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# 4 Cotton: A Conventional Material for Fashion

**Abstract:** This chapter discusses cotton, one of several conventional materials long used for the making of clothing. Although cotton plantations have been known to cause much environmental degradation, it is possible to grow cotton while respecting the environment.

**Keywords:** conventional materials, cotton, fashion, sustainability

## Introduction

Cotton agriculture (Figure 4.1, 4.2, and 4.3) has long been characterised by unsustainable practices such as mono-cropping, heavy irrigation and the consumption of synthetic fertilisers and pesticides, but there is currently a shift toward increasingly sustainable methods.Many development programmes to increase cotton production sustainability have been launched in order to safeguard farmers' livelihoods and the environment. In recent decades, there has been a great deal of interest in integrating production risk management with the goal of protecting the environment and natural resources. Domestic and worldwide regulatory measures have been implemented, and these restrictions have caused big merchants to recognise that the entire footprints of their items must be decreased in order to increase the trust of individuals who buy their products. As an outcome of these policies, a variety of production methods and standards have emerged with the goal of fostering sustainable farming and goods.

## Importance of Cotton

Other than providing a fundamental requirement of life, cotton also serves as one of greatest contributors to the net foreign exchange of several nations, through exports of raw cotton, semi-finished goods such as yarn and textiles and completed items including garments and knitwear. In India, an example of a country for which cotton

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has extremely high importance, cotton is also known as white gold.Cotton comprises one of the most significant commercial crops grown in India, accounting for around 25% of total world cotton output. It is vital to the livelihoods of an estimated 6 million cotton growers and many millions of workers employed in associated activities such as cotton processing and trading. The Indian textile industry uses a wide variety of fibres and yarns, with cotton outnumbering non-cotton fibres.

**Figure 4.1:** Cotton (photo: ISAAA KC).

## Cotton Farming Challenges

Agriculture is unquestionably a major user of water. As a result, the amount of water which an individual consumes every day in food items is substantially more than the amount of water that a human drinks. Domestic and industrial usage comprise for 10% and 20% of all freshwater extracted for human use, however, although agriculture uses over 70% and considerably more in some places. Freshwater accounts for less than 2.5% of total volume of water on the planet; due to its placement in glaciers and ice caps, two-thirds of this water is unusable. According to Gleick (1993), just 0.77% of this water is located in groundwater, soil pores, lakes, wetlands, rivers, plant life and the atmosphere, totalling less than 10,665,000 $km^3$.The troubling rate where the freshwater is being drained, as well as the high levels of water contamination, indicate that a freshwater emergency will develop in the coming years. According to the United Nations World Water Development Report, the average quantity of water per individual will be reduced by one-third over the next 20 years. According to the findings of the WWF (1999), cotton is a major driver of freshwater system damage on a regional and worldwide scale.

The three most important freshwater consumers are rice, wheat and cotton. Groundwater is projected to account for 31% of fresh water used for agriculture in Pakistan, while significant use of groundwater for irrigation in China has resulted in a drop in groundwater levels. As per the WWF (1999), cotton cultivation has a number of negative effects on freshwater biodiversity and ecosystems including runoff from cotton-cultivated areas, pollutants in drains, pesticide use, withdrawal of water for irrigation, vast irrigation and dam construction.

1. Runoff from farms
When the top of agricultural land is filled to the maximum capacity and cannot soak water that comes its way, water is regarded as in excess. Such water is referred to as "runoff" because it goes to nearby bodies of water. Poor water treatment and irrigation inexperience are two causes of runoff, which not only transfers extra water but also carries pesticide, fertiliser and salt residues from the cotton crop (Beven, 2004; Jordanien et al., 2011).

2. Use of insecticides
Contamination occurs when field runoff contaminates water bodies, resultingin fish deaths. Some of the factors that determine fish deaths are intensity and content, duration of exposure, temperature, water pH, fish species traits, physiological state and past exposure. Organochlorine and organophosphate insecticides are more hazardous than herbicides. Organochlorine is the most hazardous and chronic of the two; it increases bioaccumulation and magnifies pesticides in aquatic food chains due to close interaction between aquatic species and water.

3. Drainage and leaching
Saline soil or saline irrigation is a key issue in cotton farming. It limits soil water availability to crops and is akin to water scarcity. Cotton is sensitive to saltwater and has the ability to reject sodium ions. This may lead to a circumstance in which issues are only recognised after they accumulate. Salinity, which is prevalent in the dry and Mediterranean climates in the irrigated cotton belt that spans from Spain to Central Asia and America, has been found to harm more than half of the irrigated land in 24 main irrigation nations. Egypt, Pakistan, India, Uzbekistan (50percent of the total of irrigated land) and Northwest China have all reported salinity issues.

4. Withdrawal of water for irrigation
Cotton cultivation in the field has three types of water usage effects: evaporation of infiltrating rainwater for cotton growth, extraction of groundwater for irrigation, and contamination of water induced by fertiliser and pesticide leaching (Falkenmark, 2000; 2003; Falkenmark &Rockstrom, 2013; FAO, 2002; Wani et al., 2009). Water consumption is assessed in terms of quantities utilised per year. The amount of released chemicals after usage into the volume dilution necessary to compute the pollution level is used to measure water quality.Cotton production at the field level depletes re-

sources (fertilisers and pesticides) from the environment; in exchange, contaminated water is returned, resulting in resource pollution. Grey water is water that can be readily recycled from restrooms, kitchens and other places.Furrow irrigation is used for most cotton production, whereas sprinkler and drip irrigation technologies are limited. These techniques are estimated to irrigate 0.7% of the world's land (Sandra et al., 1996).

**Figure 4.2: Cotton Field** (photo: Vijaya Narasimha).

5. Contamination and degradation of bodies of water

Cotton farming is typically connected with the utilisation of chemicals, and discharge water consists of nutrients, salts, and pesticides. Excess irrigation in comparison to ET requirements, as well as water leaching to regulate salinity, generate positive circumstances for groundwater contamination. Surplus irrigation and leaching in cotton production require a large quantity of water to be withdrawn from water bodies, necessitating replenishment; if efficient replenishment initiatives are not implemented, there will be shortage of water in the downstream area, likely to result in the degradation of bodies of water and the environment. Water scarcity necessitates efficient water usage in agriculture and crop management. This is a significant issue in Central Asia, the Aral Sea and Uzbekistan.

6. Extensive irrigation

Cotton crops grown with intensive irrigation tend to create more runoff through into groundwater due to enhanced percolation, resulting in increasing groundwater tables. This results in the formation of shallow water tables. According to Willis and

Black (1996) and the OECD (1998), recharging from irrigated agriculture is linked to the formation of shallow water tables. This situation also causes a dry environment and soil salinisation. This state is unavoidable in locations where evapotranspiration surpasses rainfall and the volume of freshwater utilised for irrigation, such as Pakistan (15% of irrigated land), Uzbekistan (50% of irrigated land) and Brazil's salinity reports (Gillham, 1995; OECD, 2010).

7. Construction of dams

The development of man-made storage structures, such as dams, disrupts natural water flow and nearby ecosystems. The impact on residents is determined by the location and size of the dam. A dam of this type is often erected to generate hydroelectricity, provide water for irrigation, household and industrial usage and manage floods. Dams have significant environmental implications in both upstream and downstream locations, in addition to the global and regional levels. Large dams' environmental impacts may be directly tied to river characteristics and riparian or streamside ecosystems. The dam wall may obstruct fish movement, and breeding sites may be isolated from rearing habitats. Sediments that are vital to the processes and downstream ecosystems are being obstructed, threatening the survival of fertile deltas, barrier islands, rich flood plains and coastal wetlands. Dams' many repercussions include the extinction of fish and aquatic species, the extinction of birds in flood plains, massive losses in forest, farmlands, and wetlands and the erosion of coastal deltas.

8. Land reclamation

The expansion of agricultural land has been connected to increasing agricultural activities as well as a shift away from the natural ecosystems and landscapes. Cotton farming causes salty soils due to water logging and leaching. Based on their features and genetic makeup, salt-affected soils are classed as sodic soils or saline soils. Surplus water-soluble salts and adequate interchangeable sodium likely to impede with plant development are referred to as alkali or sodic soils. Saline soils, on the contrary, contain neutral salts in sufficient concentrations to effect crop development. Issues with conventional cotton growing have resulted in tremendous resource usage, raising numerous difficulties in many regions of the world. This calls for a variety of restorative and protective measures to aid in the growth of healthy, sustainable crops for the development of goods and the preservation of the environment for succeeding generations. Sustainable crop management assists in anticipating all upcoming issues in cotton cultivation and attempting to handle them using the resources available.

## Sustainable Crop Management

Sustainable crop production and management are gaining popularity as they tackle a wide range of issues and possibilities for all stakeholders. Environmental health, economic profitability and social and economic equality are the three aims of sustainable agriculture. In this context, it is vital to preserve and improve land and natural resources while also considering agricultural labourer circumstances, rural people's wants and requirements, consumer health and well-being for the present and future. Sustainable crop production is the environmentally and ethical method to cultivate crops by following procedures that include care for the environment, treating employees fairly and supporting rural and local communities. Sustainable crop management is based on agricultural systems that may be used for an extended length of time while causing little environmental impact. The next part offers an overview of the principles that aid in sustainable agricultural production and manufacturing.

1. Importance of traditional methods of agriculture
Traditional agriculture protects agrobiodiversity, genetic diversity and indigenous ecological knowledge. Notwithstanding agricultural industrialisation, many farmers remain to labour with small-scale varied agro-systems. Moreover, understanding of traditional agro-systems and related plant variety is the consequence of the combination of natural and social systems, which results in various farmland for multiple uses and local food self-sufficiency. Ethnobotany is the study of folk expertise about agriculture, land features and environmental circumstances; it examines the most adaptable traditional practises that have been passed down through the generations. All traditional agriculture is site-specific and may not be suited for other locations. Small farmers typically replicate nature by constructing a crop system that mimics the wild species of the specific region. This cohabitation with the natural environment and biotic complexity results in effective cropping systems and significant yield, promoting both productive and safeguarding activities.

2. Multi-cropping
Crop selection is an art that necessitates meticulous preparation in agriculture. Monocropping has replaced multi-cropping as a result of rapid industrialisation in farming. Multicropping is an agricultural practise of producing various crops solely on a single piece of land over the same or subsequent growing seasons. Crop rotation, or growing two or more distinct crops in close proximity to neighbours or as cover crops (intercropping), protects plants against insect and pest infestation, fixes nitrogen, offers shade, improves soil health and promotes water retention.When there is a large distance across rows of plants, short-duration crops including green and black gram or soybean can be cultivated to boost soil fertility and optimise monetary returns without harming cotton plant development (Dury et al., 2011; Sankaranarayanan et al., 2011).

3. Minimal/no pesticide use
Crop protection is critical for surviving weeds, animals, pests, diseases and viruses. According to Oerke and Dehne (2004), considering crop protection techniques, losses for some commodities (wheat, rice, corn, barley, potatoes, legumes, sugar beets and cotton) ranged from 50% to 80% over 17 areas from 1996 to 1998. Chemical pesticides such as herbicides, insecticides, microbicides and fungicides have enhanced agricultural productivity, but they have several adverse effects. Damage to agricultural lands, fisheries, and flora and fauna; non-intentional damage of beneficial pest killers, which enhances the virulence of many agricultural pests; and increased morbidity and death in humans because of pesticide exposure and intake of food grown in the environment are among the repercussions (Tisdell & Wilson, 2001; Fitt, 2000).

4. Soil health focus
Soil management is critical for preserving and improving soil structure and fertility. Plants cultivated in a sustainable environment are enriched with important micronutrients and macronutrients due to strong soil health that is an outcome of natural cultivation techniques and sustainability practises, according to various studies. The properties between soil particles and soil pores affect air, water, and nutrient transport, root development, and room for soil organisms. Soil health and fertility are greatly influenced by microorganisms and organic materials. Plant material is converted to humus by microorganisms, which acts as a binding material for sustainable soil structure (BCI, 2013). Organic fertiliser usage, crop rotation, mixed cropping, mulching, minimal or no soil tilling and a restriction in heavy machinery use are some sustainable strategies that enhance soil health.

5. Choosing sustainable seed and plant varieties
Historic crops are ones that have been cultivated in the past but are no longer employed in industrial agricultural production. They are picked for their flavour and nutritional content, and are produced in a specific habitat that makes them impervious to local pests and better placed to the local environment. For large-scale industrial production, sterile hybrid types are available, and fresh seed stock is often regulated by agricultural business agencies. Genetically modified crops are cultivated to manage pests or allow for more herbicide application, or to meet market desires, for example, genetically modified apple types that do not turn brown when sliced. Sustainable agriculture does not support gene modification due to the possible environmental effect, their impact on consumer health and the vast amounts of chemicals required for their growth.

6. Water conservation and sustainable irrigation
Water conservation measures are critical for preserving soil and environmental quality. Overirrigation raises the salinity of the soil and reduces production. Rainwater harvesting, cultivation of drought-resistant crops and low-volume irrigation are some of the strategies used to conserve water in agriculture. According to Howell (2001),

water conservation measures involve enhancing output per unit of ET, minimising losses of useable water into sinks, lowering water pollution and utilising water for high-value purposes.

## Road Map to Sustainable Cotton Production

Sustainable cotton processing is critical since it provides a source of income for many people. Because of the variety of geographical locations, numerous sustainable adaption solutions are required to meet environmental demands. Climate, water and chemical outputs and inputs, capital and agricultural efficiency, natural resources and local pests all have different elements that necessitate different techniques. Since sustainability is a changing objective that cannot be set permanently, no single answer is easily available. Furthermore, some attempt has been made here to give indications or tools to help people involved in cotton production, processing, manufacturing and retailing work toward long-term goals.

A number of the components categorised underneath the title of technology, agriculture and production are listed here, along with the choice of the cotton wide assortment to be cultivated, the environment within which the cotton plant grows, the techniques to be used prior to harvest for a sustainable crop and the technical methods to be used just after cotton harvest, in addition to the social aspects of the processes.

Sustainability requests both individual and communal efforts from everyone. In terms of domestic and global methods, they include the responsibilities of farmer, producer, retailer, buyer and government. Cotton plants demand the finest management approaches in terms of water management, soil augmentation and plant protection management without jeopardising the wellbeing of the neighbouring habitat and ecosystem. A small number of organisations assist farmers in nurturing soil health by learning the best ways to utilise fertilisers and the benefits of crop rotation, as well as in conserving and restoring environment on and around their farms. Gender inequality and fair labour are also important components of work in India. Women made up just about 20% of those trained in India in 2018–19. Furthermore, many cotton workers, especially those from disadvantaged, rural areas or migrant families, experience terrible working conditions, discrimination and low salaries. Children may also be at risk from working in cotton fields. The government is continually scaling up efforts, in collaboration with Implementing Partners, to deliver high-quality training both to men and women in a culturally sensitive manner.

Sustainability cannot be realised until the social aspect is addressed, and ILO standards must be followed for local communities and to improve the lives of agricultural and plantation workers. The road map also emphasises the involvement of parties across the supply chain, since product demand will increase only if sustainability is ac-

**Figure 4.3: Cotton Bud/Plant** (photo: Bishnu Sarangi).

knowledged, and all persons strive both individually and together achieve sustainability in the framework of sustainable cotton development and processing. Consumers' unwillingness to pay higher costs for sustainable products, as well as manufacturers' insufficient efforts, must be addressed. When a concerted effort is undertaken and only eco-friendly items are provided to buyers, these characteristics will become economically viable. Governments around the world have begun to prioritise sustainability elements in all products. Solutions to these difficulties must be debated on a worldwide scale in conferences and forums in order to transfer research discoveries from laboratories to commercial markets and to change people's and society's perceptions of the environment.

## Conclusion

The worldwide cotton value chain includes no fewer than six million small-to-medium-sized Indian cotton producers and agricultural employees. As a result, the country must guarantee that it not only maintains its place in the global production of cotton but also prepares for a robust, stable and sustainable future.

Adapting to new evolving international market-based initiatives that support sustainable development is one method.This can assist India in remaining internationally competitive in the cotton supply chainand also provide an advantage by utilising the range of development diplomacy to improve its place in the global cotton and textile trade.

The international textile supply chain is enduring a fundamental change; it is trying to pursue environmental and social improvements in attempt to meet the sustainability obligations established in order to minimise the negative effects of climate change on cotton growers and cotton farming. Voluntary Sustainability Standards, which include certification systems, labelling initiatives and private standards, are being used to achieve this. Better Cotton Initiative, Fairtrade Cotton, Cotton Made in Africa, and Organic Cotton are the key voluntary sustainability standards that now dominate the sustainable cotton value chain.Adopting voluntary sustainability standards is certainly advantageous for India. On one side, it will assist it in remaining internationally competitive in the cotton supply chain and strengthening its position in the export market, whereas on the other side, it will assist India in meeting its SDG obligations.

There are several causes for India to stay up to date with the shifts and advances sweeping the global cotton market. It will allow India to defend, enhance and further improve its position on the international development map. Because voluntary sustainability standards in cotton assures an improved manufacturing system, and sourcing techniques, while also touching the livelihoods of hundreds of millions, India must scale it up by linking it with its SDG objectives. India, as a developing country aiming to progress to a more sustainable future, will benefit from comprehending the evident links between voluntary sustainability standards and SDG achievement. A single emphasis on the sustainable ecosystem would not assist it in meeting all of the needs. Corporations, entrepreneurs and governments must collaborate to successfully employ voluntary sustainability standards to accelerate progress toward SDG objectives. The government has more responsibility and they must create an environment that encourages sustainable cotton cultivation and manufacturing, providing financial aid to supply-chain players that are dedicated to voluntary sustainability standards. Existing agricultural policies and programmes must be reviewed to support sustainable output.

## References

BCI. (2013). *Better cotton production principles &criteria explained*. http://bettercotton.org/wp-content/uploads/2014/01/Better-Cotton-Production-Principles-and-CriteriaExplained_Final-2013_eng_ext.pdf

Beven, K. (2004). Robert E. Horton's perpetual model of infiltration processes. *Hydrol. Process*., *18*, 3447–3460. http://dx.doi.org/10.1002/hyp.5740

Comparison of annual flows &peak discharges. Catena Verlag.

Dury, J., Garcia, F., & Bergez, J.E. (2011). Models to support cropping plan and crop rotation decisions. *Agron. Sust. Dev*. http://www.cicr.org.in/pdf/multitier.pdf

Falkenmark, M. (2000). Competing freshwater and ecological services in the river basin perspective. *Water Int*., *25*, 172–177.

Falkenmark, M. (2003). Freshwater as shared between society and ecosystems: from divided approaches to integrated challenges. *Science*, 2037–2049.

Falkenmark, M., & Rockstrom, J. (2013). *Balancing water for humans and nature: The new approach in ecohydrology*. Routledge. http://dx.doi.org/10.4324/9781849770521

FAO. (2002). *Land–water linkages in rural watersheds*. ftp://ftp.fao.org/agl/aglw/docs/ lw9e.pdf

Fitt, G.P. (2000). An Australian approach to IPM in cotton: integrating new technologies to minimise insecticide dependence. *Crop Prot*., *19*, 793–800.

Gillham, F.E.M. (1995). *Cotton production prospects for the next decade*. World Bank Publications.

Gleick, P.H. (1993). *Water in crises: A guide to the world's fresh waterresources*. https://www.2000litergesellschaft.ch/fileadmin/user_upload/Referenzen_und_Literatur/GLEICK_1993_Water_in_Crisis.pdf

Howell, T.A. (2001). Enhancing water use efficiency in irrigated agriculture. *Agron. J*., *93*, 1–10.

Jordanien, P., Aufleger, M., & Mett, M. (2011). *Handshake across the Jordan*: *Water & Understanding*. Books on Demand.

OECD. (1998). *Sustainable management of water in agriculture: Issues and policies – the Athens workshop*. OECD Publishing.

OECD. (2010). *Sustainable management of water resources in agriculture*. http://www.oecd.org/tad/sustainable-agriculture/49040929.pdf

Oerke, E.C., & Dehne, H.W. (2004). Safeguarding production – losses in major crops and the role of crop protection. *Crop Prot*., *23*, 275–285.

Sandra, L.P., Gretchen, C.D., & Paul, R.E. (1996). Human appropriation of renewable fresh water. *Science*, *271*, 785–788.

Sankaranarayanan, K., Nalayini, P., Sabesh, M., Rajendran, K., Nachane, R.P., &Gopalakrishnan, N. (Eds.). (2011). *Multi-tier cropping system for profitability &stability in Btcotton production*. CICR. https://www.cabdirect.org/cabdirect/abstract/20093120021

Tisdell, C.A., & Wilson, C. (2001). Why farmers continue to use pesticides despite environmental, health and sustainability costs. *Ecol. Econ*. https://www.researchgate.net/profile/Clement_Tisdell/publication/4840284_Why_Farmers_Continue_to_Use_Pesticides_Despite_Environmental_Health_and_Sustainability_Costs/links/0fcfd50cfc08db1cd7000000.pdf

Wani, S.P., Rockstrom, J., & Owes, T.Y. (2009). *Rainfed agriculture: Unlocking the potential*. CABI.

Willis, T.M., & Black, A.S. (1996). Irrigation increases groundwater recharge in the Macquarie Valley. *Aust. J. Soil. Res*., *34*, 837–847.

WWF. (1999). *The impact of cotton on fresh waterresources and eco systems*. http://d2ouvy59p0dg6k.cloudfront.net/downloads/impact_long.pdf