana and Patan revealed that cotton is a labour-intensive crop, with labour being the largest component of the total operational cost. Other major contributors to the cost of cultivation included land preparation and pesticide use. This is expected, as achieving good yields in cotton requires effective protection against bollworm, and recent outbreaks of pink bollworm have intensified farmers' concerns. The study also found that cotton cultivation was more profitable in Mehsana than in Patan, primarily due to higher yields in Mehsana. Additionally, the findings indicated a trend where larger farmers were more likely to opt for cotton as a Kharif crop, given its relatively higher costs and associated pest risks. This highlights the need for policymakers to promote awareness and adoption of Integrated Pest Management (IPM) practices. Such initiatives are crucial, as cotton continues to be a vital cash crop in the state's agricultural economy.

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