



Exploring Cotton Crop Profile In India

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Abstract: This study aims to analyze the significance, cultivation practices, and challenges of cotton production in India, emphasizing its role in the agricultural and industrial sectors. Cotton, a major fibre-cash crop, supports over 40 million livelihoods and serves as a primary raw material for textiles. India uniquely grows all four cotton species: *Gossypium arboreum*, *G. hirsutum*, *G. herbaceum*, and *G. barbadense*. However, production is hindered by pests, water scarcity, and market volatility. Optimal cultivation requires specific climatic conditions, well-drained soils, and efficient irrigation methods. Addressing these constraints through improved practices and infrastructure is essential for enhancing productivity and ensuring sustainability.

Key Words: Cotton, constraints, pest management, production, fertilizer.

I. INTRODUCTION

Cotton is one of the major fibre-cash crops and holds a dominant position in both agricultural and industrial sectors of the economy. It not only serves as the primary source of raw material for the cotton textile industry but also provides livelihood opportunities to over 40 million individuals who are involved in cotton trade and processing. India has three primary cotton growing regions, namely the north zone (comprising Punjab, Rajasthan and Haryana), the central zone (comprising Madhya Pradesh, Gujarat and Maharashtra) and the south zone (comprising Andhra Pradesh, Telangana, Tamil Nādu, and Karnataka). Additionally, cotton farming has become a major activity in non-traditional states like Uttar Pradesh, Tripura and West Bengal. Cotton cultivation involves specific practices tailored to the varied agro-climatic conditions across India. From soil preparation and seed selection to pest management and irrigation techniques, the process demands a delicate balance of traditional knowledge and modern agricultural advancements. However, the sector is fraught with challenges. Farmers contend with issues such as erratic monsoons, soil degradation, pest infestations.

II. OBJECTIVES:

This article intends to explore the significance of cotton as a key cash crop, delves into its cultivation practices, and examines the challenges faced by farmers from soil preparation, seed selection, weed control to pest management and irrigation techniques. Furthermore, the article delves into different Government assistance available to the farmers.

III. CULTIVATED VARIETIES

Gossypium arboreum, *G. hirsutum*, *G. herbaceum* and *G. barbadense* are the four cultivated species of cotton in India. *G. herbaceum* and *G. arboreum* are diploid in nature and are grown in Asia, whereas *G. hirsutum* and *G. barbadense* are tetraploid in nature and often referred to as New World Cottons. It is American or upland cotton (*G. hirsutum* variety), which is the most predominant species contributing to around 90 % of the global cotton production. Amongst the four varieties, *G. barbadense* is referred to as Sea Island Cotton or Tanguish quality cotton. In fact, India has been recognized as the only country specializing in commercial cultivation and sale of all four cultivated species of cotton.

IV. MAJOR CONSTRAINTS IN COTTON PRODUCTION

The major constraints faced by the farmers during cotton production are:

- Pests and diseases are highly associated with the cotton crop due to its succulent leaves, cultivation in hot and humid climates, long growing seasons, and many fruiting bodies. Indiscriminate use of irrigation, fertilizers, and plant protection chemicals is another major problem associated with cotton cultivation practices as it leads to the resistance of insecticides in insects and pests. Many farmers are unaware of the appropriate application of pesticides, insecticides, and other plant protection chemicals. Infestation of pests increases in multitudes due to improper crop rotation practices by the farmers.
- Water logging and salinity are the major problems of irrigated areas of the North Zone.
- There is the issue of humidity strain during the blooming and boll production, especially in the southern and central zones of India,
- The absence of irrigation facilities in certain areas and the failure of micro irrigation devices pose water constraints.
- In places experiencing lengthier periods of heavy rainfall, cloudy weather, and a minimum lack of sunshine hours, more fruiting bodies such as squares and flowers keep shedding.
- Unavailability of grade and qualitative packages practice for the Bt. variety and organic cotton production.
- Lack of timely finance to the farmers, particularly borderline and small-scale farmers, regarding procuring standard agricultural inputs such as seeds, fertilizers/biofertilizers, pesticides, etc.
- Cotton growers' economic situation does not match the required technology.
- Cotton prices are volatile, and there is a lack of market infrastructure and a cotton export policy.
- Cotton and lint are vulnerable to a high rate of contamination.

V. REQUIREMENTS OF COTTON PRODUCTION

As one of the major kharif crops after rice, the cotton crop has its own suitable cultivation requirements ranging from climatic conditions to labour requirements. However, the major requirements of cotton production are listed below:

A. **Climate Requirements:** Cotton is generally grown in tropical and sub-tropical conditions. Cotton cultivation is hugely influenced by temperature conditions, so much so that it defines the sowing date, the rate of plant growth and development, the length of the growing season and the fibre quality. The temperature conditions impact the plant reproductive activities like pollen germination, fruit set and pollen tube expansion, and the air temperature is the most important climatic factor affecting the cotton yield. Heat stress not only lowers the total crop yields but also leads to delays in crop maturity accompanied by degraded lint quality. The heat stress effect is dependent upon the variations in cotton species planted and the environment.

Better germination at field conditions requires a minimum temperature of 15°C. The cotton crop can grow under extreme temperature conditions to the extent of 43°C, and 21-27°C is considered as the optimum temperature for vegetative growth. However, a temperature less than 21°C is harmful to the crop as the growth process gets slowed. In addition to this, frost is considered the cotton's worst enemy, and hence it can only be grown in frost-free regions, i.e., locations free from frost for at least 210 days. Warm days and cool nights with large diurnal variations are conducive to good boll and fibre development.

B. **Wind:** Wind conditions also cause stresses in cotton crops by reducing output. Moderate wind conditions might be conducive to plant growth in extremely hot and humid conditions. Wind changes the temperature and humidity gradients around the cotton plant, influencing the evaporative requirement. The occurrences of crop damage by the winds happen most frequently during the first 3 to 6 weeks following the emergence of the seedlings. This may cause early flowering and seedling development.

C. **Rainfall:** The minor water requirements can be fulfilled by an average annual rainfall of around 50-100 cm. In some cases, the crop may be grown well in regions with scarce rainfall. The vegetative phase requires moderate rainfall, while severe rainfall later degrades the cotton quality. The growth of the crop is aided by light during the day and rains at night. Heavy rainfall or moisture stress results in bud and boll loss during the flowering and the fruiting season. Frequent fungal infections are the result of high

atmospheric humidity. A dry period during the ripening and boll bursting periods assures good quality of cotton.

D. Soil requirements: The diversity of soil types in India's cotton-growing region ranges from alluvial soils in the north to black soils in the central region and mixed black and red soils in the south zone, which provides a favourable environment for cotton cultivation. However, the crop is highly susceptible to water logging and salinity and thrives well best in well-drained soils.

VI. CROP SEASON:

Cotton is generally sown early in the months of April-May in Northern India, while in Southern India, the period of sowing is delayed. Cotton is predominantly cultivated as a kharif crop in major parts of India, including Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Andhra Pradesh and Karnataka. In these regions, the irrigated crop is typically sown between March and May, while the rainfed crop is shown in June and July, coinciding with the onset of the monsoon season. In Tamil Nādu, a significant portion of unirrigated and rainfed crops is shown between September and October, while in southern districts, cotton sowing may extend to November. Moreover, summer sowing of the crop in Tamil Nādu occurs in February and March. In Andhra Pradesh, the sowing of cotton occurs from the second half of December to the middle of January.

VII. LAND PREPARATION:

In the North Zone, following the harvest of wheat, the time available for land preparation is very limited, and hence the pre-sowing irrigation is undertaken post-wheat harvesting. The process of cotton cultivation typically involves using tractor-drawn implements to work the land, followed by levelling and planking. Once the land is prepared, ridges are created, and sowing is carried out. For rain-fed crops, it is recommended to undertake deep ploughing once every four years to eliminate perennial weeds. The practice is followed in both the central and southern zones of India. Before the onset of monsoon season, the field is repeatedly harrowed using a blade harrow to prepare it for sowing. In drylands, the field is repeatedly harrowed using a blade harrow to prepare it for sowing. In drylands, sowing is done on ridges and furrows to ensure moisture conservation and effective management of weeds.

VIII. METHOD OF SOWING

Cotton is sown using a tractor or bullock-drawn seed drill or dibbling. Sowing of hybrid seeds in rain-fed areas is often done by hand dibbling at the recommended spacing. This method ensures that seeds are not wasted during the process of sowing, and there is uniform geometry for a proper plant stand. Bt. Hybrids are sown in this process. Also, the cultivation of cotton on ridges helps in water conservation, decreases soil erosion and enhances yield.

IX. SCHEDULE OF IRRIGATION

The maximum water requirement is around 700-1200 mm during the crop-growing period. There is a low water requirement during the first 60-70 days after sowing, while the water requirement is highest during flowering and boll development.

Irrigation by furrow method is generally considered water-saving and effective, though cotton is commonly flood irrigated. Drip irrigation is popular in the southern and central. Irrigation of cotton is required when there is 50-70% depletion of available soil moisture. The extent of irrigation required on sandy loam soils in the northern zone is more, i.e., around 3-5 times, while in Tamil Nadu, which is rich in red sandy loam soils having low water retention capacity, around 4-13 light irrigations might be required.

X. SEEDS

One of the crucial factors in achieving a decent yield is cotton seeds. The use of seeds that are more than two years old should be discouraged, while the usage of certified seeds should be promoted. There are multiple varieties of seeds cultivated in different cotton-growing regions. However, two major varieties of seeds majorly grown are Bt and Non-Bt variety. Bt. Cotton crops are transgenic crops with a foreign gene or a

genetically modified gene from the same species. These crops carry an endotoxin protein-generating gene from the *Bacillus thuringiensis* soil bacteria.

Bengal desi, DCH-32, H-4, LRA, J-34 and BB are some of the major kapas varieties. The prices for the same type are shown in the figure below:

Year	Benga Desi	J-34	LRA	H-4	S-6	BB	DCH-32
2006-07	1868	2129		2155	2264	2128	3031
2007-08	2351	2523		2483	2613	2317	2827
2008-09	3051	2800		2850	2850	3000	
2009-10	3063	3115		3116	3226	3081	3738
2010-11	4428	5517			5271	4721	4676
2011-12	4572	4255		3871	4309	3826	4613
2012-13	4538	4451		4321	4642	3900	4780
2013-14		5211		4880	5157	4582	6005
2014-15		4078		3961	4050	4041	5101
2015-16		4601		4392	4762	4369	5222
2016-17		5529		5417	5530	5103	6179
2017-18		4878		5082	4860	4701	5639
2018-19		5571		5732	5726	5577	6302
2019-20		4897		5126	5183	4749	6567
2020-21		5728		5914	6454	5792	6768

Source: Cotton Corporation of India

XI. FERTILISER APPLICATION PRACTICES FOLLOWED FOR COTTON CROP:

Cotton, a very heavy crop, is produced within a limited time frame and hence requires the application of fertilizers in due intervals, which may vary zone-wise. The requirement for fertilizer application in the northern cotton zone is 60-100 kg of Nitrogen (N) per hectare, and Phosphorus (P) and Potash (K) is given as per the soil test results. The ring method is used for nitrogen application wherein half N is given at thinning, and the remaining half is given at first flowering. Nitrogen application might be required at sowing time in case of late sown crops, and in some cases, foliar application may be done if needed. P and K is generally given at the time of sowing. In the case of the central cotton zone, the dosage of N may vary between 40-80 kg, P may vary between 20-40 kg, and K may vary between 20-40 kg per hectare for different varieties. Depending upon the soil test results, P and K are given, and the application of nitrogen is given in three points. i.e., at sowing, squaring and peak flowering stages. In some parts of the central zone, biofertilizer like *Azotobacter* is considered beneficial and used for seed treatment. In the case of the Southern cotton zone, the recommended dose of N:P: K is almost the same as in the central zone. P and K are applied at sowing, and N is applied at squaring and peak flowering. Biofertilizer like *Azospirillum* is used for seed and soil treatment as well.

XII. INTER CULTIVATION AND WEED CONTROL

A blade harrow with a thin-tined hoe or a desi plough is used regularly for inter-cultivation. The practice of inter-cultivation not only helps in soil moisture conservation and better soil aeration but also checks the growth of weeds. The growth of weeds while cultivating cotton crops is quite a cause of concern to a farmer as weeds compete with cotton from sowing to around 70 days when the inter-spaces is covered by a canopy. Weeds also exhaust a lot of nutrients, moisture and light, which cotton should have used. The unchecked growth of weeds reduces cotton yields by 50 to 85 %. Pendimethalin at the rate of 1 kg per hectare is recommended as pre-plant incorporation with one-hand weeding and crosswise hoeing has been recommended for satisfactory control of weed growth. Summer ploughing is used to remove deep-rooted perennial weeds.

In Peninsular India and Southern parts of Gujarat, where the irrigated cotton crop is sown on ridges, the cotton crop thinning is an extra feature as it ensures optimum plant population maintenance for a better yield. In the process of thinning, the weak seedlings are removed, and the strong cum vigorous seedlings are retained.

XIII. MANAGEMENT OF INSECT PESTS AND DISEASES

Table 2: Insect/Disease and Management Practices

S. No.	<u>Insect/Disease</u>	<u>Management Practices</u>
<u>Insect Pests</u>		
1	Jassids /Aphids	Methyl demeton or Dimethoate @ 400-600 ml/ha
2	Thrips	Endosulfan @ 1.5 litre/ha should be sprayed.
3	Whiteflies	Triazophos @ 600-800 ml/ha. Or neem product @ 2.5 litre /ha.
4	Bollworms	One spray of either Endosulfan, or Chloropyriphos or quinalphos @ 2.5 lit/ha. One spray of synthetic pyrethroids (10 EC) @ 500 ml/ha. and HNPV @ 250 LE/ha. should be sprayed.
<u>Diseases</u>		
1	Bacterial blight	Spray with streptomycin (0.01%)
2	Fungal leafspots	Copper oxychloride (0.25%)
3	Grey mildew	Spray wettable sulphur (0.2%) or carbendazim (0.1%)
4	Boll rot	Copper oxychloride or carbendazim should be sprayed along with recommended insecticide.
5	Root Rot	Drench the plants in the affected patch with carbendazim (0.1%). Intercrop moth beans in such areas. ZnSO ₄ @ 24 Kg. /ha should be applied in the soil. Grow recommended resistant varieties.
6	Leaf Curl	Spray recommended insecticide to control whitefly, and grow deshi cotton and resistant varieties like LRK-516, LRK-5166, HS-875, and LHH-144.
7	Leaf reddening	Irrigate the field and spray MgSO ₄ 1%, Urea 2%, followed by DAP 2% at the time of initiation of leaf reddening.

Source: Status Paper of Indian Cotton, CICR, Nagpur

XIV. GOVERNMENT SCHEMES FOR THE DEVELOPMENT OF THE COTTON SECTOR

With an aim to increase the production, productivity and quality of cotton and to raise the income of the farmers by reducing the cost of cultivation, the Government of India launched Technology Mission on Cotton in February 2000 with 4 Mini Missions, which are mentioned in the table below:

Table 3: Government Schemes for the Development of Cotton

Mini Mission	Objective	Nodal Agency
Mini Mission I	Cotton Research and Technology Upgradation	Indian Council Of Agricultural Research
Mini Mission II	Transfer of Technology and Development	Ministry Of Agriculture
Mini Mission III	Improvement of Marketing Infrastructure	Ministry Of Textiles
Mini Mission IV	Modernization/upgradation of G and P factories.	Ministry of Textiles

Source: Cotton Corporation of India

XV. TECHNOLOGY MISSION OF COTTON (TMC):

It had the following objectives:

- To increase the farmers' income through cost reduction and proper technology dissemination.
- To improve the quality of cotton through improvements in infrastructure in the market yards through modernization in the ginning and pressing factories.

Research and Technology transfer under TMC:

The Government made concerted efforts through Mini Mission I and II, to help the farmers improve their quality, yield and output levels of crop produce by reducing the cost of cultivation. Further, under the MM-III and MM-IV, steps were taken to improve the quality of cotton processed in the modernized units in terms of cleanliness, trash and grade. This has brought down the level of contamination due to which Indian cotton

became very popular in domestic and international markets. On 31st December 2010, both MM-III and MM-IV came to an end.

XVI. CONCLUSION

This article gives an overview of the profile of cotton cultivation in India with regard to the requirements pertaining to soil, climate, seeds, fertilizers, pesticides, inputs, marketing etc. The requirements of cotton cultivation vary based on irrigation or rain-fed cotton. The understanding gained from this chapter shall enable in adequate understanding of the macro picture of cotton farming at the country.

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