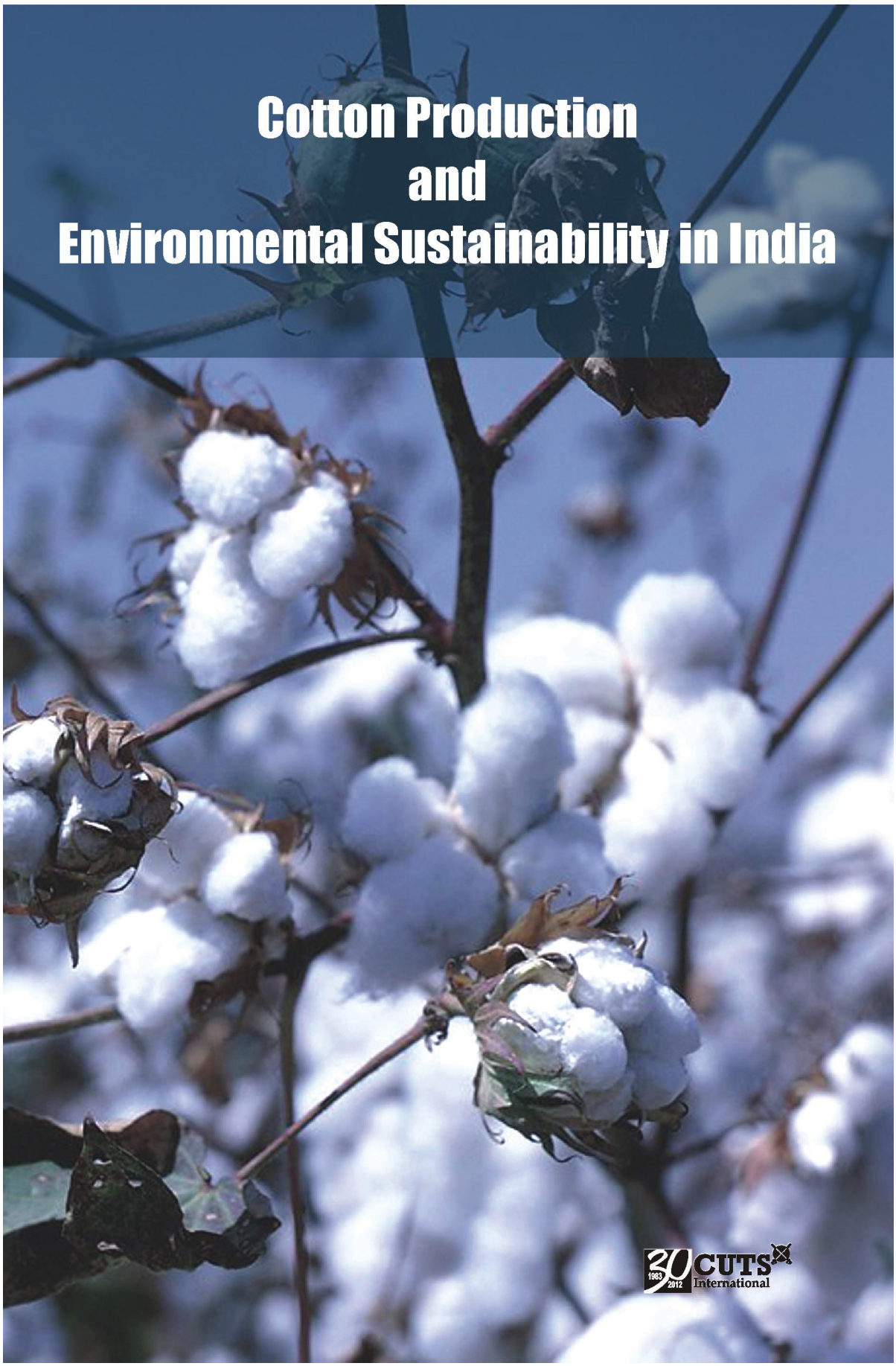
Cotton Production and Environmental Sustainability in India



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1983 2012 CUTS International

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Published by

CUTS International

D-217, Bhaskar Marg, Bani Park
Jaipur 302016, India
Tel: +91.141.2282821, Fax: +91.141.2282485
Email: cuts@cuts.org
Web site: www.cuts-international.org

With the support of

The Research Council of Norway

SIFO
National Institute for Consumer Research (SIFO)

First published: April 2013

This document has been produced with the financial assistance of the Norwegian Research Council (through National Institute for Consumer Research in collaboration with the Centre for International Climate and Environmental Research, Oslo) under a project entitled "Environmental Sustainability Impact Assessment of Cotton Value Chain in India". The views expressed here are those of the authors and can therefore in no way be taken to reflect the positions of the Norwegian Research Council and SIFO, Norway.

ISBN: 978-81-8257-186-0

Printed in India by Jaipur Printers Private Limited, Jaipur

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Abbreviations

AEO	Alcohol Ethoxylates
AICCIP	All Indian Coordinated Cotton Improvement Project
APEDA	Agricultural and Processed Foods Export Development Authority
APEO	Alkyl Phenol Ethoxylates
APMC	Agriculture Produce Marketing Committee
BCI	Better Cotton Initiative
BMP	Better Management Practices
CICR	Central Institute for Cotton Reasearch
CAGR	Compound Annual Growth Rate
CAI	Cotton Association of India
CCI	Cotton Corporation of India
CCLC	Chrome Composite Leather-Clad
CIPMCs	Central Integrated Pest Management Centre
CIRCOT	Central Institute for Research on Cotton Technology
CLP	Classification, Labelling and Packaging
CSO	Central Statistical Organisation
DAC	Department of Agriculture & Cooperation
DIQC	Director of Inputs and Quality Control
DLC	District Level Committee
DR	Double Roller
ECHA	European Chemicals Agency
EIQ	Environmental Impact Quotient
EJF	Environmental Justice Foundation

ELS	Extra Long Staple
EPA	Environment (Protection) Act
FAO	Food and Agriculture Organisation
FIC	Farmers' Information Centres
FSC	Forest Stewardship Council
GEAC	Genetic Engineering Approval Committee
GC	Green Council
GHS	Globally Harmonised System
GOTS	Global Organic Textile Standards
GRED	Gin Roller Experimentation Device
HCH	Hexachlorocyclohexane
IBS	Institutional Biosafety
IBSC	Institutional Biosafety Committees
ICAR	Indian Council of Agricultural Research
ICCOA	International Competence Centre for Organic Agriculture
ICM	Integrated Crop Management
IFOAM	International Federation of Organic Agriculture Movements
IFPRI	International Food Policy Research Institute
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IPPC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
ISO	International Organisation for Standardisation
ISFM	Integrated Soil Fertility Management
ISOT	Indian Standards for Organic Textiles
ITC	International Trade Centre
IWM	Integrated Water Management
MM	Mini Mission
MMB	Mahyco Monsanto Biotech
MOEF	Ministry of Environment and Forest
MT	Million Tonnes

NEP	National Environment Policy
NGOs	Non-Governmental Organisation
NOTS	National Organic Textiles Standards
NPM	Non-Pesticide Management
NPOP	National Standards for Organic Production
NSB	National Standards Body
NTP	National Textile Policy
PAHs	Poly Aromatic Hydrocarbons
PCF	Processed Chlorine Free
POC	Pre-Organic Cotton
RCGM	Review Committee on Genetic Manipulation
RCF	Rubberised Cotton Fabric
R&D	Research and Development
RDAC	Recombinant DNA Advisory Committee
REACH	Registration, Evaluation, Authorisation and Restriction of Chemical Substances
SBCC	State Biotechnology Coordination Committee
SEEP	Social, Environmental and Economic Performance of Cotton
SFI	Sustainable Forestry Initiative
SINET	Sustainable Industrial Networks
SSI	Small Scale Industry
TMC	Technology Mission on Cotton
TUFS	Technology Upgradation Fund Scheme
USDA	United State Department of Agriculture
VOCs	Volatile Organic Compounds
WWF	World Wide Fund
WHO	World Health Organisation

Preface

One of the greatest challenges of our time is to address global environmental changes, such as climate change and biodiversity loss, that are harming the welfare of billions of people. Linkages between cotton production and environment sustainability are a matter of debate which has caught the attention of environmentalists as well as policy-makers and practitioners. There are rounds of commentaries and policy prescriptions on the virtues and vices of the impact of cotton production and consumption on environmental sustainability.

The white fibre, once cherished as natural and better than synthetics, and admired by politicians as a tool for rural development, is now being looked at more closely because of possible adverse environmental effects of its production and consumption. It is grown in more than 111 countries, by more than 100 million farmers, on 35 million hectares of land and supplies approximately one third of the global fibre demand.

Cotton, one of the principal cash crops of India, contributes significantly to its economy and foreign exchange earnings. Approximately, 60 million people depend upon cotton production and related industries for their livelihoods. In fact, India has the largest area, which is approximately 34 per cent of the global area under cotton cultivation.

However and in terms of productivity and sustainable production and consumption practices, the Indian cotton sector is facing some major challenges. Water is extensively required for cotton cultivation. Unfortunately, cotton farmers in India rely heavily on rain-fed cultivation. And this accounts for almost 70 per cent of the total area of cotton cultivation.

Besides rainfall pattern, pest infestation has a significant effect on cotton cultivation in India. Bollworm and sucking pests have devastated cotton crops for years. Despite the fact that cotton occupies only five per cent of India's total cultivable land, approximately 50 per cent of pesticides used in India are consumed by cotton cultivation.

All these issues are affecting the current structure of cotton production and consumption in India. On economic side, the issues mainly relate to

inefficiency in the production process including choice of seeds, harvesting techniques and post-harvest storage and transportation. On environmental sustainability, there are number of factors relating to trash content and its management as well as unsustainable use of inputs such as water, pesticides and fertilisers.

At the same time and as argued in this report, sustainable cotton production and its consumption in the value chain holds immense potential for enhancing the livelihood of millions of people directly or indirectly associated with this sector. Presently, the sector suffers from various issues emerging from unsustainable practices – both in the process of production and its consumption in the value chain. And they continue to hamper the sector's progress despite a number of initiatives taken by the central and state governments.

Therefore, the objective of this study is to understand issues of environmental sustainability in cotton production in India and in its value chain, and analyse related regulations. It aims to ascertain stakeholders' awareness towards environmentally sustainable practices. It seeks to examine how domestic policies have contributed and strengthened the environmental sustainability aspects of cotton production and its consumption in India. Based on empirical findings, the study recommends policy and practice changes for promoting sustainable production and consumption practices in the cotton value chain.

The study is based on a survey of around 500 stakeholders such as farmers, ginners, spinners, manufactures and retailers along with officials of the agriculture department in three districts representing the major cotton producing states of India: Guntur in Andhra Pradesh, Yavatmal in Maharastra and Shri Ganganagar in Rajasthan.

Our work is a result of team effort and contributions made by various institutions. We thank all of them including officials of the agriculture department in these districts and officials in the Ministry of Textiles, Government of India.

Finally, I thank the Research Council of Norway and the National Institute for Consumer Research, Oslo for their support and guidance, and acknowledge the diligent work of my colleagues in producing this study. We will ensure that our recommendations will be taken forward by the relevant policy-makers and practitioners for achieving the goal of sustainable production and consumption of cotton in India.

Bipul Chatterjee
Deputy Executive Director, CUTS International &
Head, CUTS Centre for International Trade, Economics & Environment

Executive Summary

Environmental sustainability has become a phenomenon in the recent years, primarily because of increasing adverse impacts of climate change and global warming. Environmental sustainability is the ability to sustain natural resources in a way that effectively promotes sustainable production which, in turn, helps to sustainable usage or consumption. It is premised on the principle that everything that the humanity needs for survival and well-being directly or indirectly depends on the natural environment or resources. The basic approach behind environmental sustainability is to create and maintain conditions under which humans and nature can exist in harmony and thus facilitate fulfilment of the social, economic and other requirements of present and future generations. In other words, environmental sustainability ensures that humanity has and will continue to have natural resources, water and other resources to protect human health and our environment.

Environmental sustainability has now penetrated almost all areas of production and consumption. Its penetration in cotton production and consumption is no exception. The present study, commissioned to assess environmental sustainability of cotton value chain in India, is based on both primary data/information collected from different stakeholders – farmers, ginners, weavers, spinners and others – in the cotton supply chain and secondary data/information from published sources.

The report explains the growing importance of cotton in India. The country now accounts for over 22 percent of cotton production in the world. The sector's importance is also reflected by the fact that, in terms of livelihood, it is a source of employment to a large number of people. There are an estimated 5.8 million cotton farmers and about 40-50 million people engaged in related activities, such as cotton processing and trade. Besides, India has a huge area – about 30 percent – under cultivation of cotton.

The report also highlights that increased cotton production has resulted from intensive use of inputs, comprising of water, fertilisers, pesticides,

weedicides, etc. While increasing use of some inputs such as water have resulted in exhaustion of some natural resources; increasing use of other inputs such as fertilisers and pesticides are adversely impacting environment through increased CO_2 emissions, salination due to run off chemicals in ground water, etc. More importantly, it has also started adversely impacting human health as reflected by increasing cases of poisoning and deaths in the cotton producing states. In addition to the farming practices, there are various stages, such as dying and others, in the cotton supply chain which raise environmental concerns.

The emerging issues of environment and health as a result of cotton production call for greater sustainability in cotton production and consumption. This call is further reinforced by the growing preference for environment-friendly cotton and cotton products in the international market, where India has emerged as a very important player.

The report finds that in a drive to promote sustainability in cotton production and consumption a number of international standards and ecolabels have come up covering different stages of cotton supply chain. While all of these are positive developments, and in fact are required in the greater interests of humanity, these are creating new challenges for producers on the one hand and users of cotton (manufacturers) on the other, especially in the developing world, including India. The impact of these initiatives is now becoming more visible in case of India's exports of cotton and cotton-based products – distinctive shift in export destinations of cotton, yarns, and cotton fabrics is observed, with Asian countries now becoming bigger consumers, compared to what was observed a decade back.

The report finds that to address sustainability challenges and help Indian cotton industry to regain a place of prominence in its traditional markets, the Government of India has taken some focused initiatives. Some of these include Technology Mission on Cotton, Technology Upgradation Fund Scheme and fiscal support. Introduction of Bt cotton was also a big step towards sustainability. Besides, the government has also introduced initiatives such as welfare scheme for weavers, e-marketing for handlooms and handicraft products, skill development, issue of credit cards to artisans, waiver of overdue loans and some others for the overall benefit of the industry.

The report reveals many important developments in India towards environmental sustainability in cotton supply chain. One of these is that the Agricultural and Processed Foods Export Development Authority (APEDA) has introduced certification for organic textiles, called the National Organic Textiles Standards (NOTS). The NOTS standard is now

part of the certification process under the National Programme for Organic Productions (NPOP). It may be recalled that the NPOP is a legal regime administered by Department of Commerce as part of the foreign trade policy. With this, India has become one of the very few countries in the world to have introduced organic textile standards at the national level.

It is important to note that the European Commission, Switzerland and the US recognise NPOP Standards and the conformity assessment procedures of India (1SO-17011) to be equivalent to their country standards, resulting in great acceptance for Indian organic products in their markets. India is negotiating with Japan and Canada for equivalence.

The report reveals that the effort by the Government of India is duly supported by non-state actors. In addition, a number of international organisations dealing in standards and sustainable practices in cotton textiles are also present in India. These all suggest India's progressive march towards greater sustainability in cotton production and consumption.

The progress made at the ground level, especially at the cotton production stage, reveals interesting facts about Indian farmers' inclination towards sustainable production. This is reflected by the box below.

The report reveals that on most of the sustainability parameters– adoption of improved variety of seeds, such as Bt cotton, awareness on environmental sustainability and climate change impacts, influence of peer groups on adoption of environmentally sustainable practices – which directly and indirectly influence cotton production in India — farmers in India appear to be in a better position than before.

What Makes Cotton Farming in India Sustainable?	
Parameters	***Score (based on stakeholders' responses, in %)***
Adoption of improved variety of seeds	94
Awareness about environmental sustainability	82
Awareness about contamination of soil and surface water	86
Awareness about impact of climate change	95
Precautionary measures to reduce adverse impact of cotton production on human health and environment	74
Influence of peer groups on adaption to sustainable practices	1

The report also highlights the fact that, despite some significant progress made at different levels of cotton production and consumption, various issues remain. Some of the most important ones include lack of farmers' capacity to adapt to sustainable practices, low yield and productivity, lack of irrigation facilities, contamination of soil and surface water due to use of fertiliser and pesticides and inadequate dissemination of environmental-friendly technology. Most importantly, the issues that have emerged from adaption to Bt cotton, such as new types of pests that are resistant to Bt cotton seeds, pollination, weediness, effect on non-target organisms, presence of Bt gene in soil, food safety and others, is really not a good sign for sustainability.

One can hope that increasing sustainability practices as being adopted by cotton growers (as is reflected by the field data), coupled with government initiatives to help farmers raising productivity and greater dissemination of environmental-friendly technology, the overall situation will become more sustainable and will be strengthened. What is needed is a holistic approach towards promotion of a sustainable cotton regime in India.

The report consists of six Chapters. Chapter One briefly introduces and outlines the objectives of the study and project methodology. Chapter Two deals with evolution and emerging dynamics of cotton in India, with special reference to India. Major trends and issues as reflected by the economics of cotton in India are discussed in Chapter Three. Chapter Four reviews the preparedness of Indian cotton industry to sustainability challenges with special reference to India and the EU market. The findings from the field survey covering various stakeholders – farmers, ginners, weavers, spinners, and others – are presented in Chapter Five. Chapter Six concludes and provides recommendations for making cotton production and consumption environmentally more sustainable. Chapters are followed by References.

1
Introduction

Introduction to the Issue

Cotton and its social and economic importance to human life and livelihood can be summed up in two simple sentences. On its social importance, it can be said that cotton symbolises civilisation; cotton clothes mankind; cotton exemplifies a beautiful story and saga of how man converted a simple natural fibre into thread, fabric and apparel through technological innovations. On its commercial and economic importance, one can say, cotton made markets; cotton shaped industries; cotton built empires; cotton caused revolutions; and cotton even today brings prosperity to richest nations and also buys food for the poorest countries. In the recent period, its horizon has further expanded, albeit for a wrong reason. The current technological and practice innovations are having direct or indirect impact on environment and thus impacting lives and livelihood of mankind as a whole.

Cotton, mostly known for its direct commercial use, has other uses as well, including being a part of human and animal consumables. Cotton is used to make fibers, which in turn are used to make thread, which then is woven into clothing. In addition, cotton seeds are crushed and squeezed for oil, which is found in a variety of processed foods consumed by human bodies. Cotton husks and field refuse is ground for animal feed. Cotton is important not only for commercial benefits, but also for human consumption and as animal feeds. This holds true for all cotton producing countries including India.

Due to its multiple uses, cotton has become a very important agricultural crop both for India as well as for the world. Cotton, though in essence, is produced for its fibre, which is a raw material for producing cotton yarn in textile industry, but at the same time it has various other usages. It is used for both human in the form of cooking oil and animals as cattle feeds. What is more, it is a reality that in India as well as in many other

developing and underdeveloped countries, cotton is a major source of livelihood and also a major source of foreign exchange earnings for the domestic economy.

India is one of the four major cotton producing countries, along with China, USA and Pakistan that together contribute about 70 percent of the world cotton production. India has recently emerged as the second largest producer and exporter of cotton over the last one decade period.

Evolution of cotton in India, over the last six decades after independence, shows that it has passed through five different phases.[1] These phases can be categorised as: (1) period of expansion in area under cultivation; (2) period of intensive cultivation with introduction of high yielding varieties; (3) period of steady increase in both area and productivity; (4) period of stagnation in area under cultivation, decline in productivity[2] (productivity started to decline from 566 kg/ha in 2007 to 522 kg/ha in 2008, 486 kg/ha in 2009 and 475 kg/ha in 2010), production and irrigation coverage at 1996-97 levels; and (5) Period of resurgence of the cotton sector (from 2003 04 onwards). All the five phases have been characterised by varying production practices evolving around technology in use, input requirements, and level of mechanisation, which were determined by emerging issues – but primarily the need for increasing production – at that point of time. Existing production practices, in turn, have direct or indirect impact and influence – both positively and negatively – on human and animal lives, as well as the environment. Some of the possible impacts include: impact on soil, impact on water availability, impact on income, impact on human health, last but not the least impact on environment. This is, however, only the first stage of cotton chain.

What is said above is not all, as cotton chain has a much wider dimension, as it goes up to manufacturing of clothes. Overall, the cotton chain comprises of different stages and stakeholders, including farmers, manufacturers, suppliers, transporters, retailers, and consumers among others. For the present study purpose, it is understood that at each stage of its chain, it impacts on human lives, as well as the environment.

In terms of production, India now accounts for over 22 percent of cotton production in the world. India's cotton production has increased at a CAGR of 8.5 percent during the period 2003 to 2010. In fact, India's cotton production has doubled in the last seven years. The increased level of cotton production has helped the country to fulfil almost all of its raw cotton requirements from locally produced cotton. Cotton as raw material has a share of around 59 percent in the total raw material consumption of the Indian textile industry.

In terms of livelihood, it is worth mentioning that, for a significant number of people, cotton plays a major role in sustaining the livelihood. There are an estimated 5.8 million cotton farmers and about 40-50 million people engaged in related activities, such as cotton processing and trade. India has a huge area under the cultivation of cotton. The area under cotton production now constitutes about 30 percent of the global cotton area.

It is also a reality that increased cotton production has resulted from intensive use of inputs, comprising of water, fertilisers, pesticides, weedicides, and others. While increasing use of some inputs such as water have resulted in exhaustion of some natural resources; increasing use of other inputs such as fertilisers and pesticides are adversely impacting environment through increased CO_2 emissions, salination due to run off chemicals in ground water, etc. In addition to the farming practices, there are various stages, such as dying and others, in the cotton supply chain which raises environmental concerns.

Sustainability in cotton production and consumption is very important for sustainable lives and livelihood of Indian farmers and also those directly or indirectly engaged in the industry. While cotton growing and its use is critically important for a large number of people in India because of issues of lives and livelihood, and also its foreign exchange earning capacity, it is equally important that cotton is produced more sustainably keeping in view a long term perspective. This is the primary reason, why environmental impacts associated with cotton production have come into focus world over, including India. Initiatives being taken by different countries reiterate and are premised on the need for a sustainable cotton production system. The EU's standards and labelling on cotton textile is one example.

BT cotton was a big drive towards sustainability of cotton production. India also adapted the new practice in a big way, and now Bt cotton has a share of about 90 percent of total area under cotton. Indian farmers have also adopted better management practices that help them produce better quality cotton on a sustainable basis. Besides, there are many other sustainable practices being innovated and used globally, including India.

The purpose of this report is to assess issues relating to sustainability of cotton production and consumption in India, especially in terms of sustainability of livelihood, sustainability of health, and sustainability of environment. All the three issues are directly impacted by cotton production – people engaged in cotton farming – and consumption – people directly or indirectly engaged in the industry.

In addition to above, the report also intends to shed light on changing consumption patterns consumers in different countries, especially in EU, on production and consumption of cotton in India.

Rationale Behind the Study

Sustainability in cotton production and consumption is not a one step process. It can come from a combination of initiatives, addressing various relevant issues in the cotton supply chain. The process starts with proper understanding of the ground realities, such as production and consumption practices at various levels – farmers, ginners, weavers and knitters, spinners, manufacturers, and retailers. The next step is to analyse and understand government policies and initiatives for the sector. Juxtaposing this with the ground realities could probably help in identifying gaps between policies and ground realities. Once ground realities are properly understood, and gaps identified, policy and practice change recommendations can be made. The combination of these steps can probably help to achieve sustainability to cotton supply chain. In addition, there is also need for generating awareness among producers and consumers about sustainability.

The present study has the following rationale:

- To raise awareness among stakeholders in cotton value chain regarding environmental sustainability issues
- To analyse how domestic policies have contributed environmental sustainability of cotton production and use in India
- To understand cotton production practices, sustainable production alternatives and their usefulness and availability
- To provide recommendations to policymakers for enhancing environmental sustainability practices in the cotton value chain
- To provide recommendations to policymakers with regard to environmental regulatory framework in the cotton value chain.

Specific Research Questions to be Addressed

The study covers all the major stakeholders of the cotton supply chain – farmers, ginners, weavers and knitters, spinners, manufacturers, and retailers. The purpose is to come out with a holistic approach to make cotton production and consumption more sustainable. The report addresses various sustainability related questions at various levels of the cotton supply chain. While at the farmers' level, the report sheds light on trend in cotton cultivation and production, trend in cost of production

and income, issue of availability of cotton seed and water, farmers' perception, experience and satisfaction on sustainability of Bt cotton, farmers' perception on impact of early adoption of sustainable practices by a section of farmers on other farmers, and various other related issues.

In case of ginners, the report answers questions such as use of efficient technology, issue of contamination of lint cotton, issue of availability of water, and others. Waste management and the type of technology being used are the two major questions addressed in case of ginners. The focus remains the same in case of weavers and knitters also. In addition, type of looms used and disposal of wastes are also covered.

Chemicals used in dying and printing are very important issues related to sustainability of cotton consumption. The report provides answer to questions such as technology used is dying and printing. It also addresses the issue of waste management and availability of water. At the retailers' level, issue such as compliance to environmental standards has been covered.

Methodology and a Brief Outline of the Report

The report is based on both secondary and primary research. To generate a broad and holistic view on the issue of sustainability in cotton value and supply chain, secondary data and available literatures on cotton production and consumption have been used. These covers literatures on production and consumption trends, existing production and consumption practices, impact of cotton production and consumption on the environment, human health, and livelihood.

The secondary research is duly supported by field level exercise. Out of the major cotton producing states in India, three states – Andhra Pradesh, Maharashtra and Rajasthan – are identified for data collection. Within each of the states one district and within the district one village has been selected for the field survey (Table 1.1). The selection of these three states was based on the fact that these states belong to three different zones of India: Andhra in the South; Maharashtra in the West; and Rajasthan in the North Zone.

Table 1.1: States/Districts/Villages Identified for Farmers' Survey

State	*District*	*Village*
Rajasthan	Shriganganagar	Sahu Village (53)
Andhra Pradesh	Guntur	Prathipura (64)
Maharashtra	Yavatmal	Wai (66)

Figures in parentheses indicate number of farmers surveyed.

Besides farmers, 63 ginners, 50 spinners, 58 weavers, 34 manufacturer and 60 retailers were surveyed in the three states. The survey of manufacturers was limited to Rajasthan and Maharashtra.

Total number of questionnaire inclusive of all types of identified stakeholders is 448. Out of this, 41 percent are farmers, 14 percent ginners, 11 percent spinners, 13 percent weavers, 8 percent manufacturer and 13 percent retailers. The sample distribution is reflected in the following pie chart (for more details, see Figure 5.1).

Perceptions of the farmers have been collected and analysed based on a semi-structured questionnaire prepared for the purpose. The questionnaire included questions relevant to the specific stakeholders. A detailed survey methodology is included in the relevant chapter.

The report consists of six chapters. Chapter 2 analyses the evolution and emerging dynamics of cotton. It focuses on definition, evolution, uses and its importance, cotton value chain, sstructure and types of stakeholders in cotton value chain (at production, marketing and policy levels) and cotton industry linkages with domestic and foreign markets. Chapter 3 analyses economics of cotton in India, and covers trend in cotton production and consumption, backward and forward linkages, production practices (including sustainable production alternatives and their usefulness and availability), and impact on environment.

Chapter 4 attempts to assess environmental sustainability of cotton production in India. It analyses cotton production practices and its use and environmental issues. It also includes economic, social and cultural impact of cotton production and consumption. The chapter also sheds regulatory framework for cotton production and its use in India, and government policies and initiatives to promote environmental sustainability in cotton. Another important component of this chapter is the analysis of standards and regulatory requirements in foreign countries, especially the EU and its impact on Indian cotton sector.

Chapter 5 "Towards a sustainable cotton regime", is based on field data and stakeholders' perception. The data collected from the field from different stakeholders, as indicated above, is analysed and presented in this chapter. The chapter sheds light on production and consumption practices being followed by producers and consumers of cotton in India. It also presents statistical analysis of the field data focusing on the issue of adoption of Bt cotton and environmental impact of cotton production. The statistical analysis is based on descriptive statistics and ordinary least square (OLS).

Chapter 6 contains the conclusion and recommendations. This is followed by references and Annexures.

Endnotes

1 Indian Textile Journal (emphasis added), http://www.indiantextilejournal.com/articles/FAdetails.asp?id=2737

2 CICR Vision 2030, Central Institute of Cotton Research

2
Evolution and Emerging Dynamics of Cotton in India

What is Cotton?

Cotton can be described as a soft, downy substance, resembling fine wool, which grows on the seeds of the cotton plant. It is also described as a soft, fluffy staple fibre that grows in a boll, or protective capsule, around the seeds of cotton plants. The fibre is usually spun into yarn or thread and used to make a soft, breathable textile. Some specific examples of the products in which cotton is used include oils, balls, swabs, bandages, tissue, paper, napkins, diapers, socks, underwear, shirts, shorts, sweaters, pants, coats, towels, linen, cushions, drapery, upholstery, rugs, carpet, comforters, mattresses, insulation, filtration. There are various other things – people wear, people sleep on, people sleep under, people walk on and utilise in would care – used daily by human beings which are composed of cotton.

It is known as a natural fibre and is used in a variety of ways. Cotton fibre can be long (about 2 inches) staple; as well as short (from two thirds of an inch to an inch and a half) staple. In the recent periods, some other classifications of cotton have also emerged.[1]

Presently, there are four commercially-grown species of cotton, all domesticated long back. While two of these evolved in the New World, other two evolved in the Old World. These include:

New world cotton

- Gossypium hirsutum – upland cotton, native to Central America, Mexico, the Caribbean and southern Florida. This constitutes about 90 percent of world production of cotton.
- Gossypium barbadense – This is known for its extra-long staple feature. It is a native to tropical South America, and constitutes 8 percent of world cotton production.

Old World cotton

- Gossypium arboreum – This is a native to India and Pakistan. This constitutes less than 2 percent of world cotton production.
- Gossypium herbaceum – This is a native to southern Africa and the Arabian Peninsula and constitutes less than 2 percent of world production.

The two New World cotton species have gained prominence in the twentieth century. These now account for the vast majority of modern cotton production. The two Old World species were widely used before the 1900s.

Evolution of Cotton in India

Literatures on origin of cotton demonstrate that in the ancient period, cotton was first domesticated thousands of years back. However, the exact date varies between 7000 BC to 4000 BC.[2] History of cotton shows two main species namely, *G. arboreum* and *G. herbaceum* found in those days.[3] The two species are argued to be genetically very different and had varying characteristics.[4] Literatures also show that while cultivation of G. arboreum began in the Indus Valley of India and Pakistan, and from there it spread over Africa and Asia, cultivation of G. herbaceum first took place in Arabia and Syria.

Cotton for long has been converted and used as fabrics. There are literatures which show that in the old periods, several isolated civilisations had domesticated and converted cotton into fabric. The domestication was supported by invention of tools such as combs, bows, hand spindles, and primitive looms (Yafa 2005). The oldest cotton textiles were found in graves and city ruins of civilisations from dry climates, where the fabrics did not decay completely (Harry and Jacob (1958). Some of the oldest cotton bolls were discovered in a cave in Mexico, and were dated to approximately 5500 BC. However, more recent estimates have put the age of these bolls at approximately 3600 BC. Seeds and ropes dating to about 4500 BC have been found in Peru (Yafa 2005). In India, records on cotton domestication indicate that the Indus Valley civilisation spun cotton since at least 3000 BC. This is indicated by the ruins of Mohenjo-daro. Around the same time, cotton was being grown and processed in China, Mexico, and Arizona.

During the middle ages (often referred to the period between 5th to the 15th centuries), cotton had become a common fabric.[5] The cotton fabrics originated from hand-weaving practices performed on a loom.

The period also witnessed the wider spread and uses of cotton. Cotton manufacturing in Europe was introduced during the Muslim conquest of the Iberian Peninsula and Sicily. The knowledge of cotton weaving was spread to northern Italy in the 12th century, when Sicily was conquered by the Normans, and consequently to the rest of Europe. Introduction of the spinning wheel, introduced to Europe around1350, improved the speed of cotton spinning. Cotton cloth started to become highly sought after for the European urban markets during the renaissance (beginning 1300 AD) and then the enlightenment (18th century).

History on evolution of cotton in modern era show that cotton rose to attain the status of a commodity of global importance in 17th century. The evolutionary process was facilitated by the cultural transformation of Europe and Britain's trading empire. By this time, the famous East India Company had started importing cotton fabrics into Britain. Before the close of the century (1690) the company had already introduced cotton prints in Britain.[6]

India for long has remained a prominent country in production and uses of cotton. There are indications that in India, painted cottons[7] were developed in the fourteenth century, and in the seventeenth century, Europeans began to import these fabrics from India. This was because of better quality of Indian cotton, which was appreciated because of their bright colours, lightweight hand, and ease in laundering, as they expanded their trade networks. The use of block printing, exported by the Europeans to India, made the fabrics easier and cheaper to manufacture, and as Indians successfully adjusted local designs with an eye on European market.

Literatures showing the accounts of European travellers to India reveal that India in the 17th century and early parts of 18th century was economically more advanced than most of the European nations. These also reveal that traders from various parts of the world travelled to India and exchanged their precious possessions such as gold, silver, and other precious stones with cotton textiles, and others. It was, inter alia, importance of cotton in the global market that helped India maintain a favourable balance of trade during those periods. At the time when industrial revolution started in Europe, India was regarded as the richest nation of the world, mainly because of its prominence in the export of cotton till the end of 18th century.

It might be recalled that even before 18th century, the East India Company had set up its first factory at Surat and the second at Madras in 1639 AD. The establishment of the two factories was followed by direct trading of cotton goods to Britain began in the 1640s. This was, however, considered as a threat to the then existing British local woollen industry,

and this put the East India Company under severe attack for encouraging production of cotton fabrics in India. An Act of Parliament 1721 AD prohibited the import and wear of the printed fabrics. This completely changed the perspective of the East India Company.

The development at the domestic front forced the East India Company to revise their policy in 1793. The new policy aimed to (i) increase import of raw materials; and (ii) increase the export of British manufactured goods. The change in perspective and policy converted India to a major exporter of raw cotton and a major importer of fabrics. The significance of the changed dynamics can be understood from the fact that in 1801, the import of raw cotton into Britain was placed at £56 million and India was the principal source of supply of this raw material. The export of cotton increased further and by 1850, India accounted for almost one-sixth of the total textile exports from England and also became the largest consumer of British textiles. In a period of about 200 years, India was thus reduced from the position of a supplier of manufactured cotton goods to that of a supplier of raw cotton.

The decline in global importance of Indian cotton was reinforced by the invention of power loom and other mechanical devices, imposition of heavy tariff on Indian cotton and cotton goods in England, and exemption of duties on British staples imported in India.[8]

Not much change took place during the following hundred years, with raw cotton exported to Britain and manufactured fabrics imported into India. There was, however, some revival to the fate of local cotton use in India in the second quarter of twentieth century, with the spread of nationalistic movement widely known as the Swadeshi movement under the leadership of Mahatma Gandhi. Mahatma Gandhi began promoting the spinning of khadi for rural self-employment and self-reliance in 1920s. The freedom struggle primarily evolved around the use of khadi fabrics and the dumping of foreign-made clothes.

Cotton Uses and Its Importance

Cotton once produced passes through a number of processes before it is fully used/ consumed. The process starts with the picking up of the cotton by the farmers. After completion of this first step, it is delivered for ginning to a different set of people. This is the stage when the fiber is separated from the seed. After the completion of separation process, fibers are compressed into bales of about 170 kg. This, however, varies from one country to another, and go up to 380 kilos. Cotton seed is used for cooking oil, animal feed and industrial purposes.

Box 2.1: Some Important Events/Dates in the Modern History of Cotton in India

- In 1818, the first Indian cotton cloth mill established in 1818 at Fort Gloaster near Kolkata. It was, however, an unsuccessful beginning.
- In 1864, Bombay Spinning and Weaving Company were established. This laid the foundation of modern cotton industry in India.
- In 1875, the first organised futures market was established by the Bombay Cotton Trade Association to trade in cotton contracts.
- In 1893, the Bombay Cotton Exchange Ltd came into existence as a result of widespread discontent amongst leading cotton mill owners and merchants over the functioning of the Bombay Cotton Trade Association.
- In 1921, East India Cotton Association (later known as Cotton Association of India) established.
  - In 1952, the association was granted recognition for conducting futures trading in cotton [In 2007, the association was re-designated as Cotton Association of India (CAI)].
- In 1921, Indian Central Cotton Committee set up (in 1965, the Indian Central Cotton Committee was wound up and the functions transferred to the Indian Council of Agricultural Research (ICAR), New Delhi)
- In 1924, Cotton Technological Research Laboratory [now known as Central Institute for Research on Cotton Technology (CIRCOT)] was set up at Bombay
- The 1947 partition of India had an adverse impact on Indian cotton industry: a number of mills and about 40 percent of cotton growing areas became part of Pakistan.
- In 1967, All Indian Coordinated Cotton Improvement Project (AICCIP) was launched
- In 1970, Cotton Corporation of India established to deal with trade, procurement, and export of cotton
- In 1976, the Central Institute for Cotton Research (CICR) established at Nagpur
- In 1997, Meera Committee was appointed to development of handloom sector. The committee recommended establishment of National Handloom Fund of Rs500 crore.
- In 2000, the Government of India set up Technology Mission on Cotton. The Mission, consisting of four sub-missions was originally intended to run for five years (stating 1999-2000), but was extended further and is continuing even today. Major goals of the four sub-missions include:
  - Increase the productivity per hectare of cotton
  - Development of new technologies and varieties which can perform better under water stress and high pest incidence condition and give good yield of quality cotton.
  - Transfer of new technology and financial assistance to the farmers to reduce their production costs and improve farmers' income

- Improve marketing infrastructure to ensure proper grading and auction at regulated markets, ensuring that growers get full price for their produce and also improve physical facilities at regulated markets.
- Improve the seed cotton (kapas) processing for reducing contamination and thereby improving quality of raw cotton for further end user.

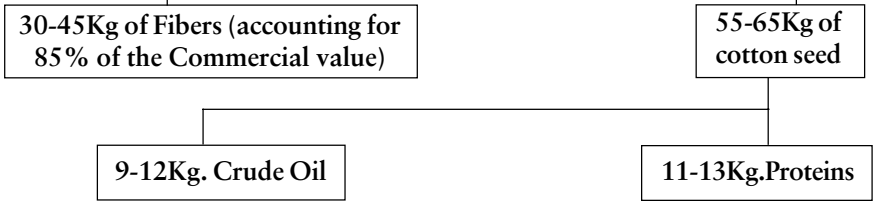
- Some important schemes for handloom development:
  - Deen Dayal Hathkargha Protsahan Yojana
  - Workshed cum Housing Scheme
  - Weavers Welfare Scheme
  - Health Insurance Scheme for Handloom Weavers
  - The Mahatma Gandhi Bunkar Bima Yojana
  - The Integrated Handloom Cluster Development Scheme
- In 2008, CAI launched cotton price index in line with some commodities futures markets in the US and UK.
- Draft The Cotton Trade (Development And Regulation) Bill, 2012

Source: Cotton Corporation of India and various others

The next step is segregation of cotton based on quality and class, and then transporting/shipping it to the port of destination. And then it goes to the spinning mills. This stage converts the cotton fiber into yarn which is used for weaving or knitting of fabric. The raw fabric goes through a number of finishing processes before being made into apparel, home furnishings and industrial products.

The above description is, however, limited to journey of cotton from field to spinning mills. Taking a comprehensive view of the life cycle of cotton, it is observed that a number of additional processes and functions are performed, and these in the process use cotton in various ways and forms, including fibre, animal feeds, cooking oil.

Figure 2.1: Cotton Composition
(100Kg of seed cotton)

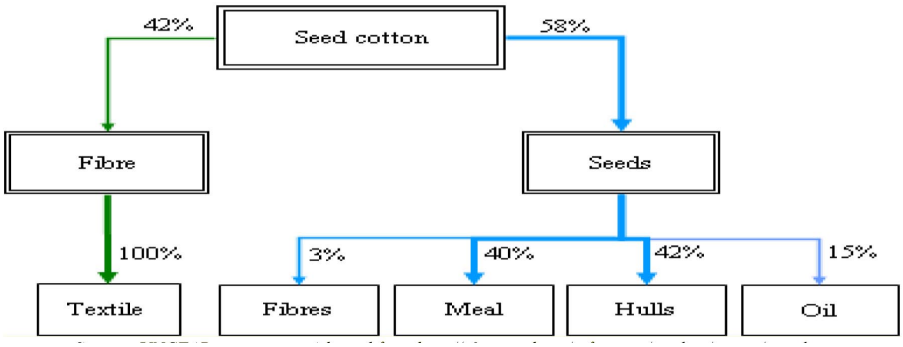


Source: AGMARK, Post-Harvest Profile of Cotton, available at http://agmarknet.nic.in/cotton_profile.pdf

In countries like the US and also in many other countries, cottonseed oil is used in preparation of cattle food, soaps, cosmetics and explosives are a few of the products that contain cottonseed oil. One major characteristic of cottonseed oil is that it is quite rich in vitamin E, and therefore it is used as cooking oil. After extraction of the oil, the residue or meal, which is high in protein, is marketed and used for animal feed and fertilisers. The remaining seed coat provides cellulose in livestock feed. Sometimes, it is added to insulations and petroleum derived plastics. A detailed graphic presentation of direct and indirect uses of cotton is made in the figures below (Figure 2.2 to 2.5)

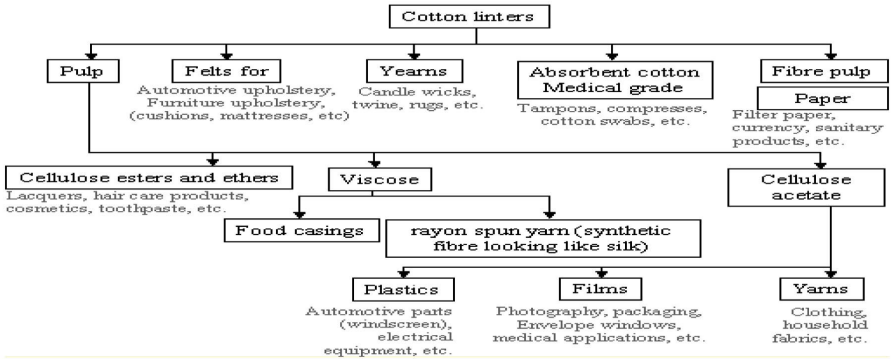
Uses of cotton is, thus, not limited to fabrics only, rather it encompasses a much wider horizon and is used to fulfil various other human needs.

Figure 2.2: Products Derived from Cotton Fibre



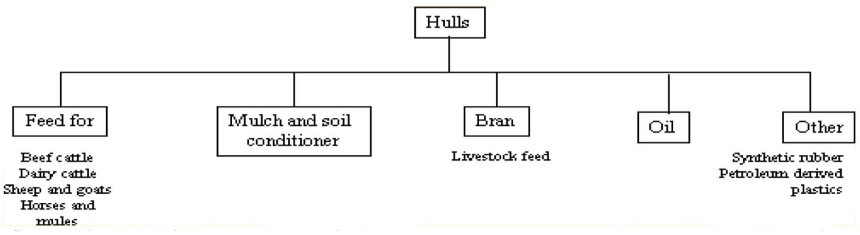
Source: UNCTAD secretariat. Adapted from http://r0.unctad.org/infocomm/anglais/cotton/uses.htm

Figure 2.3: Major Uses of Cotton Fibre



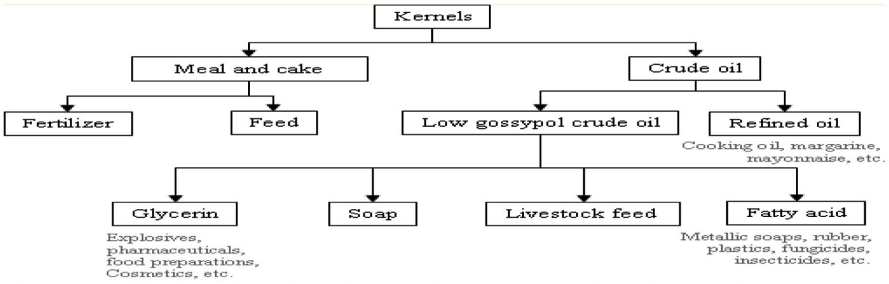
Source: Adapted from http://r0.unctad.org/infocomm/anglais/cotton/uses.htm. Originally given in Cotton Facts (2003)

Figure 2.4: Uses of Cottonseed Coat (hull)



Source: Adapted from http://r0.unctad.org/infocomm/anglais/cotton/uses.htm. Originally given in Cotton Facts, ICAC (2003)

Figure 2.5: Uses of Cottonseed Meal



Source: Adapted from http://r0.unctad.org/infocomm/anglais/cotton/uses.htm. Originally given in Cotton Facts, ICAC (2003)

Cotton Value Chain: Definition and Evolution

Value chains[9] essentially represent a series of activities a product/ service must pass through until it serves its final purpose of satisfying a customer need. All of these activities are sequential and has impact on the following activities, implying any distortion at any point of time can obstruct achievement of the final or expected output/outcome. The primary focus of any value chain is on the benefits that accrue to customers, the interdependent processes that generate value and the resulting demand and funds flows that are created. It is a well-accepted fact that an effective value chain reduces cost and generates profits. The value chain can be small or big depending on the type of product or service. It is worth mentioning, as indicated above, that each of the points in value chain is crucial and any malfunctioning in the chain is capable of breaking down the whole chain, and the objective of generating value for the customer in such cases might not be accomplished. Each of the linkages in the chain adds some value to the final product or service.

Box 2.2: Cotton Journey: Farm to Fabrics

The cotton crop is usually picked in seedpod form, either by hand or through mechanised means.

Pods are then sent to ginning mills, where a cotton gin is used to separate the cotton fibres from the pod.

From ginning mills, while the fibres are either sent to spinning mills or exported as raw cotton, seed pods are sent to oil mills.

At the spinning mill, bales of raw cotton are then processed into yarn or thread,in either hank or cone form.

While hank yarn is sold to handloom weavers,cone yarn is sold to power loom operators, to use in the production of fabrics.

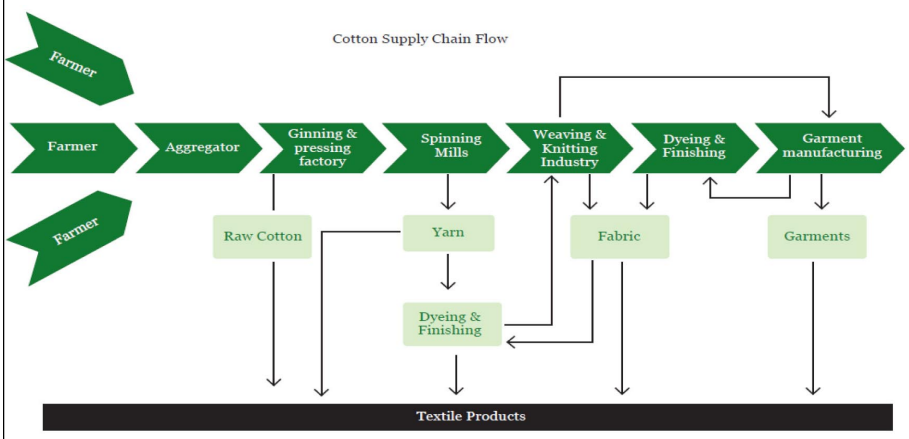
Cotton value chain has witnessed a complete evolution in India since independence. Literatures on evolution of cotton value chain show that in the earlier periods, cotton cultivation and trading was considered to be centralised activities. Most of the activities relating to cotton production and its uses starting from cultivation, production, to marketing and consumption, were found in villages throughout the country. One of the major advantage of centralised activity was that it had little information asymmetry and few price distortion. Weavers purchased cotton in local markets, spun the yarn in house and sold their fabrics in the local markets. The artisans acted as both producer and sellers as well, and they had almost complete control over the cotton value chain.

The situation, however, started changing after independence in 1947, when the government started promoting handloom weaver cooperatives. Government encouraged formation of cooperatives and members of the cooperatives were encouraged by the government to organise and strengthen handloom weavers throughout the country. Members were also encouraged to join the cooperatives to pool their resources and work together to address common social, economic and cultural needs. The new system was, however, not fool proof, as it had certain disadvantages. One major disadvantage of joining cooperatives was that the artisan could only procure their cotton yarn through the cooperative or through master weaver. This process led to emergence of other institutions in the cotton value chain which tended to alienate the role of weaver from the production unit. This also led to widening of gap between weaver and production unit. In the later periods, the role of trader became important to bridge the gap between growers, weavers and the end consumer.

In the current periods, cotton value chain in India is in line with international practices followed by other major cotton producing countries. It is more streamlined and focused now. Cotton value chain now passes through various processes before it is finally used for manufacturing of fabrics. While cotton production and its final use at the manufacturing level are the two end-to-end points, in between the two points, there lies many other points that channelise cotton to its end use, and at each point some value additions are made. More specifically, the existing cotton value chain in India includes aggregators, ginners, spinners and weavers. The chain, however, does not end here. From the level of weavers, it goes to manufacturers, and then to retailers.

The Indian cotton value chain, which culminates in textile and garment products, is very complex in structure. It is characterised by presence of numerous small-scale, decentralised and fragmented units along with some large-sized integrated enterprises. It is observed that while the small-scale sector is largely unorganised and labour-intensive, large-scale enterprises are mostly organised and capital-intensive.

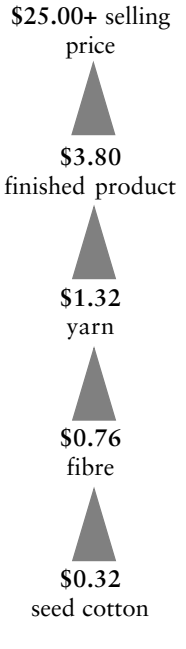
Figure 2.6: Cotton Value Chain



Source: Adapted from WWF (2012), Cotton Market and Sustainability in India

Figure 2.7 below gives a rough understanding of value additions at different stages of cotton value chain. This, however, might not be a universal or common trend, and can vary from one country to another, especially when one compares value additions in developed and developing countries, including India.

Figure 2.7: Typical Value Chain *(per kilo of product)*



In the cotton value chain, starting from procurement of seeds to manufacturing of fabrics, there is value addition at each of the stages. Each of the stages is important from both consumers and producers point of view. The importance and contribution at other stages can be understood by the fact that most of the value addition takes place at the last stage of the chain. In between the last two stages (finished products and selling price), there is nearly eight times incremental increase in the value of the finished products. As compared to this, at the initial three stages (starting from seed to yarn), about four times incremental value addition is made.

Source: BBC World Service (emphasis added)

Structure and Types of Stakeholders in Cotton Industry and its Value Chain

Structure of Indian cotton textile industry can be classified into three broad categories, namely legal structure, industry structure, and marketing structure. At the legal front, cotton industry, being closely linked to the textile sector in India, is guided by the textile policy of the government of India. While the Indian government through the ministry of textile actively participates in the industry and serves as an umbrella for government agencies like Cotton Corporation of India (CCI) and state marketing federations; the state governments and regions in which the majority of the cotton planting occurs are also highly involved. In addition, there are committees and institutions responsible for the improvement of quality – such as Genetic Engineering Approval Committee (GEAC) and the Central Institute of Cotton Research (CICR). At the industry level, as indicated in the value chain above, the industry – from cotton to fabrics – can be segmented into the followings groups:

- *Cotton farming:* Mostly cotton is grown in India in dry lands. Crops are mostly dependent on both irrigation systems available and on the rain water.

- *Ginning:* Ginning is the process where cotton fiber is separated from the cotton seed. The process when the cotton is vacuumed into tubes that carry it to a dryer to reduce moisture and improve the fiber quality. Then it passes through cleaning equipment to remove leaf trash, sticks and other foreign matter. Ginning activities are performed by two methods. While cotton varieties with shorter staple or fiber length are ginned with saw gins; long fiber cottons are usually ginned in a roller gin.
- *Oil mill*: At this stage, oil is extracted from the cotton seeds that are coming form the ginning process. The cotton seeds coming from the ginning unit are then passed through the pressing unit and crude cotton oil is produced. The pressed cotton seed oil cake is supplied as the cattle feed. The crude is further modified as the bio-diesel which could be used as the one of the energy source. The refined cotton oil is also used as the edible oil but it is proved to be unfit for the human health.
- *Spinning*: This is the process of converting cotton or manmade fiber into yarn to be used for weaving and knitting.
- *Weaving and Knitting*: Weaving and knitting converts cotton, manmade, or blended yarns into woven or knitted fabrics. India's weaving and knitting sector remains highly fragmented, smallscale, and labor-intensive.
- *Fabric Finishing*: Fabric finishing includes dyeing, printing, and other cloth preparation prior to the manufacture of clothing. This stage is also dominated by a large number of independent, smallscale enterprises.
- *Clothing*: Apparel is produced by about 77,000 small-scale units classified as domestic manufacturers, manufacturer exporters, and fabricators (subcontractors).
- *Composite mills***:** Large-scale mills that integrate spinning, weaving and fabric finishing activities account for about only 3 percent of output in the textile sector. About 276 composite mills are now operating in India, a majority of which are owned by the public sector. Mills can be divided into cooperative spinning mills and private spinning mills. Cooperative spinning mills are registered under the Cooperative Societies Act and were promoted by the government. Private composite spinning mills, on the other hand, comprise of spinning, weaving and processing activities. Whereas yarn spinning mills involve in yarn production and do not undertake weaving. It is worth mentioning that the spinning mill sector remains the most organised part of the cotton textile industry, due to the centralised nature of the spinning activities and its scale of production.

Box 2.3: Some Do's and Don't as Prescribed by the Government

Do	*Don't*
• Seed Cotton should be collected from fully opened bolls only.	• The practice of collecting half open bolls, drying them & removing the seed cotton should be discouraged.
• Picking should be done early in the morning & evening.	• Picking should be avoided in hot mid-day & when the weather condition is wet.
• Keep the seed cotton from last picking separately for marketing.	• Cotton of different picking should not be mixed as this generally lowers the quality.
• Seed cotton should be heaped on a cloth or gunny or paper spread before transportation to market.	• Seed cotton should not come into direct contact with the soil to avoid increase its trash content.
• Seed cotton should be dried in shed.	• Never expose seed cotton to excess sun as it lowers the grade due to yellowing.
• Get the market information regularly from *www.agmarknet.nic*, newspaper, T.V., concerned APMC office before marketing.	• Never market the produce without collecting market information regarding price trend etc.
• Avail the facility of future trading & forward contract to avoid price risk.	• Never sale the produce at fluctuating price in a glut situation.
• Select the shortest & efficient marketing channels to get higher share in marketing.	• Never select a longer marketing channel.
• Use proper packaging material.	• Use of improper packaging material causes loss during transport & storage.
• Follow the export rules & regulation properly during export.	• Do not keep any lacunae in export procedure.

Source: Post Harvest Profile of Cotton (2008), Government of India

Box 2.4: Some Basic Cotton Statistics in India

- There are nearly 6.2 million cotton farmers in India; out of this over 4 million are smallholder farmers who produce cotton on less than one hectare.
- Cotton cultivation in India accounts for about 5 percent of the total land under cultivation.
- There are 16 certifiers accredited for operations in India.[10]
- Cotton accounts for more than 75% of the total fibre consumption in the spinning mills and more than 54% of the total fibre consumption in the textile sector.[11]
- Acreage under cotton cultivation has also increased and from 58.82 lakh hectares in 1950-51 to a record high of 121.91 lakh hectares in 2011-12.
- The average yield has also increased from 88 kgs in 1950-51 to 554 kgs in 2007-08.
- Nearly 65% of the area under cotton cultivation is rainfed.
- Cotton cultivation accounts for nearly 50 percent of the pesticides produced in India.
- Weaving industry of India provides employment to approximately 12.5 million people.
- Dhoti, saree, towel/napkin, bed sheet, sarong, furnishings, gamcha and lungi are some of the major products originating from cotton at the weaving stage. Based on this, one can say that there are about 2 mn weavers in India. Over 2.2 mn households reported use of cotton yarn in 2009-10.[12]
- Weaving industry supports 32 other sectors that include marketing, financial, transportation, hotels and even maintenance services.
- As on 30th November 2011, there were 1946 cotton/man-made fibre textile mills (non-SSI) in the country with an installed capacity of 43.13 million spindles 5, 20,000 rotors and 52,000 looms.
- Cotton accounts for more than 75% of the total fibre consumption in the spinning mills and more than 54% of the total fibre consumption in the textile sector.
- In 2011, cotton cloth constituted nearly 73% of total clothes produced by the mill sector; 87% of the handloom sector; 31% of decentralised powerloom sector; and 86% of decentralised hosiery sector. Overall the share of cotton is nearly 51%.
- The share of cotton textile in total export was over 31% in 2010-11. Annual growth in export of cotton textile was second highest at 41%, after handloom products (74%).
- As per the National Fibre Policy (2010-11), cotton production is envisaged to rise at a growth rate of 4.7 percent from 319 lakh bales in 2010-11 to 483 lakh bales in 2019-20; cotton Consumption is envisaged to increase to 413 lakh bales by 2019-20 with 70 lakh bales being surplus.

The structure of cotton textile industry can also be seen be examining the number of mills and other industry infrastructure such as spinning, weaving, finishing, and apparel-making enterprises operating at a point of time. By nature, the structure of cotton textile industry in India is mostly disintegrated. This is primarily because of government policies that have promoted labour intensive, small-scale operations and discriminated against larger scale firms. The evolving structure of cotton textile industry in India has been presented in the table below (Table 2.1). The table below reveals the journey over the last one decade period has not been smooth. Cotton textile industry during this period has passed through both ups and down due to both domestic and global factors.

In 2000-01, the total number of spinning and composite mills were 1561 and 281. The number of spinning mills increased from to 1766 in 2010-11. However, during the same period, the number of composite mills decreased from 281 to 185. It is also observed that total installed capacity for the spindle, looms and rotors has also varied. While in 2000-01, the total installed capacity were 35.5 million for spindle, about 123 thousand for looms and 394 thousands for rotors; in 2010-11, the installed capacity increased for spindles (39.5 million) and rotors (523 thousand), and it declined for looms (57 thousand). The trend over the last one decade is reflected by the table below (Table 2.1)

Table 2.1: Cotton Textile Processing Infrastructure in India

Year	*Mills (Nos)*			*Capacity installed*		
	Spinning	Composite	Total	Spindles (Millions)	Looms (000)	Rotors (000)
2000-01	1561	281	1846	35.5	123	394
2001-02	1579	281	1860	35.8	123	409
2002-03	1599	276	1875	36.1	119	379
2003-04	1564	223	1787	34	88	383
2004-05	1566	223	1789	34.2	86	385
2005-06	1570	210	1780	34.1	73	396
2006-07	1608	200	1808	35.6	69	448
2007-08	1597	176	1773	35	56	461
2008-09	1653	177	1830	37	57	485
2009-10	1673	180	1854	37.7	57	494
2010-11*	1766	185	1951	39.5	57	523

Source: Ministry of Textile, Government of India.

As indicated above, the cotton textile industry over the last one decade period has passed through both ups and down, and this has influenced structural changes at various fronts, as reflected by changes in number of operating mills. This is, inter alia, because of the impact of changing global trade dynamics that has been constantly felt throughout this period. A number of mills have closed down affecting thousands of people employed in the sector. Some of these were revived in the later periods. This is reflected by the table below (Table 2.2).

The number of closed spinning and composite mills during 2000-01 were 262 and 121. In subsequent years, the number has changed. This all makes structural changes a regular phenomenon for the cotton textile industry in India.

Table 2.2: Total Number of Affected Textile Mills in India

Year	Number of closed mills			Spindles		Rotors		Looms		Employees on Rolls	
	Spinning	Composite	Total	No. (000)	%	No. (000)	%	No. (000)	%	No. (000)	%
2000-01	262	121	383	8964	25.2	46012	11.78	690	56.1	344	34.5
2001-02	295	126	421	9459	26.5	59712	14.6	710	57.8	362	36.2
2002-03	349	134	483	10699	29.6	66936	17.7	741	62.1	390	38.9
2003-04	374	94	468	9391	27.6	83000	21.7	515	84.1	329	37.1
2004-05	376	99	475	9646	28.2	88160	22.9	538	62.7	335	38.2
2005-06	387	96	483	9680	28.4	92808	23.5	491	67.3	339	39.3
2006-07	380	87	467	9163	25.7	91544	20.4	451	65.6	320	37.5
2007-08	318	63	381	7285	20.8	80704	17.5	328	58.6	254	32.0
2008-09	339	64	403	7380	21.1	95185	20.7	331	59.1	254	32.0
2009-10	365	68	433	7870	22.5	105508	22.9	340	60.7	265	33.4
2010-11	471	81	522	-	-	-	-	-	-	-	-

Source: Indaistat.com

Within the country, the distribution of cotton textile infrastructure, especially cotton/man-made fibre mills, is not even across different states. A major proportion of these are concentrated in a few states. Only three states, namely Tamil Nadu, Maharashtra and Andhra Pradesh account for about three-fourth of the cotton/man-made fibre mills in India. Total number of cotton/man-made textile mills (Non-SSIs) functions in India as

on May 2011 has been shown in the table below (Table 2.2). The table clearly shows that out of the total number of functioning mills (1443), Tamil Nadu (56 percent) has the largest share followed by Maharashtra (11 percent), Andhra Pradesh (8 percent). Shares of all other states are below 5 percent mark, reflective of a very high level of concentration.

Table 2.3: State-wise Share in Cotton/Man Fibre Textile Mills (Non SSIs)

States/UTs	*Number of Mills*	*Cotton textile mills (share in %)*
Tamil Nadu	803	55.65
Maharashtra	165	11.43
Andhra Pradesh	119	8.25
Punjab	80	5.54
Gujarat	44	3.05
Madhya Pradesh	38	2.63
Rajasthan	38	2.63
Haryana	31	2.15
Others		18.67
India	1443	100

Source: Indiastat.com

At the marketing level, the Agriculture Produce Marketing Committee (APMC) is the primary market infrastructure in the country through which cotton is marketed. The APMC regulate market practices such as weigh-ing, process of sale, method of grading, payment process, etc. It also provides facilities for storage, boarding and lodging for buyers, sellers, etc. For its facilitatory services, the committee charges 1 percent of the goods value as fees from the buyers. The marketing committee, which runs the market, consists of both buyers and sellers who have the responsibility of maintaining and developing the market yard for its users. In India, currently there are around 7,062 mandis that are functional.[13]

The three types of marketing agencies engaged in cotton trade are:

- Private sector comprising traders, owners of ginneries operating as individual business proprietors, partnership firms and private limited companies

- Public sector agencies like the Cotton Corporation of India (CCI)
- Co-operative sector

Estimates show that about four-fifth of the marketable surplus of kapas and lint is handled by the private marketing channels[14] and the remaining one-fifth by the institutional marketing channels including co-operatives and Cotton Corporation of India (CCI).

In terms of types of the market, cotton markets in India may be classified into three segments: a) primary wholesale markets; secondary wholesale market and terminal markets. In the first type, markets are held periodically, once or twice a week. In the second type of market (secondary wholesale market normally located at district or taluka headquarters), small merchants purchase cotton from the buyers in the primary markets. The produce is finally disposed-off in the third type of market (terminal market) directly to consumers, or processors or assembled for shipment to foreign countries. Terminal markets are linked to warehouses and storages that are available and cover a wide area.

Box 2.5: Practices Followed in Marketing of Cotton in India

Before cotton lint reaches the ultimate consumer, namely, textile mills, it is generally moved from the primary markets to the secondary market, from secondary markets to the terminal markets. As regards the market practices are concerned, cotton is sold by the producers to village merchants, itinerant traders, agents of Cooperative Marketing Federations, agents of textile mills and owners of ginning and pressing factories. Normally intermediaries are not involved in the sale operation at village level. Followings are some of the marketing practices followed in marketing of cotton.

- The business in the wholesale market is conducted in accordance with the local traditional customs and practices evolved over the periods.
- In some markets where trade associations have been formed, business is conducted in accordance with the bye-laws framed for the purpose.
- Where the markets are regulated and are managed by the market committees, business is conducted according to bye-laws framed by the market committees and approved by the State Government.
- In the whole sale markets normally raw cotton is sold and producer, village traders, itineral traders bring the produce in the market yard. Before negotiations begin, the buyers generally go round and inspect the goods.
- Where the open auction system is in vogue the auctions are conducted during fixed hours and buyers go from shop to shop and bid for various lots.

Contd...

In the terminal markets, normally, cotton lint is sold and buyers in such markets inspect the lint quality and prices are negotiated as per the quality of lint. Large number of buyers and sellers are assembled in the market. As regards the method of sale of kapas is concerned, there are many systems in vogue, including

- open agreement sale system,
- open auction system,
- secret system,
- cover system,
- party price method,
- Forward sale system.

In these marketing markets, there are various functionaries connected with the marketing of cotton, both assembling and distribution, comprising commission agents, brokers, traders, weigh men, and hammals etc.

Following agencies are engaged in the distribution of cotton at various stages of marketing:

- Producer
- Village merchant
- Itinerant traders
- The agent of corporation marketing federation
- Agent of textile mills owner
- Ginning factories

Source: Post Harvest Profile of Cotton (2008), Ministry of Textile, Government of India.

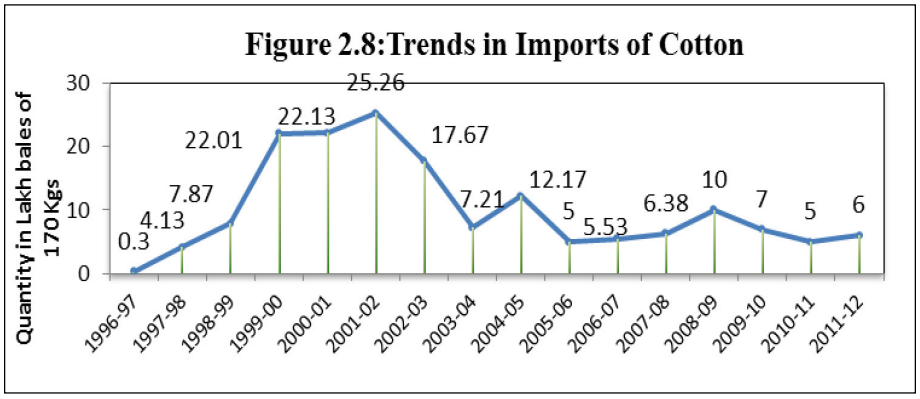
Cotton Industry Linkages with Domestic and Foreign Markets

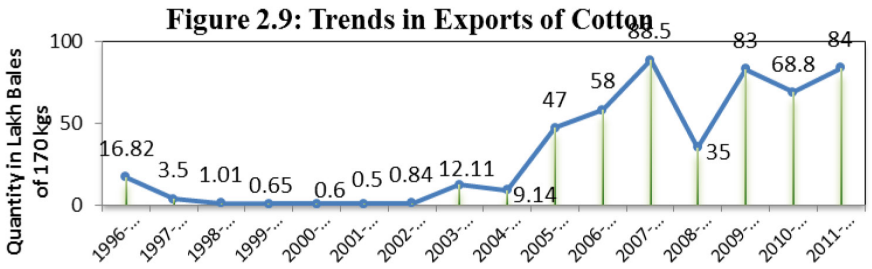
Cotton is an intermediate product, as it is used for fulfilment of various human needs. As indicated above, while one the one hand, it is used for manufacturing of clothes, it is also used as cooking oil and animal feeds. Cotton industry linkages with the domestic and foreign markets are purely because use of cotton in the manufacturing of fabrics. At the domestic front, cotton constitutes nearly 60 percent of the raw materials used by the cotton textile industry, implying that the success of the cotton textile industry in India is critically dependent on sufficient domestic production and efficient functioning of the cotton supply chain. High share of cotton textile in employment generation makes the sector more important from national point of view.

Table 2.4: Trend in Domestic Consumption and Export of Cotton*		
Year	*Export (% of total production)*	*Domestic consumption (% of total production)*
2000-01	0.429	99.6
2001-02	0.316	99.7
2002-03	0.618	99.4
2003-04	6.765	93.2
2004-05	3.761	96.2
2005-06	19.502	80.5
2006-07	20.714	79.3
2007-08	27.850	72.1
2008-09	12.069	87.9
2009-10(P)	28.136	71.9
Source: Cotton Corporation of India		

Cotton industry linkage with the global market is reflected by increasing export of cotton and cotton based products to the global market. India has emerged a major exporter of cotton over the last one decade. Presently, India exports over 28 percent of its total production to the global market. The increasing level of export coupled with its rising share in global exports, helped India to become an indispensable part of the global cotton and textile industry supply chain.

Emerging dynamics of cotton is discussed in more details in the following chapter.





Source: cotton corporation in India

Endnotes

1 Within the two major classifications, the classification is now extended to cover five types staples, short, medium, medium long, long and extra-long *(source: Santhanam, V., Extra-Long Staple Cotton Cultivation in India: Historical Perspective, Central Institute of Cotton Research)*. Some studies also show four types of staples, and does not include medium long.

2 Huckell, Lisa W. (1993), Plant Remains from the Pinaleño Cotton Cache, Arizona, Kiva, the Journal of Southwest Anthropology and History 59 (2): 148–149.

3 In addition to the two varieties found in the ancient periods, two new varieties have been added. These are G.barbadense and G.hirsutum. This takes number of available varieties to four. Further it can be noted that in all, there are about 42 species of the genus Gossypium, out of these only four indicated species are in use, and the rest are wild *(source: Kapas India)*.

4 Some of the characteristics of wild G. herbaceum cotton variety include: higher plant size compared to the domesticated shrubs; smaller fruit; and thicker seed coats.

5 Backer, Patricia, Technology in Middle Ages, History of Technology, Retrieved 12 June 2011, available at http://www.engr.sjsu.edu/pabacker/history/middle.htm

6 Schoen, Brian (2009), The Fragile Fabric of Union: Cotton, Federal Politics, and the Global Origins of the Civil War, Johns Hopkins University Press

7 Colours painted onto cloth by hand, either freehand or over a stencil. It is interesting to note that dyes for all printed cottons were until the nineteenth century were derived from vegetable (or, less frequently, from animal or mineral) sources. Most eighteenth-century dyes were derived from madder, which creates a range of colors from pink to red, purple, and black. Blues and yellows were added by hand penciling the colors onto the fabric. The dyes were created through a combination of mordant dyeing (fixative

chemicals are printed onto the cloth, which is then dipped into the dye), resist dyeing (the fabric is coated by hand so that the coated areas do not absorb the dye color), relief printing (the design is cut out of a block, which is inked or coated with dye and then pressed onto the fabric), and hand painting.

8 Bansal, U.R. and Bansal, B.B (1984), Industries in india during 18th and 19th Centrury, Indian Journal of History of Science, 19 (3): 215-223, available at http://www.new.dli.ernet.in/rawdataupload/upload/insa/INSA_1/20005abd_215.pdf

9 The Value Chain concept was introduced by Michael Porter in his 1985 best-seller, Competitive Advantage: Creating and Sustaining Superior Performance.

10 Integrity in the Indian Organic Cotton Value Chain: A Summary of Issues and Gaps for Potential Action, A Public Interest Report by ICCO, Organic Exchange and Solidaridad

11 Ministry of Textile, Annual Report 2011-12

12 Ministry of Textile, Government of India and National Council for Applied Economic Research, Handloom Census of India 2009-10

13 WWF (2012), Cotton Market and Its Sustainability in India

14 In private setup, farmers sell cotton directly to ginners, primarily in the form of kapas (raw cotton or seed cotton). Re-cently, aggregators have started to play a major role in collecting raw cotton from farm gate of 10-15 farmers and in sell-ing the consolidated produce to ginners in a radius of 100-150 km.

3
Economics of Cotton in India

Economics of cotton can be described as the efficiency of use of inputs required for the production of cotton and the efficiency in production of output (cotton) finally culminating to the satisfaction and welfare of people. Going by this description, analysis of economics of cotton within the domestic market can include production practices and use of inputs, such as seed, fertiliser and pesticides on the one hand, and the processes of use of output (cotton) – such as ginning, spinning, weaving, manufacturing and retailing on the other. Another important market segment that is distantly but inherently linked to conversion of cotton to end product is chemical market. Beyond the domestic market, the economics of cotton can include international trade (especially exports). All of these involve costs and contribute in revenue generation.

In fact, the whole cotton chain becomes part of the economics of cotton.

This chapter discusses economics of cotton in India and its linkages effect in the economy. In particular, it discusses cotton production and consumption practices, its backward and forward linkages, sustainable production alternatives and impacts of cotton production with special reference to India, and export.

Trend in Cotton Production and Consumption

Global cotton scenario

It does not need mentioning that cotton is a very important natural fibre of the 21st century. Its importance is reflected by the fact that it is now grown in about 111 countries in the world[1], with China, India, US, Pakistan, Egypt being the major producers. It is the only fibre crop in which commercial cultivation of genetically modified varieties is accepted worldwide. As far as its growth is concerned, a continuous growth of cotton production is observed since the end of the Second World War due to its increasing demand.

Global demand for cotton continuously increased till 1990s. Even during the later years, demand has continued to increase. The increase was, however, more pronounced during 2001 to 2012 periods, as reflected by the increasing area under cotton cultivation. During 2011-12 season estimate shows that cotton is cultivated in about 35.7 million hectares across the world. In a number of cotton producing countries, including China and India, area under cultivation of cotton has significantly increased. There are, however, also indications that in some countries, such as the US, the area under cotton cultivation has declined.

Four major cotton producing countries, namely China, India, USA and Pakistan have a share of more than 75 percent in the world cotton production and area. In terms of area under cotton cultivation, India is the largest cotton growing country with area under cotton around 34 percent (12.20 million ha) followed by China (5.5 million ha).

In line with increasing area under cultivation of cotton, world cotton production has also increased. Presently the production is estimated at 26.92 million tons (Table 3.1). This shows an increase of 5.73 percent over the previous year 2010-11.

Table 3.1: Current Status: Area, Production and Yield (2011-12)

Country	Area (million ha)	Prod. (Thousand tonnes)	Yield (kg/ha)
China	5.5	7294	1326
India	12.2	5878	482
USA	3.95	3412	865
Pakistan	3.2	2308	721
Brazil	1.4	2025	1446
Uzbekistan	1.34	914	682
Others	8.12	5088	-
World	35.71	26919	754

Source: ICAC Cotton: World Statistics, September, 2010 and USDA

The increasing production trend is more contributed by the two major cotton producing countries, especially China and India. These two contribute over 50 percent of total global cotton production. Besides the two, data reflect that six countries accounted for a major share (over 80 percent) in world cotton production. India has gained the status of being the second largest producer of cotton next to china. India accounted for 22 percent of world production.

Increase in production has primarily been caused by increase in yields in major cotton producing countries. Production has been increased due to sharp rise in yield. In terms of productivity, among the major cotton growing countries, Australia tops the productivity level of 1804 kg/ha followed by Brazil (1446 kg/ha) and China (1326 kg/ha). Table 3.2 below presents the trend in area under cultivation, production and yield of cotton in major cotton producing counties.

Table 3.2: Global Cotton Production (2001-2012)

Countries		*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
China	Harvested Area	11910	11120	13096	14579	13220	14703	15320	14950	13096	12726	13591	12355
	Production	24400	25200	23800	30300	28400	35500	37000	36700	32000	30500	33500	31000
	Yield	983	1088	872	998	1031	1159	1159	1178	1173	1150	1183	1204
India	Harvested Area	21572	18945	18854	21710	21925	22649	23324	23243	25476	27527	30147	26687
	Production	12300	10600	14000	19000	19050	21800	24000	22600	23800	26400	26500	23500
	Yield	274	269	356	420	417	462	494	467	448	460	422	423
United States	Harvested Area	13828	12417	12004	13057	13803	12731	10490	7569	7529	10700	9462	10811
	Production	20303	17209	18255	23251	23890	21588	19207	12815	12188	18104	15573	17651
	Yield	705	665	730	855	831	814	879	813	777	812	790	784
Pakistan	Harvested Area	7700	6904	7386	7888	7663	8031	7413	7166	7413	6919	7907	7413
	Production	8286	7972	7845	11138	9850	9580	8550	8540	9240	8640	10600	9700
	Yield	517	554	510	678	617	573	554	572	598	599	643	628
Brazil	Harvested Area	1848	1816	2718	2896	2100	2703	2661	2083	2066	3459	3459	2595
	Production	3519	3890	6015	5900	4700	7000	7360	5480	5450	9000	8700	6750
	Yield	914	1028	1062	978	1074	1243	1328	1263	1266	1249	1207	1249
Uzbekistan	Harvested Area	3608	3516	3462	3506	3539	3534	3534	3509	3212	3212	3311	3212
	Production	4900	4600	4100	5200	5550	5350	5350	4600	3900	4100	4200	4100
	Yield	652	628	568	712	753	727	727	629	583	613	609	613
Australia	Harvested Area	998	544	484	776	830	356	161	405	494	1344	1433	1174
	Production	3340	1680	1700	3000	2800	1350	640	1500	1775	4200	4900	4250
	Yield	1606	1482	1686	1856	1619	1820	1908	1778	1725	1500	1641	1738
Turkey	Harvested Area	1712	1730	1754	1730	1483	1557	1285	840	692	791	1186	988
	Production	3975	4179	4100	4150	3550	3800	3100	1930	1750	2110	3250	2750
	Yield	1114	1159	1122	1151	1149	1171	1158	1103	1214	1280	1315	1336
Turkmenistan	Harvested Area	1273	1211	1186	1236	1483	1408	1354	1359	1359	1581	1421	1483
	Production	850	690	940	920	975	1400	1350	1550	1470	1750	1400	1500
	Yield	321	273	380	357	316	477	479	547	519	531	473	486
Greece	Harvested Area	1013	877	897	927	885	914	840	692	494	568	704	642
	Production	2093	1715	1530	1800	1975	1550	1550	1150	940	940	1330	1200
	Yield	992	939	819	932	1071	814	886	798	913	794	907	897

Source: ICAC Cotton: World Statistics, September, 2010 and USDA harvested area (000, acre), production (000, 480-pound bales), yield= (pound/acre).

Data reflects that out of the ten major cotton producing countries (Table 3.3), five countries has achieved positive growth in area under cultivation, while in other five counties, the under cotton cultivation has declined. The trend in area under cultivation appears to be positively related to production trend. All the five countries which have realised increase in area, have also achieved higher production. Pakistan is the only exception which has realised an increase in cotton production despite decline in area under cultivation.

What is, however, more important is that in most of the countries yield has improved over the period (2001 to 2012). This is reflective of the technological and other innovations that have penetrated cotton production practices.

Table 3.3: Compound Annual Growth Rate and Coefficient of Variation from 2000-2012

Countries	Compound Annual Growth Rate			Coefficient of variation		
	Harvested Area	Production	Yield	Harvested Area	Production	Yield
China	0.33	2.20	1.86	0.31	0.34	0.30
India	1.95	6.06	4.03	0.32	0.42	0.36
United state	-2.21	-1.26	0.97	0.35	0.35	0.30
Pakistan	-0.34	1.44	1.78	0.29	0.31	0.30
Brazil	3.13	6.10	2.88	0.37	0.41	0.31
Uzbekistan	-1.05	-1.61	-0.56	0.29	0.31	0.30
Australia	1.49	2.21	0.72	0.62	0.59	0.30
Turkey	-4.87	-3.29	1.67	0.42	0.40	0.30
Turkmenistan	1.40	5.30	3.84	0.30	0.41	0.37
Greece	-4.06	-4.93	-0.91	0.36	0.39	0.30
World						

Source: Computed by the author based on ICAC Cotton: World Statistics, September, 2010

Cotton production-Indian scenario

As indicated above, India now accounts for about 34 percent of the global cotton area and contributes to 22 percent of the global cotton produce. India's contribution to global cotton production increased from 14 percent in 2002 to 22 percent in 2010-11. Cotton occupies a significant place in both agricultural and industrial (textile) economy in India. The sector is the second largest employer after agriculture. Cotton provides

employment and sustenance to a population of nearly 60 million people, who are involved directly or indirectly in cotton production, processing, textiles and related activities. It is estimated that more than 6 million farmers cultivate cotton in India and about 36 million persons are employed directly by the textile industry.[2]

Its contribution in foreign exchange earnings is also significant. Cotton and textile exports accounted for nearly one-third of total foreign exchange earnings of India, amounting to Rs941.5 billion in 2009-10. Over the last one decade period, India has achieved significant breakthrough in cotton yarn exports besides increasing its global market share in cotton textiles and apparels.

Cotton production trend in India shows that production of cotton increased from a meagre 2.3 million bales (170 kg lint/bale) in 1947-48 to a record production of 17.6 million bales in 1996-97 and 31.5 million bales during 2010-11. Cotton now contributes about 65 percent of the total raw material needs of textile industry in India (CICR Vision 2030).

The progress and evolution of Indian cotton industry in the last decade (2001 to 2010) is presented in the Table 3.4 below. The table clearly demonstrates that significant gains in all parameters have been achieved by India. These parameters include area under cultivation, production of cotton, and also its yields.

In absolute number, area under cotton cultivation which was 85.76 lakh hectares in 2000-01 has increased to 121.91 lakh hectare in 2011-12. India has the distinction of pulling in largest additional area under cotton cultivation in the world during this period.

The production of cotton was 140 lakh bales of 170 kg during 2000-01 and it has become more than double (345) during 2011-12. Most of the growth in cotton production has come from the adoption of better quality of seeds (Bt cotton) during 2002.

The yield of cotton production was 278 kg per hectare during 2000-01 and 481 in 2011-12.

In terms of growth in the three parameters, it is observed that while the area under cultivation has realised a CAGR of 3.2 percent, production has increased by 8.5 percent. There is also significant gain in yield per hectare, which has increased by 5.1 percent during the period.

Table 3.4: Trend in Cotton Production and Consumption in India

Year	Area in lakh hectares	Production in lakh bales of 170kg	Yield kg per hectares	Imports		Exports	
				Quantity in lakh bales of 170kg	Values in Rs crore	Quantity in lakh bales of 170kg	Values in Rs crore
2000-01	85.76	140	278	22.13	2029.18	0.6	51.43
2001-02	87.3	158	308	25.26	2150.01	0.5	44.4
2002-03	76.67	136	302	17.67	1789.92	0.84	66.31
2003-04	76.3	179	399	7.21	880.1	12.11	1089.15
2004-05	87.86	243	470	12.17	1338.04	9.14	657.34
2005-06	86.77	241	472	5	695.77	47	3951.35
2006-07	91.44	280	521	5.53	752.29	58	5267.08
2007-08	94.14	307	554	6.38	978.54	88.5	8365.98
2008-09	94.06	290	524	10	1377.8	35	3837.13
2009-10	103.1	305	503	7	1195.64	83	10270.21
2010-11	111.42	339	517	5	NA	68.8	N.A.
2011-12	121.91	345	481	6	NA	84	N.A.
CAGR	3.2	8.5	5.1	-11.2	-4.7	56.7	61.9
C.V	0.14	0.31	0.22	0.66	0.40	0.87	1.10

Source: Central Institute for Cotton Research

CAGR= Compound Annual Growth Rate, C.V = Coefficient of variation.

Trend in cotton consumption in India

India has a large and expanding domestic textile industry. Increasing number of mills over the period coupled with growth in area under cotton cultivation, increase in total production and also yield has also contributed in increase in domestic cotton consumption. The mill consumption of cotton in the country especially textile mills and small scale spinning units had been continuously on the raise from the beginning of 1990s. The consumption of cotton, which was just 103 lakh bales during 1991-92, increased to about 260 lakh bales by the year 2011-12, an increase of more than 150 percent. Even in the last decade (2000-01 to 2011-12), the growth was positive. It is observed that domestic cotton consumption has increased by more than 42 percent during the period. The combined consumption by both Non-SSIs (Small scale industry) and SSIs mills which was 160.33 lakh bales during 2000-01 increased to 234.03 in 2011-12. Moreover, there is further scope to raise the local consumption in the coming periods.

A balance sheet of cotton covering the period 2000-01 to 2011-12, consisting of total supply (availability) and demand (consumption), is presented in Table 3.5. It also shows contribution/role of imports (inflows) and exports (outflows) in total demand and supply. Data clearly establish the fact that while the role of import in total supply (availability) has significantly declined; export has emerged a very important determinant of total consumption (disappearance).

Table 3.5: Cotton Balance Sheet (in lakh bales of 170 kg lint/bale)

Item	2000-01	2002-03	2004-05	2006-07	2007-08	2009-10	2010-11	2011-12*
	Supply							
Opening stock	40.5	40	21	52	47.5	71.5	40.5	48.3
Crop size	140	136	243	280	307	305	339	345
Imports	22.13	17.67	12.17	5.53	6.38	6	5	6
Availability	202.6	193.6	276.1	337.5	360.8	382.5	384.5	399.3
	Demand							
Mill consumption	149.3	142.42	163.98	194.89	195.67	219	220.7	216
Small Mill consumption	10.97	11.63	16.57	21.26	22.08	23	24.7	24
Non-Mill consumption	12.7	14.78	14.48	15.88	19.13	17	22	20
Total consumption	173	168.8	195	232	236.8	259	267.4	260
Export	0.6	0.84	9.14	58	88.5	83	68.8	84
Total disappearance	173.6	169.6	204.1	290	325.3	342	336.2	344
Carry forward	29	24	72	47.5	35.5	40.5	48.3	55.3

*Source: Cotton Corporation of India, *As estimated by CAB (Cotton Advisory Board)*

The increase in domestic cotton consumption is led by increasing consumption trend in the non-SSI mills in India, which accounts for more than 90 percent of the total consumption. This is also reflected by both yearly and monthly trend in consumption. While yearly cotton consumption by Non SSI mills has increased from 149.36 lakh bales to 246 lakh bales during 2000-01 to 2010-11, yearly consumption of SSI units increased from 10.97 lakh bales to 20 lakh bales during the period. Average monthly consumption by SSI, though having increased by over 83 percent, is yet quite low at mills has also and to 1.67 lakh bales in 2011-12 compared to 0.91 lakh bales in 2000-01. The dominance of non-SSI units can be understood by the fact that their average monthly consumption is over 12 times higher than that of SSI consumption. It may be noted that all the non-SSI units are in the organised sector.

Table 3.6 below shows cotton consumption trend by textile mills (non SSI mills) in the organised sector and small scale spinning mills (SSI).

Table 3.6: Cotton Consumption Trend (Non-SSI and SSI mills spinning mills) *(lakh bales of 170 kg each)*

Year	Non SSI mills		SSI mills	
	Yearly Avg. consumption	Monthly Avg. consumption	Yearly Avg. consumption	Monthly Avg. consumption
2000-2001	149.36	12.45	10.97	0.91
2001-2002	147	12.25	11.7	0.98
2002-2003	142.42	11.87	11.63	0.97
2003-2004	150.39	12.53	12.99	1.08
2004-2005	163.98	13.67	16.57	1.58
2005-2006	180	15	20	1.67
2006-2007	194.89	16.24	15.88	1.32
2007-2008	195.67	16.31	19.13	1.59
2008-2009	190	15.83	19	1.58
2009-2010	207	17.25	20	1.67
2010-2011(E)	246	20.5	20	1.67

Source: Cotton Corporation of India. E= Estimated

Trend in staple wise production and consumption

India has the distinction of producing all the four major varieties of cotton being cultivated in the world. In addition, it produces different staples of cotton, which include short measuring below 20 mm; medium and medium long measuring between 20.5 to 27 mm; long measuring between 27.5 to 32 mm and extra-long measuring 32.5 and above. The production of different size of staples is influenced by existing and potential demand.

Long staple cotton[3] appears to be the most important staple, as reflected by the trend. Production of long staple has increased by more than five times during the period 2002-03 to 2011-12, with production increasing from 51 lakh bales to 266 lakh bales in the period. Compared to this it is observed that while production of extra-long and medium has remained almost constant; production of short staple has declined (Table 3.7).

Table 3.7: Staple (size) wise Production of Cotton
(lakh bales/170 kg lint /bale)

Staple group	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12(E)
Short (below 20.0 mm)	9	8	7	7	6	4	4	4	4	4
Medium/medium Long (20.5 to 27 mm)	72	76	137	64	54	61	60	57	62	70
Long Staple (27.5 to 32.0 mm)	51	90	94	165	216	237	222	230	241	266
Extra Long Staple (32.5 mm & above)	4	6	5	5	4	5	5	5	5	5
Total	136	179	243	241	280	307	290	295	312	345

Note: Staple-group-wise production figures are estimated; E= Estimated value*Source: Cotton Advisory Board and Cotton Corporation of India*

Following a similar trend as in case of production, consumption of long staple is the highest, again indicative of the qualitative preference of consumers/user of cotton in India. The consumption of long staple in India has increased over three times between the periods 2000-01 to 2011-12. Next in preference comes medium staple cotton, consumption of which accounts for nearly 25 percent of the total consumption in India (Table 3.8).

Table 3.8: Staple-wise Mill Consumption of Cotton (Non-SSIs) from 2000-01 to 2009-10.*(lakh bales of 170kg)*

NON-SSI	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10(P)
Short staple (below 20 mm)	9.71	6.96	5.99	5.93	5.14	5.95	6.06	5.52	4.67	4.84
Medium staple (20.50 to 25.50 mm)	46.05	38.57	38.05	36.29	50.13	55.8	57.01	50.97	46.87	49.14
Medium long staple (26.00 to 27.50 mm)	24.44	23.46	25.1	22.96	22.47	26.42	25.86	20.93	16.93	18.43
Long staple (28.00 to 33.50 mm)	43.79	47.68	53.02	70.3	72.24	83.18	95.59	106.95	108.29	127.43
Extra-long staple (34.00 mm & above)	3.86	4.09	4.17	4.42	4	3.83	5.19	5.87	5.1	6.8
Total Indian Cotton	127.85	120.76	126.33	139.9	153.98	175.18	189.71	190.24	181.86	206.64
Foreign Cotton	21.51	26.24	16.09	10.49	10	4.91	5.21	5.44	8.89	6.16
Non-SSI Total	149.36	147	142.42	150.39	163.98	180.09	194.92	195.68	190.75	212.8
SSI MILLS	10.97	11.7	11.63	12.99	16.57	18.85	21.26	22.07	20.22	21.23
Grand Total	160.33	158.7	154.05	163.38	180.55	198.94	216.18	217.75	210.97	234.03

Source: Central Institute for Cotton Research, P=provisional

State wise trend in cotton production and consumption

State-wise Cotton consumption by Textile Mills for the last six years is highly skewed in favour of few states. In 2001-02, the major chunk of consumption of cotton (in lakh bales) is consumed among few states like, Tamil Nadu (67.31) followed by Maharashtra (18.47), Punjab (13.72), Gujarat (13.45), Madhya Pradesh (7.46), Andhra Pradesh (6.55) with 71.44 percent of the total national consumption. And, only Tamil Nadu consumed 42 percent of the total national consumption in the same year. However, in 2009-10, consumption of cotton by the same six major states increased by 11 percent to 82 percent, and consumption of cotton by Tamil Nadu remained almost unchanged (43 percent of the total national consumption) (Table 3.9).

Table 3.9: State-wise Cotton Consumption by the Textile Mills (Lakh bales)

States/UTs	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Andhra Pradesh	6.55	6.31	7.30	7.77	8.42	9.42	9.86	10.25	11.36
Assam	0.07	0.03	0.01	0.01	0.01	0.01	0.00	NA	NA
Bihar	0.01	NA	NA	NA	NA	NA	NA	NA	NA
Delhi	0.00	NA	NA	NA	NA	NA	NA	NA	NA
Gujarat	13.45	12.52	11.68	13.89	14.41	15.06	12.03	10.58	11.57
Haryana	8.89	6.26	5.51	5.61	8.08	6.88	7.39	6.62	5.67
Himachal Pradesh	3.17	3.81	4.08	4.28	4.99	6.89	7.74	7.62	7.71
Jammu and Kashmir	0.13	0.04	0.00	0.12	0.46	0.47	0.46	0.67	0.96
Jharkhand	0.12	0.08	0.07	0.08	0.10	0.10	0.10	0.08	0.07
Karnataka	4.67	4.66	4.14	4.85	5.09	5.13	5.05	3.97	3.95
Kerala	2.36	2.26	1.80	1.93	2.22	2.25	2.01	1.70	1.87
Madhya Pradesh	7.96	8.36	8.58	8.72	9.34	10.36	10.75	11.93	14.73
Maharashtra	18.47	17.47	15.97	18.90	17.84	19.47	19.90	17.83	18.39
Manipur	0.01	NA	NA	NA	NA	NA	NA	NA	NA
Orissa	0.51	0.42	0.33	0.14	0.28	0.21	0.21	0.12	0.11
Punjab	13.72	15.13	15.60	17.27	20.64	24.55	27.58	30.60	32.92
Rajasthan	5.28	5.78	5.57	5.70	7.38	7.91	8.47	8.19	7.68
Tamil Nadu	67.31	69.31	68.29	73.28	82.74	92.98	97.56	90.30	95.15
Uttarakhand	0.03	0.00	0.00	NA	0.19	1.14	1.61	2.25	2.32
Uttar Pradesh	3.27	3.25	3.05	3.20	3.52	3.42	3.04	2.49	2.67
West Bengal	1.11	0.98	0.88	0.96	1.04	1.12	1.04	0.87	0.88
Dadara and Nagar Haveli	0.79	1.16	2.13	1.96	1.82	2.40	2.57	3.99	4.72
Daman and Diu	0.08	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01
Puducherry	0.93	0.92	1.00	1.06	0.95	0.81	0.70	0.56	0.52
India	158.89	158.77	156.00	169.74	189.53	210.59	218.07	210.64	223.27

Source: Ministry of Textiles, Government of India

At the state level, trend in area under cultivation, total production and yields show significant variations. It is observed that with good market price in the last season and augmentation of non-traditional cotton areas, overall increase of area under cotton (8.60 percent) has increased from 111.42 (last year) in 2000-01 to 121.92 lakh ha in 2011-12. Among the major producing states, Gujarat, Rajasthan and Haryana reported significant area enhancement in 2011-12.

Across the states, the production has more than doubled in 2011-12 compared to 2003-04, from 168 to 345 lakh bales. However, during 2000-01 and 2011-12, state wise area under cotton cultivation, production and productivity show that, Gujarat, Maharashtra, and Andhra Pradesh contributing significantly to the total in all parameters. However, zone wise distributions show that central zone dominated by Madhya Pradesh is leading in area under cotton cultivation and south zone dominated by Andhra Pradesh is leading in total production and productivity.

Significant increase in area under cotton cultivation, however, has not been able to raise crop productivity, with the result that the productivity hovering around 500 kg per ha for the past six to seven years.

There is need for initiative to further enhance productivity with perspective plan like discontinuation of cotton cultivation wherein the productivity is very low and identification of newer or non-traditional areas which can boost the cotton productivity level in the country. Public-Private partnership based research agenda need to be revamped. India is not dearth of innovative cotton production technologies; however farmers friendly, farmers acceptable, and practically possible technologies need to be identified and disseminated with comprehensive extension activities.[4]

From the table below (Table 3.10), it is observed that the area under cotton cultivation is the highest in Maharashtra (29.8) followed by Gujarat (16.9), Andhra Pradesh (10), Madhya Pradesh (6.23), Haryana (6.1), Punjab (6), Karnataka (5.91) and Rajasthan (3.47). Area under cotton cultivation under time consideration in some of the states has increased and some of the states have decreased. The area under cotton cultivation during 2011-12 was highest in Maharashtra (40.95) followed by Gujarat (30.23), Andhra Pradesh (18.54), Madhya Pradesh (7.06), Haryana (6.05), Punjab (5.6), Karnataka (5.49) Rajasthan (5.3) and Tamil Nadu (1.21).

Table 3.10: Statewise Trend in Area Under Cotton Cultivation, Production, and Yield *(2001-02 to 2011-12)*

State		2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11(P)	2011-12(P)
Punjab	Area	6	4.49	4.52	5.09	5.57	6.07	6.04	5.27	5.11	5.3	5.6
	Production	9.25	7.5	10.35	16.5	21	26	20	17.5	13	16	17
	Yield	262	284	381	551	610	728	563	565	432	593	591
Haryana	Area	6.1	5.19	5.26	6.21	5.83	5.3	4.83	4.56	5.07	4.92	6.05
	Production n	5.5	8.75	11.5	15.5	14	16	15	14	15.25	14	17
	Yield	153	287	356	424	373	513	528	522	511	587	561
Rajasthan	Area	3.47	3.86	3.44	4.38	4.54	3.5	3.69	3.02	4.44	3.35	5.3
	Production	7	5	9.15	11	11	8	9	7.5	12	9	16
	Yield	343	220	379	427	397	389	415	422	459	512	548
Gujarat	Area	16.9	16.34	16.5	19.06	20.77	23.9	24.22	23.54	26.25	26.33	30.23
	Production	32.5	30.5	50	73	89	101	110	90	98	103	114
	Yield	328	317	475	651	794	718	772	650	634	685	659
Maharashtra	Area	29.8	28	27.7	28.4	28.89	30.7	31.95	31.42	35.03	39.32	40.95
	Production	34.3	26	31	52	36	52	62	62	65.75	82	69
	Yield	195	158	191	311	213	288	330	335	319	379	310
Madhya Pradesh	Area	6.23	5.45	5.91	5.76	6.35	6.39	6.3	6.25	6.11	6.5	7.06
	Production	20	18	19.65	16	18	18	20	18	15.25	17	17
	Yield	546	561	468	472	494	479	540	490	424	462	426
Andhra Pradesh	Area	10	8.03	8.37	11.78	9.72	9.72	11.33	13.99	14.75	17.84	18.54
	Production	26.8	19.8	27.4	32.5	30	35	46	53	54.5	53	48
	Yield	454	418	565	469	527	612	690	644	628	566	499
Karnataka	Area	5.91	3.93	3.13	5.21	3.81	3.75	4.03	4.08	4.55	5.45	5.49
	Production	7	5	4.2	8	6.5	6	8	9	12.25	10	12
	Yield	201	216	204	261	268	272	337	375	457	346	405
Tamil Nadu	Area	2	0.85	1.03	1.29	1.52	1.22	0.99	1.09	1.04	1.22	1.21
	Production	5	3	3.75	5.5	5.5	5	4	5	5	5	5
	Yield	425	600	613	725	668	697	678	780	817	1003	1011
Orissa	Area								0.58	0.54	0.74	1.02
	Production									1	2	2
	Yield									314	470	341

p= provisional. Area in lakh ha; production in lakh bales of 170 kg; yield in kg/ha.

Source: IndiaStat

Out of the major producing states, five states have realised increase in area under cultivation. In terms of percentage increase, Andhra Pradesh and Gujarat come first showing a CAGR of about 6 percent in 2011-12 over 2000-01. These two states are followed by Rajasthan and Maharashtra with increase of over 4 percent and 3 percent respectively.

Gujarat is leading other states in terms of total cotton production. The state has achieved an increase (CAGR) in production by over 13 percent,

followed by Haryana, Rajasthan and Maharashtra which have realised increased production by about 12 percent, 9 percent and over 7 percent respectively.

Yield increase is the highest in Haryana about 14 percent, followed by Punjab (8.5 percent) and Gujarat (7.2 percent), as reflected by the table below (Table 3.11).

Table 3.11: Compound Annual Growth Rate and Coefficient of Variation *(2011-12 over 2000-01)*

	Compound Annual Growth Rate			Coefficient of variation		
	Area	Production	Yield	Area	Production	Yield
Punjab	-0.68	6.27	8.47	0.10	0.33	0.28
Haryana	-0.08	11.95	13.87	0.10	0.25	0.29
Rajasthan	4.33	8.62	4.80	0.16	0.29	0.20
Gujarat	5.99	13.37	7.23	0.20	0.36	0.26
Maharashtra	3.23	7.24	4.74	0.14	0.33	0.25
Madhya Pradesh	1.26	-1.61	-2.45	0.06	0.08	0.09
Andhra Pradesh	6.37	6.00	0.95	0.28	0.31	0.15
Karnataka	-0.73	5.54	7.26	0.19	0.31	0.27
Tamil Nadu	-4.90	0.00	9.05	0.24	0.16	0.22

Source: Indiastat

Major Issues Faced by Cotton Producers in India

Despite significant progress made by India in terms of production, consumption and yield, there are various issues[5] that hamper prospects of cotton industry in India. Some of these are delineated below.

- *Delayed sowing*: Delayed sowing of cotton production reduces the optimal sunlight conditions for crop development. Delayed sowing is due to late arrival of monsoon or delayed in harvesting of previous crop. The losses of yield due to delayed sowing can be reduced by adopting new short duration varieties and better management.
- *Monsoon Dependence*: Cotton cultivation in India depends on Monsoon and decreased in monsoon practice in last few years has reduced the cotton yields and it will affect the cotton production in coming future.
- *Poor Seed Quality*: Poor seed quality of cotton reduces the yield of cotton. Only 35 percent of cotton area is sown with certified seed. And rest of the cotton area is sown with uncertified, substandard, second generation (F2) hybrid seeds. Certified seeds are available in

the markets but the financial constraints of farmer's don't allow them to purchase it. They use the retained seed or lower price of seed.

- *Crop Management*: The low yield of cotton production is due to inappropriate varieties, seed rates, seed spacing, and fertiliser dosages. Production of cotton can be increased with the adoption of better management practices.
- *Plant protection*: Insect and disease infestations, including bollworms, white fly, jassids, and leaf curl virus, are significant problems in India's three cotton producing zones namely northern, central and southern (SINET, 2008).

The combined effect of these lead to low crop yield and makes cotton production practices highly unsustainable in India. This calls for a holistic approach and some focused initiatives to address these issues. Fortunately for the industry, a number of such initiatives has been taken by the government of India over the last few years.

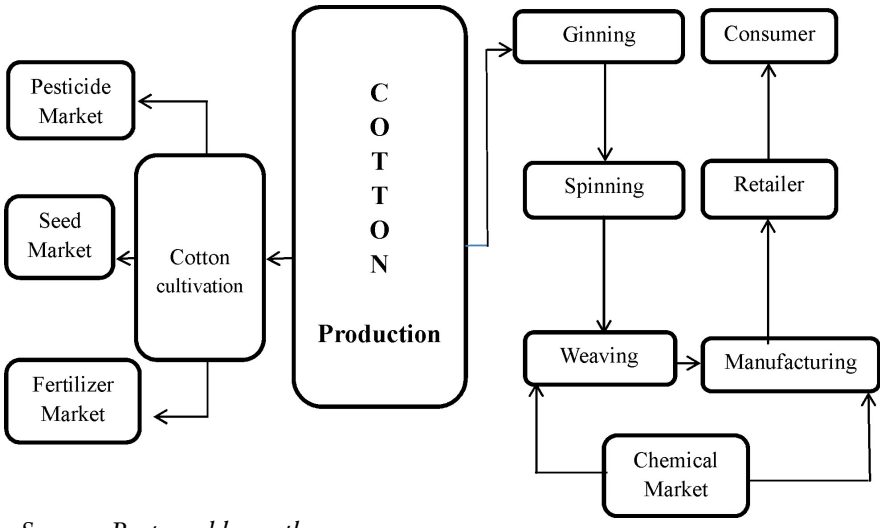
Cotton Industry Backward and Forward Linkages

A holistic approach for the cotton industry is important not only for the sake of this industry, but also for various other industry segments that are directly or indirectly tied with growth of this industry. Cotton influences and is also influenced by a number of sectors and sub-sectors. In other words, cotton industry has both backward and forward linkages.

While it has backward linkages with industries that provide and feeds inputs in production of cotton, such as seeds and chemicals industries, it has forward linkages with various other industry segments. These include ginning, spinning, weaving, manufacturing and retailing. These industry segments are fed by the cotton industry. In fact, progress of these critically depends on progress of cotton industry at the farming level. Chemical is one segment, with which cotton has both backward and forward linkages. The backward and forward linkages of cotton industry are shown in the box (Box 3.1).

From the figure above, one can say that the backward and forward linkages of cotton are extensive. These taken together account for the large number of jobs associated with the various industry sub-segments. Importance of its backward and forward linkages can be understood from the fact that over 35 million cottage level employment opportunities are generated in addition to the many trade and service opportunities along the cotton value chain through backward and forward linkages.

Box 3.1: Backward and Forward Linkages of Cotton Production in India



Source: Prepared by authors

Impact of Cotton Production on Economic Growth and Environment

Cotton growing in India has both positive (for example, employment and economic growth) and negative (for example, on environment, human health) impacts on the economy and the social structure.

Various studies found that the production practices have improved since 1990s in general and after 2002-03 in particular. Most of the studies, however, argued that the main issues for improved performance were water management, pest management and pesticide use and waste management among others.

Economic impact of cotton production and consumption

The last decade (2000-01 to 2010-11) was significant for cotton growers in India. Beside the increase in area under cotton cultivation, the decade also experienced wide adoption of Bt cotton in India. It is observed that since the inception of Bt cotton in India, both productivity and production have increased substantially. The increase in yield and productivity has helped in impressive gains for cotton growers. The income of cotton farmers has increased since 2002-03 as adoption of Bt variety is superior in terms of productivity and cost incurred.

Several problems remain. Data shows that more than 60 percent of the area under cotton cultivation is still rainfed and weather plays a key

role in the cultivation of cotton. Indian cotton cultivation is also riddled with several problems relating to crop production, protection, picking, transport and storage. Nearly 70 percent of cotton farmers in India are small and marginal, each planting less than 2 hectares of land under rainfed condition. In addition, cotton growers have also to contend with several challenges – insufficient and suspect quality of inputs, low level of input usage, high cost of cultivation[6], insufficient knowledge of modern crop management, pest menace and soul degradation due to use of toxic pesticides. All these combine to depress yields.

Environmental impact of cotton production and consumption

A study conducted by Katyal (1989) shows that in India as well as in other developing countries, commercial agriculture is characterised by the use of high doses of chemical fertilisers, pesticides, herbicides, etc., which give quick and immediate returns for the investment made. With the advent of high yielding varieties and fertiliser-centered technologies, the Indian Government offered these inputs at a subsidised rate. This has led to increased consumption of fertilizers and consequently resulted in fertiliser related environmental hazard like nitrate pollution of ground water, and also increased emission of gaseous nitrogen and metal toxicity.

Increasing demand for cotton throughout the world is influencing cotton producing countries to bring in new technologies and production practices to increase supply of cotton at the global level. Most of the cotton-producing countries are now adopting new technologies and practices to achieve higher yield and productivity. India is no exception to this as it adopted use of new varieties of seeds, and packaged technology such as Bt Cotton. A report by WWF (2007) shows that before 2001, India was engaged in the production of non-transgenic cotton. But with the success of Bt (*bacillus thuringiensis)* cotton across many countries, India also adopted Bt Cotton in 2002. Now, India has emerged as number two cotton producer and number two cotton exporter in the world. With the adoption of Bt cotton, production and productivity of cotton has increased. An important feature of Bt cotton is that it requires less amount of fertilisers and pesticides compared to Desi cotton seed varieties.

Introduction of Bt cotton, however, continues to remain a controversial issue throughout the cotton producing countries. This is mainly because of high cost of production and its package requirements, which include timely irrigation, use of fertilisers, and others. Studies show both positive and negative impacts of Bt cotton cultivation in India.

A study (Technical Efficiency and Environmental Impact of Bt Cotton and Non-Bt Cotton in North India) by Mal, P. & Manjunatha, A. V. et al. (2011) shows that there is considerable variation in efficiency among Bt and non-Bt cotton farms. The average technical efficiency of Bt cotton farms is higher than that of non-Bt cotton farms. The extent of technical inefficiencies were found to be higher in non-Bt cotton farms as compared with Bt cotton farms and these inefficiencies are driven by the significant variations in input use and output realised in addition to the variation in farm size and education of the farmer. However, the contribution of farm size and education to the technical efficiency needs further investigation of the issue. In the second step, an Environmental Impact Quotient (EIQ) analysis has shown that Bt cotton farms also have a lower EIQ than non-Bt cotton farms, indicating reduced damage to the environment.

Bt cotton has also negative impacts. The adoption of Bt cotton is argued to have created a debt trap for farmers in India leading to other fatal consequences, as reflected by various studies. An IFPRI study (IFPRI 2008) investigated the relationship between the adoption of Bt Cotton and farm suicides in India. Bt Cotton is considered to be the main reason of increasing farmers' suicides in India. However, the study found that there is no clear data available on farm suicides and adoption of Bt cotton in India in the last five years. Another finding of this study is that Bt cotton technology has been very effective throughout India. Moreover, the introduction of Bt. Cotton in some particular district and season has generated some disappointing results. The study found that Bt cotton is neither a necessary nor a sufficient condition for the occurrence of farm suicides. There are many other factors likely to play a prominent role in farm suicides in India. Bt. Cotton in some specific regions and years has indirectly contributed to farmer indebtedness, which has led to farmer suicides. The failure of Bt. Cotton in some particular region might be due to environmental factors or environment where it was planted (Guillaume *et al*. 2008).

India is home to over one third of the world's cotton farmers. A large number of producers coupled with increasing area under production and increasing chemical use are leading to increasing health and other environmental problems. Studies[7] show that cotton accounts for 54 percent of all pesticides used annually – despite occupying just 5 percent of land under crops. In a single 5 month observation period, cotton farmers experienced 323 separate incidents of ill health. Of these 39 percent were associated with mild poisoning, 38 percent with moderate poisoning, and 6 percent with severe poisoning.

Proof of adverse impacts on health and environment from existing cotton cultivation practices are also provided by various other studies. A study conducted by Roy (2006) "Environmental and social impact of cotton cultivation and use with special reference to India" shows that cotton cultivation has been a pesticide-intensive activity. Indiscriminate use of chemical pesticides has caused a wide range of problems such as escalation of cultivation cost, destruction of beneficial insects, development of insecticide resistance and consequent surge of pest intensity, pollution of the environment, presence of pesticide residues in cotton and value added products endangering human health, etc.

The vicious circle of indiscriminate application of insecticides causing resistance in pests thereby necessitating higher and higher doses of chemicals has not only damaged the eco-system but has inevitably jacked up the cost of cotton cultivation, therefore, organic cotton cultivation is second best alternative (Roy, 2006).

A study was conducted by the Environmental Justice Foundation in collaboration with Pesticides Network UK (United Kingdom) in 2007 in India in two different states (Andhra Pradesh and Punjab) to find the impact of pesticides use in cotton cultivation and its effect on human health. A survey of 95 farmers in three different villages was conducted in Andhra Pradesh. The study reports 323 separate incidents of ill health over a period of five months. Labourers reported symptoms including headaches, excessive sweating, burning eyes, running nose, breathlessness, excessive salivation, skin rashes, vomiting, nausea, dizziness, blurred vision, staggering gait, muscle cramp, twitching eyelids, tremors, loss of consciousness and seizures. Out of the total incidents reported, 39 percent of the respondents were associated with symptoms of mild poisoning, 38 percent with moderate poisoning, and 6 percent with severe poisoning, and up to 10 percent with three or more neurotoxic or systemic symptoms.

Another study was conducted by Environmental Justice Foundation in collaboration with Pesticides Network UK (United Kingdom) in 2007, in Punjab. A blood sample of farmers from 4 villages in Punjab revealed traces of hazardous pesticides commonly used in Indian cotton production: chlorpyrifos (WHO II) was detected in 85 percent of blood samples analysed, monocrotophos (WHO Ib) in 75 percent, and endosulfan (WHO II) in 25 percent. Indian researchers in 2003 tested 16 brands of bottled drinking water for traces of pesticide residues. 14 brands tested positive for chlorpyrifos, and 1 for dimethoate – both chemicals are usually applied in cotton production in India (EJF & Pesticides Network UK, 2007).

A study by Soth (1999) shows that the current methods of cotton production is not environmentally sustainable. It undermines the necessary

requirements of cotton production for future generations. The recent strategy of cotton production should be changed to conserve the natural resources for the future generation. Keeping in mind of future requirements for cotton production, the recent strategy of cotton production should adopt sustainable cotton production to minimise the impacts of overall water withdrawal as well as pollution of freshwater ecosystems for cotton production. The water consumption in cotton production can be reduced if fewer agrochemicals are used in the production practices. The impacts of agrochemicals should not be such that they reduce the fertility of soil.

Besides cotton farming, there are also other stages in the cotton chain which are argued to have environmental impacts. A study by Iyer & Mastorakis (2006) analyses the hazards of chromium contamination and pollution caused by the use of Chrome Composite Leather-Clad (CCLC) rollers commonly used in cotton roller ginning industries and attempts to eliminate the chromium contamination and pollution during the cotton ginning process. The cotton roller ginning process is the mechanical separation of cotton fibres from their seeds by means of one or more rollers to which fibres adhere while the seeds are impeded and struck off or pulled loose. When the seed-cotton is ginned, due to persistent rubbing of CCLC rollers over the fixed knives, the ginned lint cotton adsorbs about 143 to 1990 mg/kg (ppm) as total chromium of trivalent and hexavalent forms and the cotton products carry with it of about 17 to 250 mg/kg (ppm) of chromium which according to Indian Standards (MOEF-157, 1996) for yarn and fabrics, should not be more than 0.1 mg/kg (ppm).

Toxic effects from ginning, as indicated above, are produced by prolonged contact with airborne or solid or liquid chromium compounds even in small quantities because of their properties viz. carcinogenecity, mutagenecity and corrosiveness. These affect the organic tissues of the body. To offset the unsafe chromium contamination and pollution from cotton ginning industries, chrome-free rubberised cotton fabric (RCF) rollers or eco-friendly rollers both for laboratory and commercial studies have been designed, fabricated and experimented on a special-built gin roller experimentation device (GRED) and double roller (DR) gins. On the basis of the design and development of various rollers with subsequent performance evaluation studies, chrome-free RCF roller has been demonstrated with reference to techno-commercial and eco-friendliness in ginning industries.

Pollution-free and chrome-free RCF rollers were found successful in ginning out seed-cotton in an environment friendly way, while maintaining high ginning rate potential, cotton technological parameters of lint, yarn and fabric properties. The ginneries have been tested commercially and found better in all aspects with reference to cotton technological parameters, dye-catching properties, physical and chemical properties. It could be successfully used commercially as an improved alternative in cotton ginning industries for the cleaner environment with benefits to society, industry owners, traders, workers, employees and the Government.

Spinning also appears to have some impact on environment. A study by Walters, A., Santillo, D., et. al. (2005) shows that during spinning fibres are subjected to various mechanical processes that comb align and spin them to produce a yarn. In some cases, two or more yarns are then twisted together to form a twine. Chemical auxiliaries are used to provide lubrication, allowing high speed processing.

Box 3.2: Some Global Facts about Negative Impact of Cotton Production on Environment and Health

Cotton often entails the use of hazardous chemicals, polluted or dwindling water supplies and can result in habitat loss, degraded soil and unfair working conditions.

A few figures make the point:

- 8506 litres of water (irrigation and rainfall) are needed on average to grow 1 kg of cotton lint (or roughly a pair of jeans) and the textile industry is estimated to use 378 billion litres of water annually, using up to 200 litres of water to process, dye and finish each kilo of textiles.
- In the 1990s, estimated cases of pesticide poisoning a year in agriculture were up to several million, resulting in between 20,000 and 40,000 deaths some of which relate to cotton growing.
- The surface area of the Aral Sea has decreased by 85percent due to irrigated cotton cultivation in Uzbekistan and Turkmenistan over the last 40 years. Twenty of the 24 native fish species there are now extinct including the sturgeon that produced world renowned caviar, and many more fish and bird species are close to extinction.
- Although cotton cultivation in Central America has now declined to low levels, only 2 percent of the hardwood forest in the original cotton-growing areas remains intact and coastal savannas and mangrove forests have also been destroyed.
- It is estimated that more than 50 percent of topsoil from all farmland was lost in the last century, representing an enormous economic loss. As cotton

Contd...

is grown in hot arid regions, the soil is often of poor quality, with organic content less than 1 percent. This makes the soils fragile and vulnerable to erosion by wind and water, and to salinisation due to poor irrigation and drainage.

- Child labour, and "debt" or "bonded" labour in which farm workers or their families are forced to work to pay off debts to other farmers or seed and chemical suppliers, long hours and inadequate pay are among the poor social conditions to be rectified in the making of cotton.

Source: WWF, Cleaner Greener Cotton

Traditionally, mineral oils were used, which is a source of poly aromatic hydrocarbons (PAHs). PAHs are prevalent pollutants in both terrestrial and aquatic environments that can cause a wide range of toxic effects. The oils are applied as aqueous preparations and are not generally water soluble, requiring emulsifiers. Generally, these are non-ionic surfactants such as alcohol ethoxylates (AEOs) and alkyl phenol ethoxylates (APEOs). The aqueous preparations must be protected from degradation during storage and therefore preservatives such as bactericides and fungicides are also added. These end up in harming plant effluent streams.

The PAHs can be substituted by synthetic oils which do not contain the same levels of impurities (no metals, PAHs etc) as mineral oils and some biodegrade. Ester oils are also biodegradable and easier to emulsify than mineral oils (therefore, a lower surfactant loading is required).

For the spinning of synthetic fibres silicon oils predominate and account for up to 7 percent of the yarn by weight. Though these are non-toxic and bioeliminable (IPPC 2003) emulsification is difficult and so large amounts of surfactant are employed. Such processes (PAHs) have impacts on human health and environment.

A study by Walters, A., Santillo, D, *et. al.* (2005) shows that during spinning and weaving, auxiliary chemicals are generally left on the fabric by producers. Removal is carried out by finishing houses prior to dying as an impure fabric would result in poor dye take-up and inconsistent results. For this reason the effects of sizes upon waste water streams shall be discussed in full as part of the pre-treatment section. Most of the substances are relatively benign in terms of direct environmental toxicity. It is due to the quantity of these substances used that they burden the environment. Noteworthy exceptions are non-ionic surfactants potentially employed (alkyl phenol ethoxylates), borax (although no information of the prevalence of use of this substance could be found) and biocides added to preparations.

A study by European Commission, DG Environment (2008) shows that the most important environmental impacts arise from the use of pesticides during the production process of cotton as well as from the amount of water discharged and the chemical load it carries as a result of textile processing. Other important environmental impacts relate to energy consumption, air emissions and solid waste. Significant health concerns for end users also exist regarding the use of potentially carcinogenic or sensitising substances in textiles. The most direct approach for reducing the environmental impacts of textiles is to use recycled fibres or re-use textiles.

A study commissioned by International Trade Centre, "Cotton and Climate Change: Impacts and Options to Mitigate and Adapt" (2011), which focuses on the interface between cotton, climate change and trade, examines the impact of cotton production and consumption on climate change and the options and incentives for reducing emissions, also discusses the impact of climate change on cotton production and the options for adaptation from different country perspectives. This study found that, higher temperatures in already hot areas (for example, like India) may hinder cotton development and fruit formation and rain-fed cotton production may suffer from higher climate variability leading to periods of drought or flooding. This study, also suggested key actions to achieve wider dissemination of knowledge to adopt environmental sustainable production practices along cotton value chain.

What emerges from the above discussion is that cotton cultivation has been a pesticide-intensive activity worldwide. Indiscriminate use of chemical pesticides has caused a wide range of problems such as escalation of cultivation cost, destruction of beneficial insects, development of insecticide resistance and consequent surge of pest intensity, pollution of the environment, presence of pesticide residues in cotton and value added products endangering human health, etc.

The adverse impact of cotton on environment primarily comes from the product characteristics, and way it is produced starting from requirement of inputs and consumed – processed – requiring use of various inputs that is harmful to the environment.

At the production stage, cotton production impacts environment through soil and water erosion, salinity and acidity leading to degradation of crop areas. Data show that a significant percentage of land under cotton farming is infested with these issues, as revealed by the table below (Table 3.12).

Table 3.12: State-wise Extent of Land Degradation in India (May 2007 in %)

State/UTs	Water Erosion	Water Logging	Salinity/ Alkalinity	Soil Acidity	Degraded Area	State Geographical Area *(share in %)*
Andhra Pradesh	12.30	13.26	8.69	5.64	10.21	8.37
Arunachal Pradesh	2.53	1.23	0.00	12.19	3.07	2.55
Assam	0.73	0.26	0.00	3.82	1.51	2.39
Bihar and Jharkhand	3.23	13.99	3.85	6.42	4.28	5.29
Goa	0.06	0.53	0.00	0.00	0.11	0.11
Gujarat	5.56	3.66	4.98	0.00	5.54	5.97
Haryana	0.34	1.02	4.31	0.00	1.00	1.35
Himachal Pradesh	2.90	9.11	0.00	0.98	2.85	1.69
Jammu & Kashmir	5.83	1.40	0.00	0.00	4.78	6.76
Karnataka	6.20	6.58	1.85	0.36	5.20	5.84
Kerala	0.08	14.67	0.00	0.86	1.78	1.18
Madhya Pradesh + Chhattisgarh	19.09	2.51	0.77	42.39	17.85	13.50
Maharashtra	11.93	0.00	17.76	3.22	8.89	9.36
Manipur	0.14	0.78	0.00	3.00	0.65	0.68
Mizoram	0.15	0.00	0.00	6.55	1.28	0.64
Meghalaya	0.15	0.05	0.00	6.42	0.82	0.68
Nagaland	0.42	0.00	0.00	0.79	0.68	0.50
Orissa	5.37	4.76	1.26	1.64	4.17	4.74
Punjab	0.40	2.36	4.84	0.00	0.87	1.53
Rajasthan	3.35	0.37	23.85	0.00	7.74	10.42
Sikkim	0.17	0.00	0.00	0.47	0.16	0.22
Tamil Nadu	5.26	0.67	1.61	0.49	3.63	3.96
Tripura	0.13	1.34	0.00	1.27	0.43	0.32
Uttar Pradesh + Uttaranchal	12.16	16.43	23.04	0.00	10.44	8.96
West Bengal	1.28	4.97	2.86	3.47	1.87	2.70
Delhi	0.06	0.04	0.17	0.00	0.06	0.05
Andaman & Nicobar	0.20	0.00	0.15	0.00	0.14	0.25

Source: Indiastat

State-wise extent of land degradation in India for the periods of May 2007 has been in shown in the above table. The extent of land degradation was recorded highest in most of the cotton producing states. Water erosion was highest in Madhya Pradesh (19.09), Wind erosion in Rajasthan (70.13), water logging and salinity/alkalinity in Uttar Pradesh (16.43) and (23.04), Soil Acidity in Madhya Pradesh (42.39), complex problem in Gujarat (22.57), Degraded area (17.85) and Geographical area (13.50). Most of the cases of extent of land degradation were recorded in cotton growing states except two water logging and salinity in Uttar Pradesh.

Use of pesticides and fertiliser is another source of environmental degradation. It is understood that conventional cotton farming extensively relies on these two inputs for protection of crops and also for increase in yield. Various studies have been undertaken to measure of impact of these two chemicals on environment and human health. These studies show that while use of pesticides directly impacts environment and health, use of fertiliser contribute in alkanity acidity besides erosion of fertility in soil.

It is also a fact that use of pesticides has come down especially in cotton growing states during the last few years, though consumption of fertilisers has increased. A comparison of consumption of the two inputs in cotton and non-cotton growing state in India is revealed by the table below (Table 3.13. *For state level consumption of pesticide in Indian states, please see Annex 3.1*).

Table 3.13: Consumption of Pesticides in Cotton Growing States and Non-cotton Growing States *(MT=million tonnes)*

Year	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Total (non-cotton)	12888	13279	12802	13314	13454	15101	14971	18538	16819	16590
Total (cotton producing)	16372	16691	16060	17478	17693	19582	19048	22851	17183	16914
Total consumption	29260	29970	28862	30792	31147	34684	34019	41389	34003	33504
% consumption of pesticides (cotton growing)	55.95	55.69	55.64	56.76	56.80	56.46	55.99	55.21	50.54	50.48
% consumption of pesticides (non-cotton growing)	44.05	44.31	44.36	43.24	43.20	43.54	44.01	44.79	49.46	49.52

Source: Indiastat

Overall state wise pesticide consumption data in Indian states show that the pesticide use on cotton has significantly come down in the last few years in cotton growing states. The percentage share of pesticide consumption by cotton growing states has declined from 55.95 percent in 2000-01 to 50.48 percent in 2009-10 (Table 3.14).

The use of insecticide use on cotton has also declined from 46 percent of the total insecticides used in India in 2001 to 25 percent within 4 years of Bt cotton introduction. Insecticide usage on cotton further declined to only 21 percent of the total usage in India during 2009 and 2010 (CICR Vision 2030).

Table 3.14: Pesticide Usage (Rs mn) on cotton

Year	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Insecticides on cotton	8390	10520	5970	9250	10320	6490	5790	7330	7906	8337	8804
Fungicides on cotton	96	64	34	78	60	85	111	248	315	522	669
Herbicides on cotton	15	10	5	34	39	78	118	215	261	455	869
Total insecticides in Agri.	20520	22680	16830	21460	24550	20860	22230	28800	32820	39090	42830
Total pesticides in Agri.	29725	32070	26223	31474	35814	24388	33960	46970	529330	69988	76836

Source: Pesticide Industry

One of the most important factors responsible for decline in pesticide and insecticide consumption is the government's effort to educate the farmers to minimise the consumption of pesticides in agricultural cultivation particularly in cotton.

It will, however, take a much longer time to address the issue effectively. The ways of impact of such chemical use in the production and processing of cotton for final use is shown in the following figure. The figure clearly reflects ecological and social impacts of chemicals used.

As reflected by the table above, besides use of pesticides and fertilisers at the production stage, activities at various other cotton processing stages raise environmental concern. For example, the spinning, weaving and knitting stages use significant amount of energy, produce solid waste and generate dust and noise and also involve the use of lubricants and oils to strengthen and protect the fibres from the stresses of processing.

Box 3.3: Ecological and Social Impact of Cotton Production and Uses

Stages of production and use	Source of ecological impact		Source of social impact	
	High	*Medium/Low*	*High*	*Medium/Low*
Fibre production	• Intensive of pesticides, fertilisers and other chemicals • Destruction of soils' self-regeneration capacity • Disturbance in soils' water balance, and contamination of water sources		• Adverse impact of pesticides and chemicals use on human health • Increased financial dependence on companies producing pesticides and other chemicals • Volatility in cotton prices/ market	
Spinning	—	Energy intensity	—	
Fabric production	—	Energy intensity	—	
Dying/ finishing	• Toxicity of chemicals (dyestuff and additives) • Pollution of waste water and insufficient degradability • Use of formaldehyde and heavy metals • Water and energy consumption • Impact on human health			
Clothing production		Materials wastes	• Issue of labour conditions • Issue of minimum wages • Issue of child labour	

Cotton processing at various stages involves a huge amount of water and the use of more chemicals, like pentachlorophenol, a rot-proofing agent added to cotton fabric to protect it in transport and storage. The fabric finishing stages prepare the fabric to be dyed and/or printed. Finishing, which use significant quantities of water, energy and chemicals and producing substantial amounts of effluent is considered the chief cause of environmental impacts in the production phase. . It is understood that chemicals used for finishing contain, amongst many others, heavy metals like copper, chromium and cobalt which are known hormone disrupters, and formaldehyde, a chemical.

Formaldehydes are used in wrinkle-free, non-iron finishings but also as a fixing agent for cotton. It is an irritant to the skin and also a hormone disrupter. Further in order to achieve white fabrics, it is necessary to bleach fibres as natural fibres have an off white colour. Bleaching is also used prior to dying to achieve better colour results. After bleaching the fabrics or fibres are dyed. All these processes have some elements of environment and human health concern, as these are harmful to human bodies.

To address the concern, and to reduce atmospheric pollution and health hazards due to pesticide residues in cotton, the Government of India has banned the use of 25 pesticides and 6 formulations. In addition, the Indian Council of Agricultural Research (ICAR) has promoted researches in pest management through Agricultural Universities in cotton growing States. These researches have yielded location-specific IPM packages.

Social impact of cotton production

Social impacts include both positive impacts relating to the role of cotton production in creating jobs and supporting livelihoods, and 'negative' impacts relating to illegal or unsustainable production/ labour practices. Growing cotton provides work, and work provides vital income. It is for this reason that it is often asserted that cotton farming employs a substantial number of people, and that this work is important for these people's livelihoods and development of other socio-economic activities.

However, cotton growers are exposed to several types of health hazards. The hazards are both short and long term in nature. If not attended to, health hazards become fatal and causes poisoning and death. India's experience in pesticide related poisoning is shown in table below (Table 3.15).

Table 3.15: State-wise Distribution of Number of Pesticides Poisoning Cases in India *(in percent)*

State/UTs	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10 (Apr-Sept)
Andhra Pradesh	0.55	1.44		1.06	0.00	0.00	0.00	3.67	1.41	0.44
Haryana	1.32	1.70	3.17	8.54	9.34	3.34	3.24	4.70	1.25	3.60
Himachal Pradesh	3.78	0.10	1.52	0.27	0.00	0.08	0.10	0.22	0.20	0.16
Jharkhand	0.00	0.00	0.00	0.00	0.00	2.53	3.47	1.61	1.67	9.93
Kerala	19.75	65.72	13.6	11.69	11.34	8.99	4.38	15.8	6.79	5.95
Maharashtra	56.5	15.01	66.6	47.65	64.76	60.08	57.40	37.0	57.71	36.8
Pondicherry	6.49	6.25	5.00	4.80	4.15	10.21	10.71	23.03	14.99	15.6
Punjab	3.95	3.44	5.85	9.90	9.52	2.16	2.28	5.37	3.22	2.98
Rajasthan	5.61	5.03		8.29	0.80	2.53	2.76	3.94	1.26	1.84
Uttaranchal	0.00	0.16	0.02	0.27	0.00	0.10	3.01	1.19	1.22	5.95
Uttar Pradesh	0.00	0.00	0.00	0.00	0.00	9.58	12.29	1.81	5.55	10.5
West Bengal	0.00	0.00	0.00	0.00	0.00	0.15	0.34	0.96	2.11	4.70
Total poisoning cases (No.)	6506	8315	9391	4789	3255	13137	11506	5962	9806	4302

Source: Indiastat

State-wise number of pesticides poisoning cases in India from 2000-01 to 2008-09 have been presented in the above table. Data shows that overall poisoning cases in India have significantly declined. It is also observed that at state level while the shares of many states in total poisoning cases have declined; it has increased in others during the period. States in which interstate share of poisoning cases have increased include Haryana, Jharkhand, Pondicherry, Uttaranchal, Uttar Pradesh and West Bengal. However, no definite trend can be drawn from the table. It is observed that the share of states in poisoning cases has varied over the period. In the terminal year, the table reveals increase share of poisoning cases in most of the states, except in Madhya Pradesh, which however does not appear in the table. This might be taken as a result of initiatives taken by different state governments.

Out of total poisoning cases in India, many growers have succumbed to poisoning and died over the period. This is shown in table given below (Table 3.16).

Table 3.16: State-wise Number of Deaths* due to Pesticides Poisoning Cases in India *(2005-06 to 2009-10)*

States/UTs	2005-06	2006-07	2007-08	2008-09	2009-10 *(April to Sept.)*
Andhra Pradesh	-	-	25	119	4
Bihar	-	-	-	-	6
Chhattisgarh	-	-	-	-	-
Gujarat	-	3	2	-	-
Haryana	67	48	40	29	16
Himachal Pradesh	5	3	2	4	2
Jammu and Kashmir	-	-	35	55	-
Jharkhand	66	46	34	40	52
Kerala	310	96	203	146	33
Maharashtra	1236	1413	174	773	244
Pondicherry	16	40	25	25	11
Punjab	119	88	70	62	23
Rajasthan	331	317	59	124	79
Uttarakhand	-	-	-	51	-
Uttar Pradesh	190	934	24	39	16
West Bengal	1	1	-	3	3
India	2341	2989	693	1470	489

*= The poisoning may be suicidal/homicidal/accidental/occupational
Source: Indiastat

As in the total number of poisoning cases, the table above clearly shows that the total number of death due to pesticides poisoning has declined in most of the states over the last few years.

Cotton production and its linkages to poverty in India

A study by the International Food Policy Research Institute (2008) shows that of the nearly 90 million farm households in India, more than 4 million are cotton producers with production concentrated in nine principal cotton-producing states in three regions: central, north, and south. Out of these, nearly half operate farms classified as marginal (less than 1 hectare) or small (1–2 hectares). The marginal and small cotton farmers produce about one quarter of the total cotton output, with evidence that they use inputs more intensively than optimally so that their efficiency is less than for the semi-medium farms (2–4 hectares). Cotton

accounts for less than 20 percent of the incomes of marginal cotton farmers and about one-quarter of the incomes of small cotton farmers, with about 80 percent of their incomes coming from all farming activities and 20 percent from wages. The study also estimates poverty rates among marginal and small cotton farm households, estimated to be only around 15 percent nationally, which is about half of the poverty rate among all farm households.

The national poverty rate among cotton-producing households is estimated to be 12.8 percent, with the highest poverty levels among the nine main cotton-producing states in Madhya Pradesh and Andhra Pradesh. The study applied partial equilibrium simulation analysis to assess the effect of higher cotton prices on poverty among producing households. This analysis suggests that a 30 percent increase, which would match the extent to which real prices fell in the late 1990s, would bring the poverty rate down to around 2 percent nationally and to less than 10 percent in all of the nine main cotton-producing states. Thus, higher cotton prices have a substantial effect on poverty among cotton-producing households in India.

Production Practices and their Usefulness

Evolving production practices

Mechanisation of Indian cotton production has still not deeply and widely percolated into the production practices, therefore it results in low per hector yield (around 500 kg/hector) with low and contaminated fibre quality. The accelerated demand for cotton fibre for industries and textile products for consumers both within and outside the country has put enormous pressure on Indian farmers to produce sustainable and higher crop yields. As a move towards greater sustainability, in many parts of India, Bt cotton has been introduced and is widely being cultivated (more than 90 percent of cotton cultivating area) due to its higher productivity and lesser pesticide use, and thus being profit enhancing. However, in many cotton growing states, a significant percentage of area is still under non-Bt cotton (Table 3.17). Discussions with farmers revealed that under non-Bt. cotton cultivation pest incidence, particularly sucking pests and bollworm, was the major factor affecting cotton yields. To manage the pests, at present, on an average, the crop is sprayed nine times during the crop period of which five were aimed at controlling Heliothis, and the rest against the sucking pests. As indicated earlier, there are also other factors that affect yields, like poor seed quality, delayed

sowing, improper soil and water management practices and inadequate organic manure application.

The increasing adoption of Bt. cotton in India has not helped in increasing productivity; it has also helped in significant improvement in quality of cotton. Introduction of Bt. Cotton has also led to introduction of latest production technology and plant protection technologies, adoption of scientific and agronomic practices by farmers, increase in area under irrigation, and increased fertilisers use. The new production method has been duly supported by the government policies which lay greater emphasis on research and development in cotton, encourage use of quality seeds and also provide price support.[8]

Table 3.17: State-wise Area Under Bacillus Thuringieusis Cotton in India

States	2006-07	2007-08	2008-09	2009-10	2010-11
Andhra Pradesh	19.61	18.29	17.14	16.72	18.27
Madhya Pradesh	9.24	8.77	7.20	6.93	5.84
Gujarat	12.02	7.84	13.34	21.34	20.29
Maharashtra	49.36	46.82	43.18	36.83	38.30
Karnataka	2.21	2.68	3.37	3.06	3.96
Tamil Nadu	1.19	0.84	1.13	0.91	0.54
Punjab	4.77	8.95	7.15	5.54	4.93
Haryana	1.49	5.09	5.67	5.55	5.03
Rajasthan	0.11	0.71	1.81	3.10	2.84

Source:Indiastat

State-wise area under Bt cotton from 2006-07 to 2010-11 have been presented in the above table. In 2006-07, the highest percentage of area under Bt cotton was in Maharashtra (49.36) followed by Andhra Pradesh (19.61), Gujarat (12.02), Madhya Pradesh (9.24), Punjab (4.77), Karnataka (2.21) and Haryana (1.49) during 2006-07. In the subsequent years, the state wise structure of area under Bt cotton has changed in many states. During 2010-11, the area under Bt cotton was highest in the Maharashtra (38.30) followed by Gujarat (20.29), Andhra Pradesh (18.27), Madhya Pradesh (5.84), Haryana (5.03), Punjab (4.93), Karnataka (3.96) and Rajasthan (2.84).

Sustainable production alternatives

Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable farming systems are biologically-based and designed to be productive in both the short and long-term. Sustainable approaches are the least toxic and least energy intensive, and yet maintain productivity and profitability.

Sustainable agriculture integrates three main goals – environmental health, economic profitability, and social equity. Specific practices that can be called sustainable, however, can vary depending on the crop and the specific environmental and social issues important to a region. Overall, sustainable practices can be termed as production practices that protect health of soil that helps in producing healthy plants that are less susceptible to pests. To maintain a sustainable farming practices proper soil, water and nutrient management is required. Furthermore, crop management systems that impair soil quality often result in greater inputs of water, nutrients, pesticides, and/or energy for tillage to maintain yields.

Various sustainable production practices have been developed over the last few years by national and international agencies engaged in the area. One such example is the WWF's work on agriculture and water. The WWF has come out with Better Management Practices that help farmers produce more sustainable cotton that reduce costs, increase crop yields, minimise health risks and environmental damage. These practices include reducing the use of chemical fertilisers and pesticides (that lead to long-term illnesses for the farmers and their families) along with better and more efficient use of natural resources, such as water and nutrients thus, promoting sustainable production practices. Another important example and which can be argued to have element of indigenous development is adoption of organic cotton farming practices. This is now increasingly practiced in India as delineated in the following sub-sections.

Organic cotton productions: a move towards greater sustainability

Organic farming is probably the best available option to ensure sustainable production of cotton without releasing any harm to either environment or human health. In addition to this, it also has economic benefits, as the produce is usually sold at a premium of about 20 percent. Recent development, world over, and users' and consumers' preference to this cotton variety has provided a new momentum to it.

Box 3.4: Factors that Distinguish Organic Cotton from Conventional Cotton *(production and preparation for commercial use)*

ORGANIC	CONVENTIONAL
Seed Preparation 1. Uses untreated seeds; 2. Never uses GMO seeds.	**Seed Preparation** 1. Treats seeds with fungicides or insecticides; 2. Uses GMO seeds.
Soil and Water 1. Builds strong soil through crop rotation 2. Uses water efficiently	**Soil and Water** 1. Apply synthetic fertilisers; 2. Requires intensive irrigation
Weed Control 1. Physical removal instead of chemical methods	**Weed Control** 1. Applies highly toxic herbicides
PEST CONTROL 1. Uses beneficial biological insects; 2. Maintains a balance between pests and nature.	PEST CONTROL 1. Uses highly toxic pesticides 2. Uses Insecticides
Harvesting 1. Relies on the seasonal freeze for defoliation	**Harvesting** 1. Defoliates with toxic chemicals
Production 1. Warp fibers stabilised using double-plying or nontoxic cornstarch	**Production** 1. Warp fibers stabilised using toxic waxes
Whitening 1. Relies mostly on the seasonal freeze for defoliation	**Whitening** 1. Chlorine bleaching creates toxic byproducts released into the environment
Finishing 1. Soft scour in warm water with soda ash, for a pH of 7.5- 8	**Finishing** 1. Hot water, synthetic surfactants, additional chemicals which can include formaldehyde
Trade Industry 1. Criteria in place to promote safe, healthy, non-abusive, adequate wages and environmental friendly.	**Trade Industry** 1. Not much social screening with possible forced or child labor used. 2. Facilities usually unsafe and unhealthy

Because of its environmental, social and economic benefits, organic farming practice is argued to be one of the best alternatives to maintain environmental sustainability given its methods and materials used that have a low impact on the environment. As indicated earlier, organic production systems replenish and maintain soil fertility, reduce the use of toxic and persistent pesticides and fertilisers, and build biologically diverse agriculture.

It is believed that by reducing the overall exposure to toxic chemicals from synthetic pesticides that can end up in the ground, air, water and food supply, and that are associated with health consequences, from asthma to cancer, cotton production in India can attain greater sustainability.

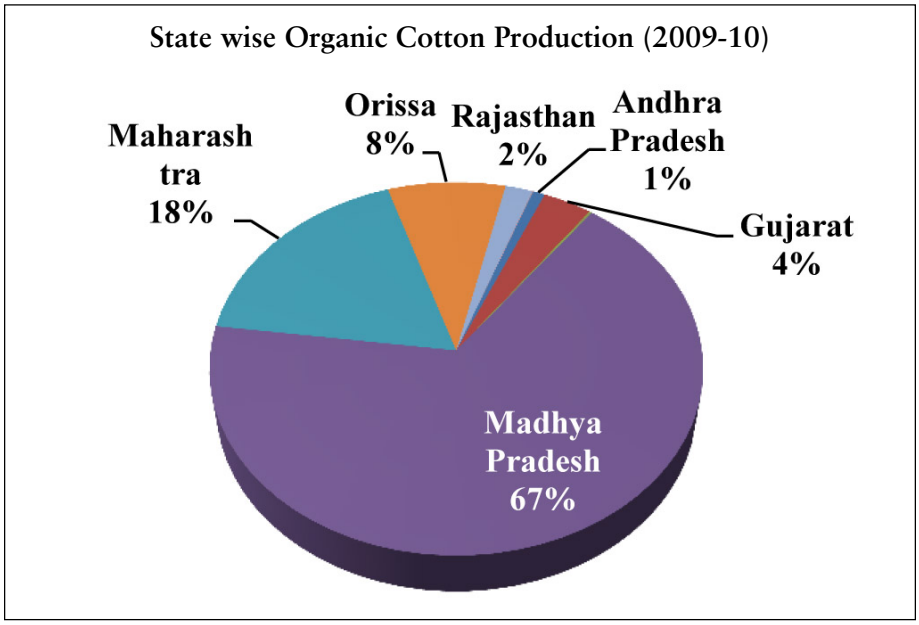
Comparison of Indian and global production trend

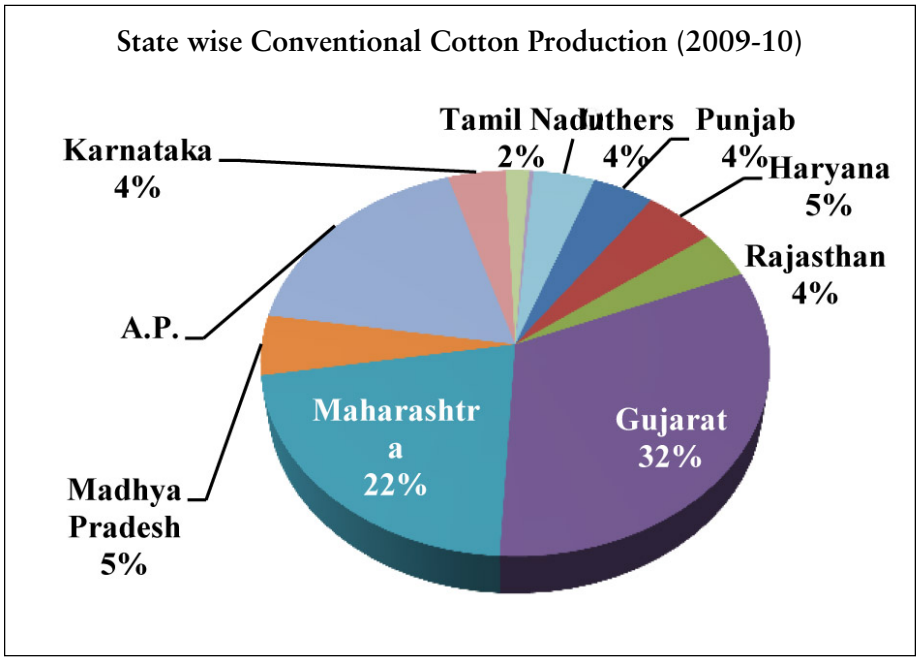
India and various other countries are taking steps to promote and strengthen organic cotton farming. As indicated earlier, organic cotton is organically produced and is grown using methods and materials that have a significantly low impact on the environment. Some of the characteristics of organic production are: it is a system that replenish and maintain soil fertility, reduce the use of toxic and persistent pesticides and fertilisers, and build biologically diverse agriculture. This is opposed to conventional system of cotton production which uses hybrid seeds, agrochemicals and intensive water. Non-use of chemicals make clothes manufactured out of this cotton least exposed to environmentally harmful chemicals covering its whole production chain during processing. It appears to be the most sustainable option in the present context, especially in the light of environmental, health and sustainability concerns.

According to 4th annual Organic Exchange Farm and Fiber Report, 2008-09 organic cotton was grown in 22 countries by approximately 220,000 farmers, with India as the top producer, followed by Turkey, Syria, Tanzania, China, USA, Uganda, Peru, Egypt and Burkina Faso. In 2009-10, South Asia remained the highest producer. India, with over 80 percent share (195,757 metric ton in 2009-10) in world's organic cotton production remained the largest producer. The share is higher than the preceding year (68 percent). For India, this represents a growth rate of 38 percent for India. The high growth can be attributed to factors such as: a strong agronomy, economies of scale and close links to a vast manufacturing base. Compared to India, in the same year (2009-10), Syria and Turkey occupying the second and third position produced 20000 metric ton and 11599 metric ton, respectively.

Within India, state wise data and distribution of organic cotton production in 2009-10, show that, Madhya Pradesh leading with around 67 percent share of area under organic cotton cultivation and organic cotton fibre production in India followed by Maharashtra and Orissa (Table 3.6). Whereas, state wise distribution in convention cotton production shows that Gujarat leading with around 32 percent followed by Maharashtra (28 percent) and Andhra Pradesh (18 percent) in the same year (Figure 3.1).

Figure 3.1: Share of Countries/States in World Organic and Conventional Cotton Production in India *(2009-10)*





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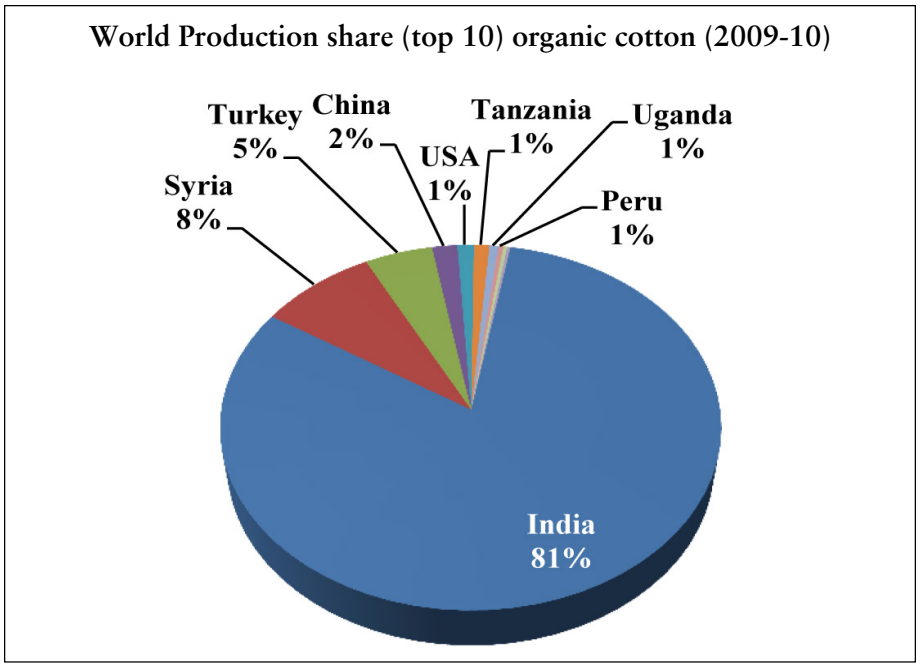

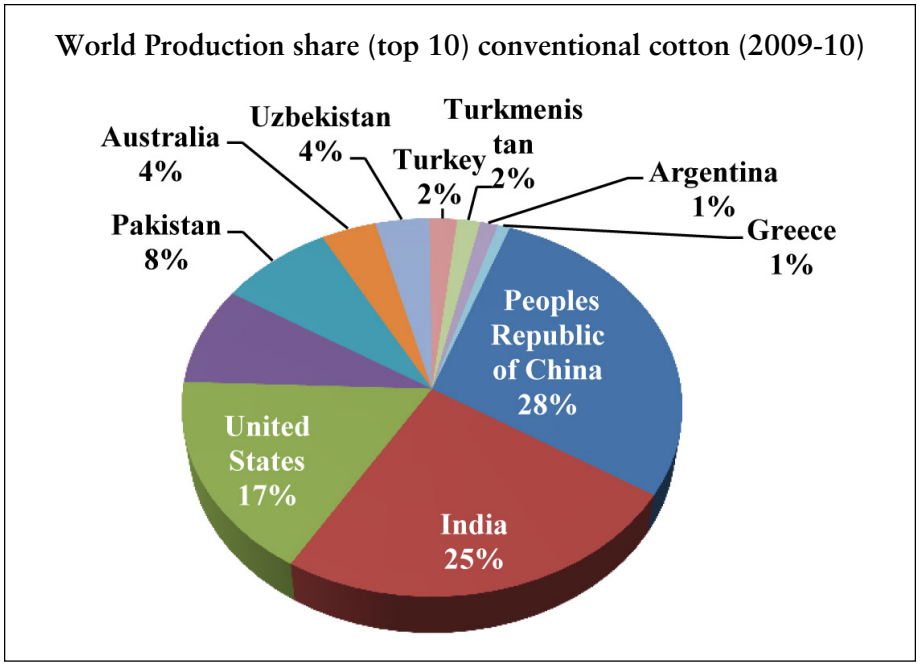

Source: Organic Exchange Farm and Fibre Report, 2009-11

Organic Cotton Farming and its Future Prospects in India

The practice of organic farming is expected to significantly increase in the coming periods. This could be because of various reasons, including but not limited to concerns arising of unsustainable cotton growing practices, leading to loss in soil fertility, risk involved for both lives and livelihood because of increasing exposure to hazardous chemicals used in the production of cotton. Estimates show that area under cotton cultivation can increase to 6 lakh hectare and production can increase to two billion bales by 2015.

Box 3.5: Trend in Production of Environmental Sustainable Cotton Crops in India

Production of speciality cotton comprising of **organic** and **suvin** is showing a mixed trend in India.

In case of organic cotton, currently, India has the distinction of being the world's largest producer (8.97 lakh bales) and accounts for almost 51% of the world organic cotton production. Because of its (organic cotton) higher sustainability, and its capacity to revitalise fast depleting agricultural land, organic cotton fibre is considered highly important to Indian agronomy. It also has a unique advantage of having a highly evolved end to end value addition chain.

Though, production of organic cotton is increasing, it is difficult to forecast the future production of organic cotton. However, simply extrapolating from current levels gives an indication of the potential of this fibre. Presently, approximately 200,000 hectares land is under Organic cotton cultivation and it yields 500,000 bales. Assuming that if the area goes up to 500,000 hectares by 2015 (as estimated by experts), the potential output would be approximately 1,250,000 bales. This is based on the assumption of no government intervention or support. However, if support is provided to this sector, it is possible that the total output of organic cotton could touch 2,000,000 bales by the year 2015. This forecast is premised on the fact that the area under cultivation would increase to over 600,000 hectares and there is improvement in yield.

It also needs to be mentioned that while considerable progress has been made in Organic cotton production in India, the sector still encounters certain issues and challenges. The organic cotton sector in India is still in its infantile stage and it needs support to mature and become sustainable.

Suvin cotton, the finest cotton being produced in India, is perhaps the most important local variety of cotton. It is known as the jewel in the Indian cotton crown and argued to have no parallel and alternative in the world till date. It is the only commercially available fibre in the world today with spinnability up to 240s count. It may be recalled that the Suvin variety was released in 1979 by cross breeding Sujatha (Indian cotton variety) with St.Vincent (Sea-Island cotton variety). The highest production of Suvin was 36,000 bales (170 kg), achieved in the year 1989-90. However, the production of Suvin has

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depleted steadily over the years and currently stands at 300 MT i.e. around 1250 bales. It will be a national loss to let a world renowned fibre to phase itself out, for lack of initiatives.

Source: National Fibre Policy 2010-11 (emphasis added)

Farmers in India are now increasingly opting for organic cotton farming, as indicated by growing area under organic cotton cultivation followed by a very dominant position of India in this field. India is leading with more than 80 percent of organic cotton production in the world in 2009-10 (Farm and Fibre Report, 2010). Current status of India is presented in the table below (Table 3.18).

Table 3.18: Current Status of Organic Farming in India (2010-11)

Total production	3.88 million M.T.
Total area under certification (including wild harvest)	4.43 million hectares
Total area under certified organic cultivation	0.24 million hectares
Total quantity exported	69837 M.T
Value of total export	USD 157.22 million (Rs. 699 Crores)
Share of Exports to total Production	4% approx.
Increase in Export Value over previous year	33% approx.

Source: APEDA, Ministry of Commerce and Industry, Government of India

A number of states in India are adopting organic farming practices. State wise trend in area under organic cotton cultivation and total production is presented in the table below. In both the parameters, area under cultivation and total production, Madhya Pradesh is way ahead other states.

Among the leading organic cotton producing states in India, Madhya Pradesh is leading other states, both in terms of area under cultivation and total production. While the state has a share of about 58 in total area under cultivation of organic farming, its share is total organic cotton production is more. It accounts for more than three-fifth of organic cotton production in India. Madhya Pradesh is distantly followed by Maharashtra and Orissa with shares of about 18 percent and 13 percent respectively in area under cultivation. Status of different states in organic cotton production is represented in table below (Table 3.20).

Table 3.19: India Organic Cotton Production (2009-10)

States	Area under organic cotton production (Ha)	Seed cotton production (MT)	Fibre (lint) production (MT)	Bales of Cotton Fibre/Lint
Andhra Pradesh	2,461	5,178	1,709	7,843
Gujarat	15,608	20,899	6,897	31,656
Karnataka	968	956	315	1,446
Madhya Pradesh	2,47,934	3,96,755	1,30,929	6,00,964
Maharashtra	62,333	1,06,310	35,082	1,61,028
Orissa	32,635	50,141	16,547	75,949
Rajasthan	6,569	11,624	3,836	17,607
Tamil Nadu	300	296	98	448
India Total	3,68,808	5,92,159	1,95,412	8,96,941
In-conversion				
Andhra Pradesh	3,998	15,787	5,210	23,913
Gujarat	4,373	7,151	2,360	10,831
Karnataka	889	163	54	247
Madhya Pradesh	14,629	26,118	8,619	39,561
Maharashtra	34,769	6,637	2,190	10,053
Orissa	4,943	6,084	2,008	9,215
Rajasthan	4	21	7	32
Tamil Nadu	21			
India Total	63,626	61,961	20,447	93,853

Source: Farm & Fiber Report, 2010 (Textile Exchange)

Table 3.20: Percentage Distribution of Area under Organic Cultivation and Production (%)

State	Organicin		conversion		Total	
	Quantity (MT)	Area (Ha)	Quantity (MT)	Area (Ha)	Quantity (MT)	Area (Ha)
Andhra Pradesh	0.70	0.71	17.08	13.85	2.50	1.98
Delhi	0.00	0.00	0.00	0.00	0.00	0.00
Gujarat	5.03	6.22	11.38	14.65	5.73	6.91
Haryana	0.00	0.00	0.00	0.01	0.00	0.00
Karnataka	0.02	0.06	0.66	2.63	0.09	0.31
Maharashtra	16.47	15.86	35.77	43.25	18.60	18.18
Madhya Pradesh	66.27	63.35	21.86	0.00	61.37	57.99
Orissa	9.62	12.12	8.28	19.74	9.47	12.59
Rajasthan	1.89	1.67	4.97	5.87	2.23	2.04
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Organic Farming Statistics, Government of India,

The trend in organic cotton cultivation and production is further reflected by state wise number of registered farmers in India. Madhya Pradesh with a share of nearly 30 percent is leading the table distantly followed by Maharashtra and Orissa with shares of over 10 percent each. What is, however, important is that there is a growing preference for organic farming in India in most of the cotton producing states (Table 3.21).

Table 3.21: Distribution of Farmers Registered for Organic Farming in India (2009-10) (%)

State/UTs	Total no. of farmers		
	Organic	In Conversion	Total
Andhra Pradesh	2.58	9.11	5.27
Arunachal Pradesh	0.03	0.24	0.12
Assam	0.14	1.12	0.54
Bihar	0.00	0.86	0.35
Chhattisgarh	0.00	0.05	0.02
Delhi	0.00	0.03	0.01
Goa	0.18	0.08	0.14
Gujarat	5.51	4.14	4.95
Haryana	0.51	1.41	0.88
Himachal Pradesh	0.10	0.34	0.20
J & K	0.04	0.03	0.03
Jharkhand	0.00	0.00	0.00
Karnataka	1.73	10.61	5.39
Kerala	1.77	3.59	2.52
Manipur	0.59	1.18	0.83
Maharashtra	12.68	8.56	10.98
Madhya Pradesh	43.25	10.17	29.61
Mizoram	4.04	5.63	4.69
Meghalaya	0.23	1.09	0.59
Nagaland	0.98	6.34	3.19
Orissa	14.10	5.11	10.39
Punjab	0.02	1.21	0.51
Rajasthan	2.90	3.08	2.98
Sikkim	0.89	1.90	1.31
Tripura	0.00	0.12	0.05
Tamil Nadu	0.06	1.41	0.61
Uttar Pradesh	1.57	10.73	5.35
Uttarakhand	5.89	10.74	7.89
West Bengal	0.21	1.13	0.59
Other	0.00	0.00	0.00
Total	100	100	100

Source: Indiastat

Other Useful Alternatives to Sustainable Production Practices

Besides organic cotton cultivation, there are other sustainable production practices in operation in India. These include the followings:

1. Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management. It uses natural predators, pest-resistant plants, and other methods to preserve a healthy environment in an effort to decrease reliance on harmful pesticides.
   IPM methods are a combination of the following attributes:
   - Cultural methods (e.g., crop rotations to prevent build-up of pests, buffer strips to reduce their spread);
   - Biological controls (e.g., introduction of natural enemies of insect or bacterial pests which destroy or limit the impact of the pests);
   - Physical and Mechanical Control (row covers or trenches prevents insects from reaching the crop, cold storage, hand picking of pests, sticky boards or tapes for control of flying insects in greenhouses and various trapping techniques) and;
   - Chemical methods (insecticidal and other crop sprays) which should be used only as a last resort because of the environmental risks and high costs involved.
2. Integrated Crop Management (ICM)
   - ICM is a system of crop production which conserves and enhances natural resources while producing food on an economically viable and sustainable foundation. It is based on a good understanding of the interactions between biology, environment and land management systems.
   - ICM is particularly appropriate for small farmers because it aims to minimise dependence on purchased inputs and to make the fullest possible use of indigenous technical knowledge and land use practices.

3. Integrated Soil Fertility Management (ISFM)
   - The application of soil fertility management practices, and the knowledge to adapt these to local conditions, which maximise fertiliser and organic resource use efficiency and crop productivity. These practices necessarily include appropriate fertiliser and organic input management in combination with the utilisation of improved germ plasma;
   - ISFM encompasses the use of improve crop germ plasm and application of mineral fertiliser in combination with various organic resources, including crop residues, animal and compost manure and

legume residues. ISFM also provides for judicious and management of nutrient resources to improve the agronomic efficiency of the fertiliser, while avoiding detrimental effects on the environment.

The policy framework and the initiatives taken by the government to promote sustainable cotton farming and steps taken along with emerging global standards and its impact on growth of Indian cotton industry to are presented in detail in chapter 4.

Endnotes

1 Journal of Asian Research Consortium

2 CICR Vision 2030, Central Institute for Cotton Research, Nagpur

3 It is widely believed that the long staple cotton is the highest quality cotton and therefore longer the fiber the better the quality as such staples can create stronger and finer yarns.

4 http://aiccip.cicr.org.in/CD_11_12/2_PC_report.pdf

5 SINET Conference Secretariat – Europe

6 For cost of production, please refer to Annex 3.2 and 3.3.

7 The Deadly Chemicals in Cotton, Pesticide Action Network, UK

8 Despite some impressive developments, as indicated above, India still has to go long way to catch up with the world average yield of 754 kg lint per hectare – cotton yield in India is presently estimated at around 500 kg lint per hectare.

Annexures

Annex 3.1: Distribution of Pesticide Consumption in Cotton Producing and Non-cotton Producing State in India *(2000-01 to 2009-10)*

States/UTs	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Andhra Pradesh	9.2	8.2	7.7	5.0	5.3	5.0	3.4	3.5	3.2	2.4
Gujarat	6.5	8.7	9.3	9.8	7.1	6.8	6.4	0.0	0.0	0.0
Haryana	11.5	10.7	10.4	11.5	11.1	11.5	11.1	10.1	0.1	9.7
Karnataka	4.6	5.3	5.6	4.1	5.4	4.1	3.3	3.6	3.8	3.9
Madhya Pradesh	2.0	1.5	2.1	0.2	1.8	2.0	2.3	1.6	1.5	1.5
Maharashtra	7.4	6.7	7.7	8.3	7.5	8.0	7.7	7.0	5.5	1.1
Orissa	2.3	2.2	2.4	1.7	1.7	2.4	1.9		2.6	3.8
Punjab	16.1	15.3	14.9	16.5	17.0	14.1	14.4	13.9	13.1	3.9
Rajasthan	7.0	9.8	6.6	5.6	4.0	2.5	8.6	8.7	7.6	8.4
Tamil Nadu	3.8	3.4	6.9	3.5	6.1	5.6	4.9	9.0	5.3	5.6
Major cotton producing states	70.4	71.8	73.5	66.1	66.9	62.0	63.9	7.5	42.7	60.5
Others	29.6	28.2	26.5	33.9	33.1	38.0	36.1	42.5	57.3	39.5

Source: Indiastat

Annex 3.2: Item wise Estimated Cost of Cultivation of Cotton in India (2006-07)

Items	Andhra	Gujarat Pradesh	Haryana	Karnataka	Madhya Pradesh	Mahara-shtra	Punjab	Rajasthan	Tamil Nadu
	Cost of Cultivation (Rs./Hectare)								
A1	19254.4	15704.1	13774.1	9830.0	15926.0	14783.4	17093.4	8763.9	15253.3
A2	21156.4	15743.9	13857.1	9830.0	15926.0	14795.3	18357.9	8991.2	15253.3
B1	20086.4	17331.2	14836.6	10306.4	18055.8	16262.0	19272.2	10232.3	15832.1
B2	32801.1	23449.2	23567.3	14364.8	25366.5	19683.8	32864.6	15409.6	22751.2
C1	22284.1	21066.1	21048.4	11743.5	21434.1	18247.5	23273.2	16203.9	22502.6
C2	34998.8	27184.1	29779.1	15801.9	28744.8	21669.2	36865.6	21381.2	29421.7
C2 Revised	34998.8	27184.1	29779.1	16482.8	28994.1	21669.2	36865.6	21381.2	29421.7
	Cost of Production (Rs./qntl)								
A1	879.41	1025.41	891.61	1158.34	1273.12	1401.6	755.7	496.39	985.49
A2	973.24	1027.08	897.02	1158.34	1273.12	1402.89	811.12	508.91	985.49
B1	916.74	1124.84	959.96	1214.82	1482.76	1544.43	852.19	578.88	1022.79
B2	1497.59	1482.24	1524.22	1694.29	2017.81	1867.85	1452.95	873.63	1503.96
C1	1017.31	1351.41	1359.38	1387.56	1766.5	1728.52	1029.31	916.55	1477.31
C2	1598.16	1708.81	1923.64	1867.03	2301.55	2051.94	1630.07	1211.3	1958.48
C2 Revised	1598.16	1708.81	1923.64	1946.96	2321.29	2051.94	1630.07	1211.3	1958.48
C3	1757.98	1879.69	2116	2141.66	2553.42	2257.13	1793.08	1332.43	2154.33
Value of Main Product (Rs./ Hectare)	42754.1	36204.0	29196.5	18446.87	27794.2	19870.32	41687.5	31937.57	30659.0
Value of By-Product (Rs./ Hectare)	253.11	844.9	968.41	498.34	1448.45	647.81	2260.55	1351.1	461.14
	Material & labour input/hectare of								
Seed (Kg.)	1.59	3.54	9.25	4.16	1.62	3.02	3.96	14.45	7.11
Fertiliser (Kg. Nutrients)	226.35	124.93	106.86	92.09	173.08	106.03	145.7	78.69	209.83
Manure (Qtl.)	28.7	33.31	0	16.44	13.02	6.55	0.64	13.46	7.65
Human Labour (Man Hrs.)	824.46	967.28	769.65	696.77	715.41	839.65	832.11	697.25	1190.33
Animal Labour (Pair Hrs.)	53.23	41.26	65.42	67.69	93.48	129.65	4.67	22.29	14.13

	Rate per Unit (Rs.)								
Seed (Kg.)	1370.6	583.66	142.23	397.08	1564.26	629.79	827.51	45.88	194.79
Fertiliser Kg. (Nutrients)	12.6	13.67	12.87	14.58	13.47	14.38	12.5	13.52	12.44
Manure (Qtl.)	39.45	26.47	0	38.92	72.13	71	5	39.86	16.41
Human Labour (Man Hrs.)	9.67	8.31	11.91	6.08	9.44	6.38	11.73	10.66	10.86
Animal Labour (Pair Hrs.)	31.66	33.71	26.05	17.38	27.02	43.5	42.02	29.38	33.05
Implicit Rate (Rs./Qtl.)	1994.2	2164.61	1958.83	2078.36	2011.9	1954.94	1951.85	1918.01	1919.89
Number of Holdings in Sample	51	354	94	46	49	212	93	53	21
Number of Tehsils in Sample	11	54	13	13	8	34	13	9	10
Derived Yield (Qtl./ Hectare)	21.77	15.54	14.99	8.24	11.9	10.24	21.45	16.95	14.79
	Break-Up Human Labour Hours								
Family	217.38	436.03	489.51	237.2	369.1	297.89	314.2	562.24	601.94
Attached	42.26	31.77	34.21	0	25.6	22.05	100.4	80.2	26.38
Casual	564.82	499.48	245.88	459.57	320.71	519.71	417.51	54.81	562.01
Total	824.46	967.28	769.65	696.77	715.41	839.65	832.11	697.25	1190.33

Note: The estimates are provisional unless specified. Cost A1= All actual expenses in cash and kind incurred in production by owner. Cost A2= Cost A1+ rent paid for leased-in land. Cost B1= Cost A1 + interest on value of own capital assets (excluding land). Cost B2= cost B1 + rental value of own land (net of land revenue). Cost C1= cost B1+ imputed value of family labour. Cost C2= cost B2+ imputed value of family labour. Cost C3= cost c2 + 10% cost c2 on account of manager function performed by farmer.

Source: Indiastat

4
Preparedness of Indian Cotton Industry to Sustainability Challenges

Preparedness of Indian cotton industry to sustainability challenges can be assessed in terms of globally emerging issues in the field of production and processing. Some of these challenges include intensive of use of fertilisers and pesticides which adversely impact soil, water, air, use of other chemicals in processing that often has adverse effects on consumers. These issues are now globally addressed at different level, and these are reflected by the increasing number of sustainability standards, certifications, and products' labelling. The impact of such standards on Indian cotton sector and steps being taken to address these challenges in India are discussed in this chapter.

Concept and Definition of Standards, Certification and Labels

Products' standards, certifications and labels are interrelated. While the first one (product' standards) refers to adherence and conformance to a set of criteria for production by manufacturers or service providers; the second one (certification) is a declaration by the standards' owing organisation or its affiliates that the product or service conform to the approved/mandated guidelines of production. In other words, certification is a procedure by which a third party gives written assurance that a product, process or service is in conformity with certain standards. Adherence to the first by the producers and subsequent certification leads facilitates the third, labelling. A certification label is, thus, a label that symbolises that compliance with standards has been verified.[1]

As far as definition of standard is concerned, it is defined as "documented agreements containing technical specifications or other

precise criteria to be used consistently as rules, guidelines or definitions, to ensure that materials, products, processes and services are fit for their purpose."[2] A similar definition is provided by the BSI, the world's first and UK's National Standards Body (NSB). According to the BSI, standard is an agreed, repeatable way of doing something. Standard is a published document that contains a technical specification or other precise criteria designed to be used consistently as a rule, guideline, or definition. Standards are created by bringing together the experience and expertise of all interested parties such as the producers, sellers, buyers, users and regulators of a particular material, product, process or service.

Creation of a standard, which is to increase the reliability and the effectiveness of goods and services, is a collective work. A number of stakeholders including committees/associations of manufacturers, users, research organisations, government departments and consumers work together to draw up standards that evolve to meet the demands of society and technology. Standards are usually voluntary in nature and in no way these impose any regulations. There are, however, instances when laws and regulations of a country refer to certain standards and make compliance compulsory.

Imposing standards on international trade can have positive effects as it can lead to increased trade through elimination of trade barriers. This may also ease logistical procedures, prevent consumer deception and improve product quality. The standards serve as a benchmark in international trading and can be used by cotton merchants for the purpose of cotton classification and arbitrators to resolve quality disputes in the case of a need for quality arbitration.[3]

Standards can be at three different levels, as indicted below:

- International standard: a standard adopted by an international standardisation organisation
- Regional standard: a standard adopted by a regional standardisation body, such as the EU
- National standard: a standard adopted by a national standardisation body and made available to the public'. Such standards, however, often are in sync with and conform to similar standards at the international or regional standards.

Major International Standards in Cotton and Textile

Applying basic definition of standards to cotton and textile, one can argue that the purpose of standards is to create a universal system for measuring cotton fiber and its product quality. This implies that standards

can be treated as a business management tool. In many cases, standards can also be a strategic tool for developing new markets at both domestic and global levels.

Box 4.1: A List of Selected ISO in Cotton Textile

- ISO 2403:1972 Textiles – Cotton fibres – Determination of micronaire value
- ISO 3060:1974 Textiles – Cotton fibres – Determination of breaking tenacity of flat bundles
- ISO 4911:1980 Textiles – Cotton fibres – Equipment and artificial lighting for cotton classing rooms
- ISO 4912:1981 Textiles – Cotton fibers – Evaluation of maturity – Microscopic method
- ISO 4913:1981 Textiles – Cotton fibers – Determination of length (span length) and uniformity index
- ISO 10290:1993 Textiles – Cotton yarns – Specifications
- ISO 10306:1993 Textiles – Cotton fibers – Evaluation of maturity by the air flow method

Emergence of Sustainability Issues in Cotton Production and Usage

Heavy use of water and chemicals (including pesticides and fertilisers) in cotton production chain make the whole chain environmentally unsustainable. While intensive use of water lead to continuous decline and exhaustion of precious ground water level, use of chemicals raise both environment and health concerns. Through its adverse impact on human health and environment, it directly and indirectly impacts a large section of people benefiting from the industry. Ensuring sustainability in cotton production and maintaining a clean and healthy environment has, therefore, now become an imperative for all – producers, consumers and end users.

Consumers' consciousness and preference for environmental sustainability and eco-friendly cotton and cotton products have been continuously rising over the last few years. There are an increasing section of consumers in many countries, especially in developed regions of the world, who prefer using such products. Sensing the challenge (ensuring sustainability) and also the opportunity (increasing market for eco-friendly products), many governments and institutions world over, have introduced sustainability approach which cover both production and consumption processes covering the whole of cotton value chain. In other words, one

can say that the sustainability approach encompasses whole cotton value chain. In addition, and as a cross cutting issue, the sustainability approach should also ensure economic and environmental viability of cotton production and consumption, implying it should have inbuilt characteristic of increasing yield and productivity without harming the environment on the one hand, and or reducing cost of production on the other. Increasing size of market for such products is prompting many other governments, including in developing countries, to initiate measures for greater sustainability.

There are two specific stages in cotton value chain which require greater focus to ensure environmental sustainability. These include production stage where inputs such as seeds, pesticides, and fertilisers are used, and processing stage in the cotton value chain in which chemicals such as dyes, harmful to human health and environment, are used. Ensuring sustainability at these two stages can help both producers and consumers to avoid risks associated with use of harmful inputs in production and use of cotton and its products.

Out of the two, at the production stage, there are three pillars of sustainability. These include (i) improvement in input efficiency and productivity; (ii) economic and health security to farmers; and (iii) reduced environmental footprint and enhancement of biodiversity. Therefore, addressing these issues could ensure sustainability at the production stage.

At the post production or processing stage, measures such as reduced use of chemicals, waste and water management could help establishing a sustainable system.

The primary focus of this chapter is to assess preparedness of India in addressing emerging sustainability challenges because of changing consumer preferences and environment and health concerns. It analyses emerging standards and labelling practices in the international market, especially the EU. As a measure of India's preparedness, government policy framework and other institutions including farmers' and producers' initiatives taken at both production and processing stages are analysed. The chapter also makes a presentation of some emerging sustainability standards and labelling in the international market, and impact of such standards on Indian cotton market – mainly exports.

Sustainability Requirements in the EU

There are three pillars to environmental sustainability in cotton and textile sector. These include resource efficiency, chemical use and management, and product labelling and harmonisation. All of these are

presently covered by legislation and directives of the EU. While European Commission's Sixth Environmental Action Plan directly seeks to regulate the sustainable use of natural resources during the life cycle of textile products; the labeling of textiles in the EU is regulated by three specific Directives (*Directive 2008/121/EC1*, *Directive 73/44/EEC2 and Directive 96/73/EC3*, *Directives 89/686/EEC and 89/656/EEC*). As in the case of labelling, chemical use and management is regulated by the three Directives, which include, Integrated Pollution Prevention and Control (1996/61/EC), VOC Solvents Emissions Directive (1999/13/EC), and REACH Directive (EC/2006/1907). These converge to make cotton textile production and use more sustainable with respect to environment and human health. These are briefly discussed below.

Resource efficiency

The European Commission's Sixth Environmental Action Plan directly seeks to regulate the sustainable use of natural resources during the life cycle of textile products. The Directives are premised on the fact that, as per the statistics, the EU currently discards 5.8 million tonnes of textile waste per annum. The provisions in the Directive are summarised below.

- *Landfill Directive 1999/39/EC*: The Directive requires a 35 percent reduction in the biodegradable waste being sent to landfill by 2016. This will include textiles manufactured that are readily biodegradable i.e. those manufactured from natural or bio-polymer materials.
- *Waste Framework Directive 2008/98/EC*: It seeks to promote re-use and re-cycling. Bio-waste is also a thematic issue under the Directive.
- *Incineration Directive 2000/76/EC*: This Directive sets emissions limits and monitoring requirements for pollutants to air and also seeks to control releases to water resulting from the treatment of waste gases by pollution control equipment. The Directive is premised on the fact that textiles may contain substances that could undergo chemical reactions or transformations during the combustion process and become concentrated in waste gases and/or bottom ash.

Product labelling and harmonisation

The Directives relating to labelling seek to ensure the consistent labeling for fibre composition and associated sampling methods. Specific Directives also apply to Personal Protective Equipment (PPE):

- *Directive 2008/121/EC1:* This Directive stipulates that all textile products have to be labelled or marked whenever they are put on the market for production or commercial purposes. The directive covered

all raw, semi-worked, worked, semi-manufactured, semi-made, made-up products with more than 80 percent textile weight content. The labelling indicating the fibre composition is mandatory in all stages of the industrial processing and commercial distribution of a product.

- *Directive 73/44/EEC2* and Directive 96/73/EC3: It seeks to harmonise the methods for sampling and analysis to be used in Member States for the purpose of determining the fibre composition of binary and ternary textile fibre mixtures. Both Directives have been introduced in order to facilitate the implementation of the provisions on the harmonisation of textiles names. As a result of the implementation of these Directives, manufacturers, importers, traders and retailers must carry out fibre tests in accordance to the uniform test methods set out in the Directives.
- *Directives 89/686/EEC* and 89/656/EEC*:* This Directive regulates the health and safety performance of Personal Protective Equipment (PPE) ensuring that there is consistent labelling of the performance of garments and the hazards they will protect users against. The second Directive addresses the design and performance of products to be used in workplaces.

Chemical use and management

The provisions in various EU's Directives that guide use and management of chemicals in textiles are briefly summarised below.

- *Integrated Pollution Prevention and Control (IPPC) 1996/61/EC*: The Directive aims at minimising pollution from various industrial sources throughout the European Union. Plants for the pre-treatment (operations such as washing, bleaching, mercerisation) or dyeing of fibres or textiles where the treatment capacity exceeds 10 tonnes per day are subject to the IPPC Directive. In such cases, companies are required to obtain an authorisation (environmental permit) to operate. Furthermore, permit conditions must be based on Best Available Techniques (BAT).
- *VOC Solvents Emissions Directive 1999/13/EC*: The VOC (Volatile Organic Compounds) Solvents Emissions Directive is the main policy instrument for the reduction of industrial emissions of volatile organic compounds (VOCs) in the EU. It covers a wide range of solvent using activities, including printing, surface cleaning, vehicle coating, etc. The VOC Solvents Emissions Directive requires installations in which such activities are applied to comply either with the emission limit values set out in the Directive or with the requirements of the so-called reduction scheme.

- *REACH Directive EC/2006/1907*: REACH (Registration, Evaluation, Authorisation and Restriction of Chemical substances) Directive which came into force in 2007. Its primary aim is to ensure a high level of protection of human health and the environment. The REACH Directive places the burden of proof on industry, which has to collect or generate the data necessary to ensure the safe use of chemicals. REACH requires the registration of substances used by industry and provides rules for the phasing out and substitution of the most dangerous chemicals based on the latest scientific evidence in relation to the hazards they may pose.
- REACH is regulated by the European Chemicals Agency (ECHA). REACH is complemented by the new Regulation for Classification, Labelling and Packaging of Substances and Mixtures (CLP Regulation, January 2009). This Regulation incorporates the classification criteria and labelling rules agreed at UN level - the Globally Harmonised System of Classification and Labelling of Chemicals (GHS). In relation to textiles a number of relevant substances are currently authorised or restricted by the REACH Directive.

Some of the specific provisions on use of chemicals included in the REACH are flame retardant (with threshold limit o.1 percent, w/w), surface repellents (prohibited in textile), biocides (must not contain pentachlorophenol), and dyes (a group of synthetic chemical).

Some Important Ecolabels Relating to Cotton Textiles in the EU

The approach towards sustainability is reinforced by growing preference for environment friendly among consumers in the EU. Based on the EU requirements emerging from various directives and legislations, and increasing consumer preference, a large number of ecolabelled products adhering to specified standardisation and with due consideration for the environment and human health have come up locally and being marketed by other countries in the EU market. Some of the most visible ecolabels with their inherent characteristics in the EU are shown in the box below (Box 4.2).

Box 4.2: Key EU Environmental Labels Covering Textiles Products and their Scope

	EU Ecolabel	Nordic Ecolabel	Blaue Engel	Ökotex 100	Ökotex 1000	GOTS
						
Fibres	✓	✓	✓			✓
Sustainable resource use	Cotton, recycled content	Natural fibres, recycled content				Cotton
Production	✓	✓	✓		✓	✓
Energy consumption	✓	✓			✓	
Air and water pollution	✓	✓	✓		✓	✓
Substance restrictions	✓	✓	✓	✓	✓	✓
Social and ethical criteria	✓	✓	✓	✓		
Consumer health	✓	✓		✓		
Fitness for use	✓	✓	✓	✓	✓	✓
End of life						

Source: Revision of European Ecolabels and Green procurement Criteria for Textile Products, European Commission, February 2012

Other Requirements in the EU and Other Countries

The EU regulation on organic production

In the member states of the European Union (EU), the EU Regulation 2092/91 governs labelling of plant products as organic. The Regulation came into force in 1993. It protects producers from unfair competition, and consumers from pseudo-organic products. The EU Regulation on organic production lays down minimum rules governing the production, processing, storage and import of organic products and feedstuff for organic husbandry, including inspection procedures, labelling and marketing for the whole of the European Union. The regulation makes each European country responsible for enforcement and for its own monitoring and inspection system.

EU logo for organic products

In February 2000 the European Commission introduced a logo for organic products that may be used throughout the EU by producers operating in accordance with the provisions of the EU regulation on organic production. The logo may only be used on organic products where 95 percent of the ingredients are organic products that originate from the EU and that have been processed, packaged and labelled in the EU or on imports from countries with an equivalent inspection system. The use of the symbol is voluntary.

The EU Regulation 2092/91 (Article 11) governs market access for organic products in the countries of the EU. It stipulates that organic foods imported into the EU from third countries must have been produced, processed and certified in accordance with equivalent standards. Enforcement is the responsibility of the EU Member States. At the present time there are two ways of authorising imports into the EU:

- Access via the list of third countries: A country or certification body may apply to be added to the list of third countries via its diplomatic representatives in Brussels. In order to be added to this list, the country making the application must already have enacted organic farming legislation and a fully functional system of inspection and monitoring must be in place. In addition, it must provide an attestation of equivalence and other information on organic farming methods. The European Commission decides upon the application based on an assessment of the implemented system (some of the countries listed under this are Argentina, Australia, Costa Rica, Israel, New Zealand and Switzerland. Even for these countries exports are required to be accompanied by a consignment-specific "Certificate of Inspection for Import of Products from Organic Production".
- For countries not included on the list of third countries, requirements vary from one EU country to another. In such cases, an importing company needs to sign an inspection contract with a European certification body. The importer needs to apply for an import permit with the local competent authority. With the application the importer has to provide documentation to prove that the production and certification of the respective products has been equivalent with the EU requirements. It may also be noted that procedures relating to the issue of import permits tend to differ between the EU countries.

Ban and restrictions on use of chemicals

Since the 1990s, many countries have adopted environmental standards and requirements restricting the use of harmful chemicals in the production

of textiles and clothing. Some of these standards and requirements are imposed by laws and regulations. The best known is the Second Amendments to the Consumer Protection Act enacted by the German government in 1994 prohibiting the use of azo dyes. The Fifth Amendments to the Act came into force in April 1997. Since then, many other European countries have followed suit. In 1996, the Netherlands also enacted a law prohibiting the use of certain azo dyes. The contents of this legislation are similar to the list of banned substances in the German law. Other countries in Europe, such as Sweden, France, Denmark and EU are also in the process of formulating legislation concerning azo dyes.

In addition to mandatory environmental standards and requirements for textiles, there are some ecolabelling schemes imposing environmental requirements for textile products on a voluntary basis. The most well-known programmes include Milieukeur and Eko of the Netherlands, and Oeko-Tex Standard 100 and Toxproof of Germany.

Generally speaking, the German Act of 1994 forbidding azo dyes and some ecolabelling standards for textiles such as Oeko-Tex Standards 100 are the ones that have the most trade implications. They have had both positive and negative impacts on the world textile trade, imposing a great challenge for textile exports of China as well as other developing countries.

Regulations in the US

Besides the EU regulations, regulations in the US market appear to be most important in terms of their strong influence on the global market. The US regulation on organic agriculture the National Organic Programme (NOP) came into effect in October 2002. From the perspective of the consumer one could say that production and inspection standards of US organic products, EU organic products and organic products from other countries are equivalent with each other. However, it is required that traders who want to export organic products ensure that both production standards and procedures for imported products are met.

The US regulation is argued to be more precise in its requirements for imported products to fully meet the NOP provisions. The US system approves certification bodies as agents to operate the US certification programme. It is required that inspections are conducted by inspectors trained on NOP, and only certificates issued by certification bodies accredited by the US Department of Agriculture USDA are accepted. So far above 100 certification bodies had been accredited by USDA according to NOP, and only produce certified by these certification bodies can be exported to the US market.

Private standards

In many other countries, particularly in the EU, a number of associations of stakeholders including farmers' associations have been formed. These associations have their own private standards and labelling schemes, and these standards are reflected by their logos. These quality marks or logos, for example in the UK, in Denmark, Austria, Sweden, Switzerland, and others are well trusted by consumers and are one of the reasons for the current boom in the market for organic products in these countries.

Private standards are more a set of guiding principles rather than the detailed production and processing standards. These private standards in some elements exceed the minimum requirements stipulated by national regulations. It is also observed that some private standards are more demanding in the field of agriculture and in processing. For imported products to be awarded the private labels, all of the foreign operators (producers, processors and traders) need to fulfil not only the requirements set out in EU Regulation 2092/91 or other national regulations, but also comply with the respective private label standards. Those private labels undertake an additional verification of compliance.

The private standards have determined the content of the IFOAM Basic Standards (an off-the-shelf certification standard based on the IFOAM Basic Standards or IBS), which has a major influence on the EU Regulation 2092/91, besides the Codex Alimentarius[4] (strictly for the protection of health of consumers). Compared to national regulations, private standards are developed from the bottom up rather than imposed from above. However, since the implementation of national regulations, private standards are forced to compile with them.

How is India Responding to Sustainability Challenges in Cotton?

At the country level, India's response to sustainability challenges in cotton is embedded with different policies, but especially its policies relating to agriculture and textile sectors. In addition, various initiatives taken by the state governments, and other non-state institutions, such as NGOs, farmers, international organisations, and others also seek to promote sustainability in cotton production and usage.

Box 4.3: Some Commitments to Better Cotton Initiative (BCI) by Some Companies in India	
Company	*Commitments*
Abhishek Industries Ltd.	AIL has made a commitment towards ethical business. AIL has partnered with BCI to promote measurable improvements in cotton cultivation to make it more economically, environmentally, and socially sustainable
Arvind Limited	Arvind initiated the first BCI approved project in India and is a newly elected member of BCI council. Arvind's project covers over 30,000 acres of farmlands and involves working closely with nearly 3,800 farmers. The project size is set to double within the next financial year.
IKEA	Founding member of BCI. IKEA and WWF started working with farmers in India in 2005 with the aim of making conventional cotton production more sustainable. As of now, 13.4percent of their total cotton use is sustainable cotton.
Source: WWF	

Government policy

There is no direct government of India policy specific to cotton production and consumption. Cotton is, however, covered by the government of India policies on agriculture and textile industries. Promotion of sustainable cultivation of cotton and its use comes under various initiatives. It might be recalled that, in 2000, the Government of India announced the National Textile Policy – 2000 (NTP 2000), which replaced the previous Textile Policy of 1985. One of the main objectives of the new policy is to enable the textile industry to attain and sustain a pre-eminent global standing in manufacture and export of clothing.

For development of cotton sector, the primary aim of the policy is to improve production, productivity and quality, and stabilise prices. The policy endeavoured to achieve all-round development of the sector (Box 4.4).

Box 4.4: Salient features of National Textile Policy, 2000		
Measures introduced	***Objectives***	***Influence***
De-reservation of garments and knitting from Small Scale Industries	Increasing output	Growth in hosiery segment
Implementation of TUFS, covering all manufacturing segments of the industry	Technological Up-gradation	Slow progress initially, but picked up pace in recent times–major capacity expansions underway
Implementation of Technology Mission on Cotton and Technology Mission on Jute	Productivity enhancement Quality improvement Strengthening raw material base Reviving textile research associations (TRAs) to focus research on industry needs	Strengthening of raw material base for the industry Substantial increase in cotton production, though no major progress in jute production
Encouraging private sector to set up world-class, environment-friendly, integrated textile complexes and textile processing units	Infrastructure development	40 textiles park projects have been approved by the Ministry of Textiles.
Strengthen and encourage the handloom industry to produce value-added items	Product diversification	No major progress in terms of product diversification
Marketing assistance to the industry to forge joint ventures to secure global markets	Export expansion	Increased interaction between Indian textile industry and foreign counterparts through participation in foreign exhibitions and delegate visits
Employment generation	Setting up a venture capital fund for tapping knowledge-based entrepreneurs of the industry Re-design and revamp schemes and programmes initiated in the handloom, sericulture, handicrafts, and jute sectors to ensure better returns for those from the disadvantaged categories	
Strengthening HRD institutions, including NIFT, on innovative lines	Human resource development	Development of skilled labour in the industry
Source: Ministry of Textile, Government of India		

In the case of cotton, the policy aimed to achieve the followings:

- Increase cotton productivity and upgrade its quality to international standards, through effective implementation of the Technology Mission on Cotton
- Reduce the ratio between cotton to non-cotton fibres in line with international trends
- Encourage full fibre flexibility between cotton and man-made fibres
- Encourage modernisation of the spinning sector
- Liberalise and encourage export of cotton yarn

Considering that cotton is one of the most important materials which could lend greater sustainability to textile sector, for achieving the embedded policy objectives, as indicated above, the policy provided for launch of Technology Mission on Cotton (TMC) as an instrument. Realising that the success of the policy is critically dependent on various inline ministries and others, it also seeks to involve and promote active cooperation and collaboration among Ministry of Textiles, Ministry of Agriculture, Cotton growing States, farmers and industry associations in the implementation of this Mission.

The Technology Mission on Cotton

The Technology Mission on Cotton (TMC) was launched on 21st February, 2000 by Government of India, and is continuing till now with five distinct goals. It comprises of five Mini Missions and is organised by the Ministry of Agriculture and the Ministry of Textiles. The specific objectives of the Mission include (i) increase the productivity per hectare of cotton, (ii) development of new technologies and varieties, (iii) transfer of new technology and financial assistance to the farmers, (iv) improvement in marketing infrastructure, and (v) improvement in the seed cotton (kapas) processing for reducing contamination. Focus of each of the Mini Missions is enumerated below (Box 4.6).

Box 4.5: Inbuilt Characteristics of Government of India's Technology Mission on Cotton

MM 1: Genetic Improvement of Cotton

- MM 1.1: Development and promotion of medium and long linted diploid cottons
- MM 1.2: Development of extra-long Staple with improved fibre qualities to meet requirements of textile industries
- MM 1.3: Identification of genotypes suitable for machine picking and development of agronomic package

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- MM 1.4: Development and promotion of Bt transgenic cotton for bollworm resistance
- MM 1.5: Molecular characterisation of cotton germplasm using DNA markers
- MM 1.6: Exploitation of apomixis for hybrid cotton seed production

MM 2: Natural Resource Management

- MM 2.1: Development of production technologies for Bt cotton and improvement of water and nutrient use efficiency with precision farming techniques
- MM 2.2: Identification of innovative Bt cotton based cropping system
- MM 2.3: Mechanisation of cotton cultivation
- MM 2.4: Physiological manipulation of cotton plant morpho frame for enhanced productivity under varied agro-climatic conditions

MM 3: Biotic Stress Management

- MM 3.1: Emerging and key pests: their characterisation, taxonomy, genetic diversity and control
- MM 3.2: Development and validation of IPM / IRM strategies for Bt and conventional cotton under different eco-systems
- MM 3.3: Development, validation, utilisation and/or commercialisation of bio-pesticides and bio-inoculants
- MM 3.4: Development of farmers' friendly diagnostic kits for transgenic event seed purity

MM 4: Post Harvest Technology of Cotton Fibre

- MM 4.1: Quality Evaluation of Cotton Fibre
- MM 4.2: Commercial technology development for value addition

MM 5: Technology Impact and Assessment

- MM 5.1: Total factor productivity of cotton in India
- MM 5.2: Studies on social dynamics of cotton production in distress areas
- MM 5.3: Indian Cotton Portal
- MM 5.4: TMC MMI Co-ordination and monitoring cell

Source: Central Institute for Cotton Research

The TMC has inbuilt characteristics to promote and realise distinctive improvements in production and processing of cotton. It has set standards for various activities during processing and use of cotton. For example, for ginning and pressing it has set standards for ginning machines, pre-cleaner and lint cleaner practices, kapas and lint conveyor systems, bale press, conveyor for seed, humidifier/ moisturiser, fire fighting system, underground wiring and others, as indicated in the box below (Box 4.7).

Box 4.6: Minimum and Desirable Standards in Respect of Machinery and Civil Structures in Ginning and Pressing (G&P) Modernisation Projects under the TMC

S. No.	*Item*	*Minimum Standard**	*Ideal Standard**
1.	Ginning Machines	Minimum of 3 saw gins/24 double rollers (DRs) of normal size/22 extra-long DRs/18 Jumbo DRs. Each DR gin should have Auto-feeder.	Minimum of 3 saw gins/24 DRs of normal size/22 extra-long DRs/18 Jumbo DRs. Each DR gin should have Auto-feeder. Ample space in Gin Hall with proper ventilation and good lighting
2.	Pre cleaner	Cleaner with 4 or more cylinders/rolls	Cleaner with 4 or more cylinders with automatic feeding facility and automatic trash expeller. Pod Opener
3.	Lint Cleaner	Cleaner with 3 or more cylinders/rolls	Cleaner with 5 or more cylinders with automatic feeding and mechanical trash expeller
4.	Kapas Conveyor System	Mechanical/Pneumatic conveyor from heap to Precleaner and from Precleaner to individual gins. Central/ Side Platform system not permitted unless it exists already	Complete automatic conveyance from heap to precleaner and from Precleaner to each gin through appropriate droppers/regulators without involving labourers. Moisturiser in the system after Precleaner.
5.	Lint Conveyor System	Mechanical/Pneumatic conveyor from Gins to Lint Cleaner, from Lint Cleaner to Pala House and from Pala House to Press Hall. In case of new Bale Presses, direct feeding from each Pala House into the Press Box through Lint Slide and Pusher arrangement.	Mechanical/Pneumatic Conveyor from gins to Lint Cleaner and from Lint Cleaner to Bale Press (without Pala House) through Lint Slide and Pusher Arrangement along with on-line moisturiser
6.	Bale Press	New Press with box dimensions to suit BIS specifications for size and weight should have a built-in Autotramper, should be single stage and oil hydraulic and with Lint Slide and Pusher mechanism for direct feeding into the box. Water hydraulic, two-stage presses without auto tramping facility will however be permitted if they already exist.	In addition, automatic moisture restoration on Lint Slide and automatic Bale Packaging facility.
7.	Conveyor for seed	Automatic Conveyor from gins to Seed Platform	Conveyor and roofed platform with an area of 3000 sq. ft.
8.	Humidifier/ Moisturiser	At least 4 Moisturisers in Gin House and 2 units in each Pala House. In case of direct feeding into press	More number of moisturisers or superior system. On-line moisturising of kapas immediately after precleaner.

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		without Pala House, moisturising at Lint Slide to be provided. In the absence of moisturiser at lint slide, it should be provided in the Press Hall where at least 2 units should be fixed.	
9.	Fire Fighting System	Overhead tank, sump and pump, with a minimum of 10 hydrants strategically located, hose pipes with nozzles and a stand-by diesel engine.	Same as in the last column, with more number of hydrants.
10.	Underground Wiring	All high tension and low tension cables to be under-ground	All high tension and low tension cables to be underground.
11.	Weigh Bridge	Capacity : 20 tons	Capacity : 20 tons. Electronic machine with digital display and print out facilities. Additional weigh bridge with 5 ton capacity for carts and tractors.
12.	Pucca Platform for Kapas	Raised platform with cemented surface or with round stones embedded in cement. Platform should have a minimum area of 10,000sq.ft.with 10 ft. wide cemented pavement around.	Raised and roofed platform with cemented surface or with round stones embedded in cement, with an area of over15,000 sq.ft. and 10 ft. wide cemented pavement around. The platform should be 1 or $1_{1/2}$ ft. in height.
13.	Covered Storage Space for Lint (Pala House)	Hall(s) with a minimum area of 4000 sq.ft., pucca floor and inner walls plastered up to 10 ft. height.	Hall(s) with area of 6000 sq.ft., fully plastered inner wall and cemented floor.
14.	Seed Platform	Raised, cemented platform of minimum 2000 sq.ft. area, with 2 ft. high outer wall.	Raised Cemented platform with 3000 sq.ft. or more and 2 ft. high outer wall and roof.
15.	Bale Storage Space	Platform with cemented floor adjoining Press Hall and admeasuring a minimum area of 600 sq.ft., preferably with roof.	In addition to platform, a roofed shed covered fully from all sides with cemented floor.
16.	Road	CC Road with at least 10 ft. width preferably elevated.	Elevated CC Road having a width of 12 ft. or more.
17.	Boundary wall/ fence	Wire mesh fence or barbed wire fence with less than 1 ft. gap between wires, or masonry wall, all of a minimum height of 6 ft.	Masonry wall for the entire compound with a height of 7 ft. or more.

* *Size* and quantity are for a unit with production capacity limited to 8 bales/hr. For larger units the size and quantity will be proportionately higher.

Source: Kapas India

The TMC appears to have direct impact on different issues relating to production and usage of cotton. The report[5] reveals that as a result of MM-I, Planting of cotton on flat beds and opening of ridges and furrows at last intercultural operation has increased the productivity to the tune of 18 percent over farmers' practice of sowing of cotton on flat beds without opening of ridges and furrows. In Central zone, it has been observed that on an average 16 percent more yields can be achieved by adopting INM model. In South zone, INM model increases the productivity by 22 percent over farmers' practice.

The MM-II led to positive impact on yields and productivity. Compound growth rate in production during the decade 1990-2000 which was 2.17 percent with negative growth rate of -0.40 percent in yield increased to 17.36 percent and 16.35 percent respectively during the TMC period (2001-2007). In addition, the use of pesticides has also come down. The pesticide consumptions has been reduced by more than 30-40 percent especially in the States of Andhra Pradesh, Haryana, Maharashtra, Gujarat and Tamil Nadu.

Similarly in case of MM-III and MM-IV, impressive results are observed. By providing the required civil infrastructure in markets, the sources of contamination are being effectively plugged. Setting up of grading laboratory enables the farmer to get a price commensurate with cotton quality. Farmers' Information Centres (FICs) provide information for better crop management and price realisation by which the profitability of cotton cultivation has improved. Till 2009 about 104 APMCs reported completion of their market yards. With the anticipated completion of all the 250 market development projects about 90 percent Indian cotton would be transacted in clean environments.

MM IV has direct impact on the Textile growth of the country in recent years. The number of mills which was 1569 increased to 1700 in 2006 in the country during the last decade with Spindle capacity of 34.34 million. The Rotors which was hardly 1.36 lakh increased to 3.95 lakh. The hand loom sector also showed increased growth.

Technology Upgradation Fund Scheme (TUFS)

It may be recalled that even before launch of TMC, the government of Indian had launched Technology Upgradation Fund Scheme (TUFS) in April 1999. The TUFS was launched in order to modernise the textile industry as well as increase its competitiveness. Under the scheme, textile firms across segments could avail of loans for technological upgradation at lower interest rates. The scheme has provision for benchmarking technology in terms of specified machinery for each sector of the textile

industry. , and machinery with technology levels lower than that specified are not be permitted for funding under the TUFS. The scheme, which was to expire in March 2007, was extended to cover a period up to 2012. Some of the incentives provided under this scheme included:

- Interest reimbursement at the rate of 5 percent of the normal interest rate charged by the lending agency or rupee term loan, or
- Coverage of 5 percent exchange fluctuation (interest and repayment) from the base rate on foreign currency loan, or
- Credit-linked capital subsidy of 15 percent for SSI textile and jute sector, or
- Credit-linked capital subsidy of 20 percent for the powerloom sector, or
- Interest reimbursement at the rate of 5 percent plus 10 percent capital subsidy for specified processing machinery.

Fiscal support

While TMC and TUFS primarily focus on strengthening cotton textile sector by improvement in quality and technology, the Government of India, as part of its policy initiative, to encourage foreign trade in cotton, has also streamlined the duty structure on cotton. The Government which had increased customs duty on cotton fibre exports from 5 percent in 2002-03 to 10 percent in 2003-04, the Government in 2009-10, removed the customs duty on cotton. The customs duty on cotton yarn also has gradually decreased from 20 percent in 2005-06 to 15 percent in 2006-07 and further to 10 percent in 2008-09. The duty on cotton fabric has also decreased substantially over the years. In addition to these, the Government has allowed 5 percent export incentive for raw cottons (Table 4.1). These measures have provided an incentive as well as impetus for generating greater volumes in cotton trade. Moreover, it may be noted that cotton production does not attract excise duty, though excise duty is applicable on cotton yarn and cotton fabric, which have been reduced substantially.

Table 4.1: Customs Duty on Cotton Textile

Customs duty on different categories of cotton textiles (percent advalorem)

Items	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Cotton	5	10	10	10	10	10	10	Nil	Nil
Cotton Yarn	20	20	20	20	15	12.5	10	10	10
Cotton Fabrics	**30/35	**30	**20	**20	**15	**12.5	**10	**10	**10

**Attracts advalorem rate or specific rate whichever is higher basis
Source: Ministry of Textiles, Government of India

Initiatives to control use of hazardous inputs and chemicals

At the production stage, use of chemicals is guided by the Environment (Protection) Act, 1986 and the National Environment Policy 2006. Under these two (EPA 1986 and NEP 2006), the Ministry of Environment & Forests has notified the rules for the manufacture, use, import, export and storage of hazardous microorganisms/genetically engineered organisms under the Environment (Protection) Act, 1986. These rules and regulations cover the areas of research as well as large scale applications of GMOs and products made there from throughout India. The rules also cover the application of hazardous microorganisms which may not be genetically modified. Besides, the rules cover activities involving manufacture, use, import, export, storage and research. The target substances covered are, besides the hazardous natural microorganisms, all genetically engineered organisms including microorganisms, plants and animals.[6] The Rules mandate risk assessment and regulatory approval for every proposed release of GMOs or GM products.

Rules under the EPA also define the competent authorities and composition of such authorities for handling of various aspects of the rules. Presently there are six competent authorities that is , Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committees (IBSC), Review Committee on Genetic Manipulation (RCGM), Genetic Engineering Approval Committee (GEAC), State Biotechnology Coordination Committee (SBCC) and the District Level Committee (DLC).

The RCGM established under the Department of Biotechnology supervises research activities including small scale field trials, whereas approvals for large scale releases and commercialisation of GMOs are given by the GEAC, established under the Ministry of Environment and Forests. The Rules also mandate that every institution engaged in GMO research establish an IBSC to oversee such research and to interface with the RCGM in regulating it.

Considering that chemicals use in the form of pesticides, herbicides, insecticides among others create enormous environmental hazards, government of India started regulating its use many years back. Approval to transgenic Bt cotton by the GEAC was one such attempt and was premised on the fact that it will lead to reduced use of pesticides in cotton production. The government followed a policy of case by case approval of transgenic crops. Bt. Cotton was the first and only transgenic crop approved by GEAC for commercial cultivation in 6 States namely Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. This has now extended to cover all the cotton producing states in India.

Box 4.7: Sustainability of Bt Cotton is Now Increasingly Questioned in India
Government bans Mahyco Monsanto Biotech

Based on a complaint lodged by the Vidarbha Jan Andolan samiti, reports from agriculture officers, and after being convinced that Bt Cotton played a key role in accelerating the farmer suicide saga in Vidarbha since June 2005, the Director of Inputs and Quality Control (DIQC), the licensing authority in Maharashtra has banned Mahyco Monsanto Biotech (MMB) in its final order. A notice has been sent under the provisions of the 2009 Maharashtra Cotton Act which states that all trade activities of the company are illegal.

The DIQC in its notice announced that any violation could invite stern punitive action against the company. The DIQC's announcement has brought a closure of sorts to a long battle against Bt Cotton.

There is now call for replacement of Bt cotton by straight variety seeds. It is argued that the cost of straight variety seeds is much lesser than the Bt varieties. Also, these varieties become ready for plucking in 150-160 days unlike Bt varieties which take 180-200 days. This in turn reduces need for fertilisers, pesticides and other nutrients substantially.

Further it is also alleged that Bt cotton had failed to supply good quality seeds despite taking huge advances from debt trapped farmers in the state.

Source: DNA, 10 August 2012

What is important to note is that the approval and adaption to Bt cotton is not an end in itself. These is mechanism in place – led by both government agencies and non-state actors – to continuously monitor developments both relating to Bt cotton and non-Bt cotton. The approach has been strengthened by growing people's consciousness on issues such as health and environmental in the recent periods.

Box 4.8: Towards Greater Sustainability in Cotton Production
the Maharashtra government to test Brazilian model

The Maharashtra government is taking a major step towards ensuring sustainable cotton production. The state, a major producer of cotton in India, is implementing a pilot project in eight districts of Vidarbha region to increase the per-acre yield of cotton while reducing its per-acre cultivation cost. It is understood that India presently has the lowest cotton productivity in the world and Maharashtra, the lowest in India. The world average is around 725 kg/lint per hectare (ha.) whereas India's average is around 500 kg/lint per ha, and Maharashtra's average is just around 350 kg/lint per ha. With this new Brazilian model, the state hopes to increase its yield to India's level. One major difference between Indian and Brazilian model is that the Brazilian

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model which uses straight varieties of cotton and not the hybrid or Bt (genetically-modified) ones.

The project is being undertaken in collaboration with the Central Institute of Cotton Research (CICR) over 160 acres of land belonging to 160 farmers in this region. The project is premised on adoption to the Brazilian model of cotton cultivation where the per-acre density of cotton is double what it usually is in India. It might be recalled that cotton is the only cash crop in Vidarbha and the region's economy depends upon it. It is expected that besides increasing yields per hectare, it will also lead to substantial reduction in cost of production, and this in turn will lead to improved living standards of farmers and decline in number of suicides.

The Vidarbha region has seen a large number of cotton-growing farmers committing suicide since 2005 (nearly 9,000 cotton growing farmers have committed suicide till date although official government figures stand at 4,000). This is because of several issues, including crop failure due to erratic rains, low yields and rising cost of cultivation.

In the Brazilian model, which uses straight varieties of seeds, cost of seeds is much lower than Bt varieties. Besides, these varieties become ready for plucking in just 150-160 days whereas BT varieties take around 180-200 days. Relatively shorter production cycle reduces the need for fertilisers, pesticides and other nutrients substantially. And unlike Bt cotton varieties, seeds derived from straight cotton varieties can be used during the next season also. All these factors reduce the cost of cultivation from around Rs. 12,500 per hectare to under Rs. 5,000 per hectare.

What is more important here and which is reflected by the initiative is that the move indicates a rethink of the strategy of using genetically modified cotton.

Source: LiveMint, 16 August, 2012 (emphasis added)

Some recent issues that have emerged from adaption to Bt cotton, especially new types of pests that are resistant to Bt cotton seeds, pollination, weediness, effect on non-target organisms, presence of Bt gene in soil, food safety and others, are leading to emergence of some new dimensions in terms of greater acceptance of organic or other types of non-transgenic production practices.

In addition, it might be recalled that in 1997, the government of India banned the use of hexachlorocyclohexane (HCH), which accounted for about 30 percent of total pesticide consumption. In the same decade, subsidies for insecticides were also abolished.

The use of harmful insecticides is also monitored and controlled. This is based on the Insecticides Act, 1968, Ministry of Agriculture, Department of Agriculture & Cooperation (DAC) that regulates the import,

manufacture, sale, transportation, distribution, and use of insecticides with a view to preventing risks to humans or animals, and for matters connected therewith. Under the Act, a Registration Committee is empowered with the registration of insecticides after verifying that it is safe for use by farmers. During 2009-10 (April to December 2009), over 2,490 registrations were granted.

The Registration Committee has the right to review the pesticides from time to time and to ban or restrict the use of any pesticide product. Accordingly, the government has banned the use of more than 30 pesticides, restricted the use of seven pesticides including DDT, and refused registration for 18 pesticides.[7]

To provide for a more effective regulatory framework for the introduction and use of pesticides in the country, the government amended the Pesticides Management Bill, 2008, which replaced the Insecticides Act, 1968. In addition, a campaign to prevent the manufacture and sale of spurious pesticides was launched by the DAC in cooperation with all the state governments and the respective Central Integrated Pest Management Centre (CIPMCs).[8] The quality of pesticides is monitored by the central and state insecticide inspectors, who draw samples of insecticides from the market for analysis.

As a result of various measures and policy initiatives by the government of India consumption of chemical pesticides have been reduced and use of bio-pesticides has increased as better replacement. Consumption of chemical pesticides has reduced from 65,462 MT during 1994-95. It has come down to 47, 020 MT during 2001-02. In the later years, the overall consumption of pesticides in agriculture shows significant variations. While it increased during 2002-03, there was a drastic fall in the following year (2003-04). The consumption declined to 41,000 MT. Since then, however, an increasing trend is observed. Total pesticides consumption again crossed 55.000 MT in 2010-11.

The increase in consumption, however, might not be due to its increased use in cotton. Some studies suggest that after introduction of Bt cotton in 2002-03 in India has led to substantial decline in use of pesticides.

Other important government initiatives

Government of India has taken various initiatives as well as schemes though regulations, legislations and awareness programmes among others to promote sustainable production practices in agricultural sector.

Integrated Crop Management and Integrated Pest Management (IPM) are some of the government initiatives though which sustainable production practices can be promoted. Integrated Crop Management (ICM) is a

concept that balances the three dimensions of sustainability and sets a framework of good agricultural practices. These comprise a wide portfolio of measures such as soil and nutrient management, seed choice and pest control. IPM includes indirect measures for weed, insect and disease prevention, crop rotation, and direct control measures through biological, biotechnological, chemical and mechanical means. The combination of breeding and crop protection research provides tools to manage weeds, pests and diseases in an integrated way.

One of the very important recent development (July 2012) in India is the introduction of national standards for organic textiles. The Indian Standards for Organic Textiles (ISOT) is introduced in the National Standards for Organic Production (NPOP) and is administered by the Commerce and Industry Ministry as part of the Foreign Trade Policy. It may be recalled that there are over 1,000 branded organic products produced in India and each one is backed up with certification and traceability.

Other major initiatives by the government of India are demonstrated in the box below (Box 4.10).

Box 4.9: Some Government of India Initiatives to Promote Cotton and Textile Products

- **Welfare scheme** (the government has offered insurance coverage and life insurance coverage to 161.1 million weavers and ancillary workers under the Handloom Weavers' Comprehensive Welfare Scheme). In addition, 733000 artisans have been provided health coverage under Rajiv Gandhi Shilpi Swasthya Yojana);
- **E-marketing** (the Central Cottage Industries Corporation of India and the Handicrafts and Handlooms Export Corporation of India have developed a number of e-marketing platforms to simply marketing issues. Besides, a number of other initiatives have been taken up to promote niche handloom and handicraft products);
- **Skill development** (as per 12th Five Year Plan, the Integrated Skill Development Scheme aims to train over 2,675,000 people within the next five years);
- **Credit linkages** (as per the Credit Guarantee programme, over 25000 artisan credit cards have been given to the artisans. Another 16.5 million artisans are likely to be given credit cards by banks. This initiative has been taken under the Credit Linkage Scheme);
- **Financial package for waiver of overdue loans** (the Government of India has announced a package of $604.56 million to waive of overdue loans in the handloom sector. This is expected to benefit over 300,000 handloom weavers of the industry and 15000 cooperative societies);

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- **Textile parks** (the Government of India has approved 40 new textile parks. This would provide employment to 400,000 textile workers).
- **Quality improvement** (The Textile Commission, under the Ministry of Textiles, facilitates firms in the industry to improve their quality levels and also get recognised quality certifications. Out of 250 textile companies that have been taken up by the Commission, 136 are certified ISO 9001. The other two certifications that have been targeted by the Textile Commission are ISO 14000 Environmental Management Standards and SA 8000 Code of Conduct Management Standards.)

Source: A Brief Report Textile Industry in India, Cotton Corporation of India, March 2012

Besides, EPA (1986) and the National Environment Policy (2006), various other initiatives have been taken by India to reduce use of hazardous chemicals. Legislations have been enacted in India since independence to protect and preserve its' flora and fauna from the deadly effects of chemical fertilisers and pesticides. Some of these are briefly descried below.

Initiatives have also been taken control use of chemicals and address other sustainability issues. Towards this, the Government of India had also taken steps to ensure production of eco-safe textiles in the country. More specifically, following steps have been taken by the Government of India:

- The ban of 70 carcinogenic dyes in textile applications.
- The Bureau of Indian Standards has launched the ecolabelling scheme. It permits to use "Eco-Mark" label on textile processed with safe chemicals.
- Setting up of a chain of eco-testing laboratories in all textile production centers in the country.
- To encourage textile industry to invest in effluents treatment plants, Technology Upgradation Fund scheme has been launched.
- Financial assistance for setting up common effluent treatment plants to benefit small processing units (Roy, 2006).

Box 4.10: Some Important Milestones towards Sustainable Cotton Production and Usage in India

In a recent initiative to strengthen India's position in the world organic cotton market, the Agricultural and Processed Foods Export Development Authority (APEDA) has introduced certification for organic textiles. India has also the distinction of being one of the very few countries in the world to have introduced organic textile standards at the national level.

Recently, the National Programme for Organic Productions (NPOP) has included the National Organic Textiles Standards (NOTS), as part of the certification process under NPOP. The NPOP is a legal regime administered by Department of Commerce as part of the foreign trade policy.

It is important to note that the European Commission, Switzerland and the US recognise NPOP Standards and the conformity assessment procedures of India (1SO-17011) to be equivalent to their country standards resulting great acceptance for Indian organic products in their markets. India is negotiating with Japan and Canada for equivalence.

India's organic products have been growing at an average of 30 percent over the past five years. There are more than 1,000 branded organic products produced in India and each one is backed up with certification and traceability.

Source: The Hindu Business Line, 20 July, 2012

Sustainability initiatives by non-state actors

Besides the initiatives taken at the government level, a number of other agents – both national and international – are active in promoting sustainable cotton production and consumption in India. Presence of these non-state actors has not strengthened the move towards greater sustainability, but has also contributed in integrated the sector with global emerging sustainable production and processing practices. Some of the most important initiatives that are under progress are briefly described in the following sub-sections.

WWF's India's Sustainable Cotton Project

WWF's India's Sustainable Cotton Project is working towards developing improved sustainable cotton production systems, in which farmers, by adopting BMPs,[9] are equipped to produce quality cotton by using environment-friendly organic fertilisers produced from locally available resources. The project which started in 2007 now has presence in different agro-climatic cotton-growing regions of the country—Andhra Pradesh, Maharashtra, and Punjab. The project aims at reaching one-tenth million of cotton growers.

The thrust of the project is to discourage the use of chemical pesticides, which are not only expensive, but also damage the crop and environment, and lead to long-term illnesses for the farmers and their families.

Results from BMP fields
30 percent–51 percent water reduction in BMP fields
38 percent–80 percent lessening of chemical pesticides in BMP field
32 percent–53 percent reduction in chemical fertiliser
40 percent–50 percent reduction in GHG emission
31 percent improvement in gross margin of BMP farmers

Conservation, as well as efficient use of water and sustainable use of natural resources by cotton farmers is also promoted under the project. Emphasis is also given to clean cotton picking and reduction of cotton contamination for the mutual benefit of the farmers and the industry.

The Project uses an integrated approach: by developing water and nutrient management practices for cotton and cotton-based cropping systems; and IPM technology, has thereby created a ripple effect among farmers in the Warangal district of Andhra Pradesh, as well as the Jalna and Aurangabad districts of Maharashtra.

The cotton produced under WWF-India's BMPs is procured by the local suppliers of the global brands and retailers, such as IKEA and Marks and Spencer. Thus, a supply chain is ensured, focusing on production and uptake of sustainable raw materials. WWF-India is creating a network of reputed national textile brands and retailers to create awareness about sustainable raw material supply. By integrating production with producers, WWF-India's BMP's have contributed towards producing environmentally sustainable cotton within an enabling environmental framework.

bioRe promoting greater sustainability[11] in cotton production in India

bioRe India, established in 1991 and situated in the state of Madhya Pradesh, has established a unique international network for the production and distribution of quality textiles conforming to international ecological and social requirements. The organisation works for contract producers and with the farming community at the grass root level. It aims to achieve good yields and sustainability in the organic agricultural practices.

The organisation procures the certified organic cotton from the individual farmers by paying them fare prices. It undertakes the work of ginning and eventually converts the same into cotton yarns to use either for the bioRe garments or sold as cotton yarns worldwide.

Box 4.11: Some Commitments to Better Cotton Initiative (BCI)[10] by Some Companies in India	
Company	*Commitments*
Abhishek Industries Ltd.	AIL has made a commitment towards ethical business. AIL has partnered with BCI to promote measurable improvements in cotton cultivation to make it more economically, environmentally, and socially sustainable
Arvind Limited	Arvind initiated the first BCI approved project in India and is a newly elected member of BCI council. Arvind's project covers over 30,000 acres of farmlands and involves working closely with nearly 3,800 farmers. The project size is set to double within the next financial year.
IKEA	Founding member of BCI. IKEA and WWF started working with farmers in India in 2005 with the aim of making conventional cotton production more sustainable. As of now, 13.4percent of their total cotton use is sustainable cotton.
Source: WWF, YES BANK, 2012.	

bioRe is certified and adheres to the following standards:

- National Programme for Organic Production (NPOP): This Indian standard is equivalent to the European standards of organic production.
- National Organic Programme (NOP): This is consistent with USA standards.
- SA-8000 – bioRe's ginning unit is the first ginning factory in India to be SA 8000 certified.
- Global Organic Textile Standards (**GOTS):** All yarn sold is certified as per this standards.

bioRe works on five basic principles. These include, Organic (no chemical production, no monoculture); Fairness (dignified production conditions for farmers, farm workers and factory workers); Ecology (respect nature and resources); Quality (production of high quality cotton, cotton yarn and food crops); and Transparency (information from and direct contact with all stages of production).

Data for 2011-12 shows that the company under is organic farming initiative has 5957 hectare of area under cotton, produced 4658 tons of

seed cotton and 1529 tons of lint cotton in 2011-12. In addition, it sold 904 tons of yarn during the year.

ITOCHU Corporation and Kurkku response to Business Call to Action (BctA)[12]

In a recent development emerging from BCtA (Business Call to Action, a global initiative supported by several international organisations, including the United Nations Development Programme and which encourages companies to develop innovative business models that combines commercial success with sustainable development), Japan-based general trading company ITOCHU Corporation and kurkku, a firm that promotes environmentally conscious lifestyle through sales of sustainably sourced food and apparel, have pledged to improve the income of Indian farmers, their health, and the environment, by scaling up production of organically produced cotton, which is free of synthetic pesticides and chemical fertilisers.

The initiative is first of its kind by any Japanese companies in India. The two companies have pledged to scale up their Pre Organic Cotton (POC) Programme, which encourages farmers in India to switch from conventional to organic cotton production by guaranteeing to buy the cotton that is organically produced at a price higher than that of conventional cotton. The initiative is expected to help farmers not only to reduce their loss during the three year conversion periods, but also to realise a 20 to 30 percent increase in their income.

Under the initiative and through its commitment to BCtA, ITOCHU will work with Indian companies to identify farmers who are interested in switching to organic cotton farming. ITOCHU will then supply farmers with the necessary training and certified organic cotton seeds. The company will also provide a guarantee to purchase the pre-organic cotton at a higher price than what farmers would have received for uncertified cotton, and in addition will assist farmers by funding their certification fees.

This BCtA commitment scales up the companies' existing four-year partnership (starting 2008) with Indian farmers, and will enable an additional 6,000 families to transition to organic cotton production by 2015. Overall the initiative is likely to benefit about 30,000 low income farmers in terms of health and income. The initiative will also rid 30,000 acres of land from harmful agricultural chemicals while improving the farmers' health.

Initiative[13] of IFOAM and ICCOA to promote organic agriculture in India

The International Federation of Organic Agriculture Movement (famously called IFOAM), an umbrella organisation for the organic movement and working with more than 750 member organisations in 116 countries, has entered into a joint initiative with the Bangalore based International Competence Centre for Organic Agriculture (ICCOA).[14] The mission of this initiative is to help unite and strengthen the organic stakeholders and assist the organic movement in India.

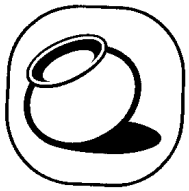
It aims at promoting nationwide adoption of ecologically, socially and economically sound systems that are based on the principles of organic agriculture.

The India centre has the following objectives:

- To represent IFOAM and to promote it through special initiatives and campaigns
- To increase the membership of IFOAM from India
- to maintain close contacts with members
- To provide quick local access to IFOAM materials and other resources and information
- To establish linkages to the regional organic movement
- To serve members and non-members with respect to organic agriculture
- To analyse issues of the regional organic agriculture movements and to assess the needs to strengthen organic agriculture
- To establish linkages with organisations and institutions related to organic agriculture in the region, and
- To raise funds for other projects that may be agreed between IFOAM and ICCOA.

Emergence of ecolabels and standards in India

Initiatives taken by government on the one hand and active role played by national and international non-state actors have helped Indian cotton textile industry to become more sustainable in terms of production and consumption practices. Sustained efforts by these actors have resulted in emergence of a number of standards and ecolabels in the domestic markets. What is of greater importance is that these developments have also contributed in increasing adhering to global standards and ecolabels by Indian companies. A list of ecolabels and standards in India is shown in the box below (Box 4.12).

Box 4.12: Some Selected Ecolabels in India	
Logo	*Name and Description*
 **Ecomark**	**Ecomark:** A government operated seal of approval programme for environmentally preferable consumer products. It was launched in 1991 to increase consumer awareness, and to ease identification of environment-friendly products. The criteria follow a cradle-to-grave approach, i.e. from raw material extraction, to manufacturing, and to disposal. The Ecomark label is awarded to consumer goods that meet the specified environmental criteria and the quality requirements of Indian Standards.
	**EU Ecolabel:** A voluntary scheme designed to encourage businesses to market products and services that are kinder to the environment and for European consumers - including public and private purchasers - to easily identify them.
	**Forest Stewardship Council (FSC) Chain of Custody Certification:** The Forest Stewardship Council (FSC) promotes environmentally appropriate, socially beneficial, and economically viable management of the world's forests. FSC® chain of custody tracks FSC certified material through the production process - from the forest to the consumer, including all successive stages of processing, transformation, manufacturing and distribution.
	**Global Organic Textile Standard:** The Global Organic Textile Standard (GOTS) was developed with the aim to unify the various existing standards and draft standards in the field of eco textile processing and to define world-wide recognised requirements that ensure organic status of textiles, from harvesting of the raw materials, through environmentally and socially responsible manufacturing up to labelling in order to provide a credible assurance to the end consumer. Processors and manufacturers are enabled to supply their organic fabrics and garments with one certification accepted in all mayor selling markets.

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	GoodWeave: GoodWeave is working to end child labor in the carpet industry and to offer educational opportunities to children in South Asia. Through its monitoring and inspections programme, GoodWeave is helping to combat the problem of exploitative child labor and to transform the handmade rug industry by certifying child-labor-free rugs and providing education and opportunities to rescue at-risk children.
	Hand in Hand: Private fairtrade programme of the company Rapunzel Naturkost GmbH which is a supplier of organic products. From the very beginning of dealing with producers from the Southern countries (the so-called developing countries) not only the quality of the organic products but also the quality of the cooperation with the producers was important for us.
	Hong Kong Green Label: The HKGLS is an independent, non-profit-making and voluntary scheme for the certification of environmentally preferable products launched in December 2000 by Green Council (GC). The scheme sets environmental standards and awards "Green Label" to products that are qualified regarding their environment performance. As with all eco-labelling programmes, the aim is to encourage manufacturers to supply products with good environmental performance and provide a convenient means for consumers to recognise products that are more environmentally responsible, thus promoting a more sustainable pattern of consumption.
	National Programme for Organic Production (NPOP): The national programme involves the accreditation programme for certification bodies, norms for organic production, promotion of organic farming. The NPOP standards for production and accreditation system have been recognised by European Commission and Switzerland as equivalent to their country standards. Similarly, USDA has recognised NPOP conformity assessment procedures of accreditation as equivalent to that of US.
	Processed Chlorine Free: Processed Chlorine Free (PCF) audits require a chain of custody for all raw materials, measures the impact of a manufacturing process on the environment: water and energy use, chemistry, carbon gas releases, reviews environmental policy and

	permit compliance, reviews ethical management practices and compliance, financial performance, product stewardship, public information, funding of research and development, and employee recognition.
SUSTAINABLE FORESTRY INITIATIVE Certified Chain of Custody Promoting Sustainable Forest Management www.sfiprogram.org	**Sustainable Forestry Initiative (SFI):** The SFI programme has on-product labels to help customers and consumers identify exactly what they are buying: three SFI chain of custody labels and one SFI certified sourcing label.
TOTALLY CHLORINE FREE	**Totally Chlorine Free:** This certification is based on use of sustainability index, which include, environmental policy, environmental management, mill process, forestry certification, environmental risk management, public information, environmental compliance, employee recognition. Adhering to this certification leads to reduced water consumption. In addition, the process does not create known toxic chlorinated carcinogenic compounds like Dioxins, Furans, PCB's, etc.
BCI Better Cotton Initiative	**Better Cotton Initiative:** The Better Cotton Initiative (BCI) promotes a comprehensive set of production principles and criteria for growing cotton in a more sustainable manner: socially, environmentally and economically. BCI currently has a system in place to trace Better Cotton from the farm to the gin. The organisation's goal is to catalyse the mass market production of cotton produced more sustainably, by creating demand on a global scale for a new mainstream commodity, Better Cotton. BCI is complementary to other initiatives like Certified Organic, Fair-trade cotton and Cotton made in Africa (CmiA).

Impact of International Environmental Standards on Cotton Production in India

In recent years, the increasingly stringent environmental regulations including those for textile products have begun to impact on international trade, in particular trade in textile. Cotton textile, being a highly polluting sector because of pollution problems during the textile production (in particular in the processes of dyeing, printing and rectifying) and harmful residues in the finished products have aroused great public concerns.

In addition to the aforementioned mandatory laws and regulations, there are several ecolabelling standards concerning textile and clothing products in many European countries. Although voluntary in nature, there are evidences that suggest that ecolabelling has potential impacts on international trade, particularly in the textile sector. EU and its member states have a number of ecolabelling programmes that appear to have rigid standards for textile products. EU has had a region-wide ecolabelling programme (Eco Label) since 1992. It might be recalled that way back in 1996, the Commission of the European Communities established its ecological criteria for the award of the Eco Label to Tshirts and bedlinen. Other ecolabelling programmes are either national (such as the Sweden Good Environmental Choice), or private. The private programmes are managed by some textile certification institutions with a worldwide application, such as Oeko-Tex Standard 100 and Texproof in Germany.

Box 4.13: Benefit from High Environmental Requirements—An Example

Germany banned use of azo dyes in 1994 through an ordinance 'German Consumer Goods Ordinance'. The German ban on use of azo dye had a substantial impact on India's export. At that time, the export of the products using German-banned dyes accounts for 38 percent of the total export of textiles and clothing from India. India reacted actively to this ban mainly through legal means and upgrading the capability of adjusting to this new situation. The Indian Ministry of Forestry and Environment announced in March 1995 that the use of 74 categories of azo dyes would be banned nationwide and the import of dyes strictly controlled. In addition, India has established some testing institutions and helped the textile and dyeing companies adjust their product structure by providing domestic and international information and technical assistance.

The Indian Ministry of Forestry and Environment issued on March 26, 1997, a notification which bans the use of azo dye, which went into force after the date of issuance and was implemented nationwide. In this notification, a list of banned azo dyes was incorporated and adjustment was made to the previously banned dyes.

Century Textile Industry Company Ltd. adopted measures to enable its products to pass the accreditation of the German Eco-Tex label in January, 1995 and became the first company in India to pass the accreditation of such a label.

The accreditation increased the cost of the product of this company by 10-15 percent, but expanded the market of its products. One year after the accreditation was given, the market share of the company expanded by at least 10 percent and an extra benefit achieved by 8-10 percent. The experience of Century Company shows that the companies from developing countries can benefit from the increasing environmental requirements.

Impacts of Environmental Standards and Requirements in EU Countries on China's Textile Industry, Policy Research Center for Environment and Economy, August 1999

Trend in exports of cotton and cotton fabrics from India

Data on export of cotton and cotton products from India reflect that India's position in the international market has improved over the last decade. However, data also reflect that the composition of exports has changed. While during the earlier period, export of cotton yarn and cotton fabrics were relatively bigger than that of raw cotton; in the later periods, raw cotton has gained in importance.

Data on export of raw cotton show a gigantic jump in its export during 2000-01 to 2009-10 periods. It has jumped by over 42 times from Rs2251.3 million in 2000-01 to Rs94152 million in the terminal year 2009-10, realising a compound annual growth of over 51 percent.

Another important feature of the export trend is that there a massive shift in India's export destinations for raw cotton. China which accounted for less than 7 percent share in 2000-01 has turned out to be the biggest consumer of raw cotton (Table 4.2).

Table 4.2: India's Major Export Destinations for Raw Cotton (including waste)

Countries	*Share in percent*									
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
China PR	6.57	0.36	1.44	17.28	21.43	63.09	48.55	45.47	44.44	54.89
Pakistan	0.00	0.00	0.00	21.39	10.87	6.89	14.71	20.17	13.33	11.51
Bangladesh	5.23	4.72	1.63	24.10	6.25	7.38	3.39	12.50	12.85	8.74
Indonesia	0.35	0.00	2.11	7.08	5.01	4.16	5.07	5.12	7.73	4.58
Turkey	0.46	0.00	0.00	0.00	0.17	0.79	6.83	2.52	1.02	4.05
Vietnam SOC REP	0.32	0.24	0.00	1.27	1.40	3.28	3.52	3.29	2.51	3.72
Hong Kong	7.91	0.00	0.00	0.40	2.46	2.72	3.73	2.40	3.12	3.54
Chinese Taipei	1.19	0.00	0.88	6.25	20.20	3.64	2.64	1.93	1.87	3.05
Thailand	0.94	0.61	0.48	3.82	6.12	3.13	4.87	1.99	5.47	1.93
Malaysia	0.00	11.28	12.21	0.26	1.57	0.26	0.48	0.72	1.67	1.07
Other Countries	77.03	82.79	81.24	18.16	24.51	4.67	6.21	3.88	6.00	3.46
Total (value in Rs mn)	2241	427	505	9424	4226	29127	61175	88858	28668	94152

Source: Central Institute for Cotton Research

The growth in the export of cotton yarn is not as impressive as in the case of raw cotton. Over a ten year period, the segment export has increased an unimpressive 19 percent, implying a compound annual growth rate of less than two percent for the decade (Table 4.3). As in the case of raw cotton, export destinations for cotton yarn have also undergone significant changes. Now Asian countries (Korea, Bangladesh and China) along with Brazil have emerged as the biggest consumers of yarns from India.

Overall, the unimpressive growth trend in export of cotton yarn raises some serious issues relating to India's global competitiveness in cotton yarn. This might be because of growing competition, or issues relating to quality, which in turn is linked to production and processing practices.

Table 4.3: India's Major Export Destinations for Yarn (including waste)

Countries	*Share in percent*									
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Korea RP	8.76	10.85	13.97	15.99	13.20	13.66	11.87	8.68	8.76	14.39
Bangladesh	10.70	10.42	7.53	7.46	11.60	11.98	10.75	14.18	15.29	12.35
China P RP	4.10	5.21	4.69	4.88	4.76	6.20	5.20	3.65	5.99	9.02
Brazil	0.00	0.00	0.00	0.00	0.21	0.61	0.88	2.62	6.42	6.04
Egypt A RP	2.58	2.54	2.77	3.53	4.50	4.99	5.82	5.05	7.20	5.10
Peru	0.00	0.00	0.00	0.00	0.69	0.81	1.37	3.87	3.54	4.26
Italy	4.74	5.70	6.16	6.69	6.89	7.91	8.03	6.09	5.22	3.88
Turkey	0.81	0.93	1.74	3.55	2.68	2.47	3.26	9.80	3.00	3.75
Portugal	1.40	1.56	1.91	1.72	2.17	2.56	3.57	3.88	3.23	3.71
Colombia	0.00	0.00	0.00	0.00	1.04	0.75	1.68	1.66	2.36	3.14
Others countries	54.71	54.43	51.72	48.57	52.27	48.05	47.57	40.52	38.99	34.36
Grand Total (value in Rs mn)	61814	52936	58197	58833	54935	66139	76403	77259	69458	73662

Source: Central Institute for Cotton Research

Of all the three segments (raw cotton, yarn and fabrics), trend in exports of fabrics presents a very disappointing picture. In absolute term, the export of cotton fabrics has declined from a level of Rs44569.6 million in 2000-01 to Rs42303.6 million in the terminal year 2009-10 (Table 4.4). It has realised a negative growth rate of (-) 0.58 percent over the 10 year periods.

The ten year period has also witnessed significant changes in importance of different markets for Indian exports of cotton fabrics. While the market for Indian products in advanced countries such as the US, Germany has distinctly declined; markets in other countries, especially in Asia and Africa appears to have improved. Countries in Asia now account for about 30 percent of total exports of cotton fabrics.

Table 4.4: India's Major Export Destination of Cotton Fabrics

Countries	*Share in percent*									
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Sri Lanka	3.72	3.74	4.85	5.48	5.97	6.80	6.74	7.26	10.91	12.01
Bangladesh	6.96	5.50	5.78	8.02	6.96	6.94	4.66	9.00	9.21	9.53
U Arab Emts	5.80	4.73	4.85	4.94	7.29	8.44	5.43	4.80	5.49	6.48
Senegal					0.65	1.21	2.98	3.00	4.34	6.08
USA	10.77	8.57	10.26	8.55	7.26	7.38	6.53	5.18	4.52	4.49
Italy	4.22	6.73	5.06	4.95	5.24	4.53	5.43	4.35	3.75	4.40
Turkey	2.05	2.18	2.02	2.58	4.08	3.64	3.97	4.48	3.77	4.12
Togo	2.00	2.45	3.15	2.67	2.21	2.25	2.73	2.86	3.11	3.48
Sudan					0.43	0.93	2.26	2.48	2.38	2.36
Saudi Arab		0.91	0.84	0.92	1.47	2.05	3.00	2.00	2.51	2.51
German F Rep	2.00	2.03	3.16	2.80	2.18	2.00	2.17	2.06	1.77	1.89
Others countries	62.48	63.16	60.04	59.10	56.24	53.82	54.08	52.54	48.23	42.65
Grand Total (Values in Rs mn)	44571	40931	46847	43902	41027	38653	41452	43244	44462	42304

Source: Central Institute for Cotton Research

In the case of EU, it is observed that the importance of different EU countries for Indian exports has changed over the ten year periods. Data on exports of cotton and cotton products to the EU market show a steady increase. Exports have increased to 19 out of 27 EU countries. However, it is also observed that the increase in exports to most of the countries is unimpressive (Table 4.5). Annex 4.1 and Annex 4.2 illustrate India's current trend in export and import of cotton and cotton-based products to/from the EU countries.

Table 4.5: Trend in Export of Cotton and Cotton-based Products from India to the EU *(value in $ mn)*

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Germany	3.7	3.3	3.5	4.3	3.9	4.7	5.1	5.1	5.8	6.9	7.5
UK	8.3	7.3	7.1	7.6	6.4	9.0	7.9	8.6	8.5	10.1	1.5
Italy	6.4	5.7	6.7	7.2	8.9	9.4	9.3	8.9	8.7	9.1	9.2
France	3.0	3.0	2.7	3.0	2.9	3.5	3.3	3.5	3.8	3.9	3.7
Austria	3.9	4.1	3.3	10.5	9.0	6.1	2.7	1.9	1.6	1.3	2.2
Netherland	3.6	2.8	2.8	3.4	4.2	2.4	2.5	2.7	3.0	4.9	4.2
Belgium	5.7	4.9	5.4	5.0	6.0	7.2	7.0	7.4	7.4	8.6	9.2
Spain	6.4	8.1	6.0	5.9	7.5	9.4	8.6	7.4	6.2	8.5	0.5
Sweden	3.9	2.9	2.8	3.8	4.9	4.0	3.5	3.2	4.1	4.5	3.7
Poland	2.6	2.5	3.2	4.3	4.0	4.8	5.9	5.8	7.0	10.5	0.5
Portugal	4.3	5.1	4.1	5.8	6.1	9.6	11.7	13.7	15.1	21.7	9.1
Finland	3.1	3.8	3.1	1.8	2.4	2.8	2.5	3.6	4.0	4.5	2.2
Denmark	0.5	0.9	0.9	1.3	1.6	1.4	1.4	2.3	4.6	7.4	6.3
Romania	0.2	0.4	0.5	0.8	0.5	0.4	0.1	0.2	0.6	1.0	1.0
Slovenia	4.2	5.1	4.9	5.1	4.1	3.5	3.2	7.7	5.9	4.1	4.8
Czech Republic	5.2	5.2	4.9	5.4	5.8	5.6	5.7	6.0	11.3	11.3	0.1
Hungary	2.4	1.7	1.8	1.2	1.0	0.8	0.9	1.3	0.4	0.4	0.1
Greece	5.0	5.6	4.0	4.2	4.5	4.6	7.7	5.7	6.2	7.9	5.4
Luxembourg	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.1
Ireland	3.3	2.8	1.0	0.8	0.7	1.1	1.9	2.3	2.3	2.4	3.0
Bulgaria	1.5	1.3	1.0	1.1	0.4	0.5	1.5	2.1	2.9	3.2	3.1
Malta	8.4	8.2	9.7	6.1	6.4	10.0	11.4	1.9	0.7	4.3	0.6
Latvia	0.6	2.4	2.4	1.8	2.9	2.0	1.7	2.3	4.0	2.9	2.5
Lithuania	8.2	10.0	9.4	5.3	5.1	6.0	6.1	4.1	3.7	2.5	3.3
Estonia	2.6	2.4	2.6	2.9	3.2	1.9	2.0	1.5	1.3	1.8	3.5
Cyprus	12.9	7.3	6.5	7.8	6.3	12.4	8.1	8.3	6.6	6.3	4.4
Slovakia	0.6	0.5	0.8	0.8	1.4	1.8	1.6	1.2	0.9	1.4	1.1
EU (27) share (%)	4.6	4.3	4.2	4.8	5.1	5.9	5.9	6.0	6.3	7.9	7.8

Source: ITC Trade Map

Future Prospects of India's Cotton Textile Industry

The future prospect of India's cotton textile industry is linked to India's National Fibre Policy. The policy presents a holistic picture of what is required to done in addition to the existing initiatives and schemes for promotion of Indian cotton textile and to make it gain lost ground in the international market. Important objectives and features of India's National Fibre Policy is delineated in the following sub-section.

Multi-Fibre Policy of India (National Fibre Policy 2010-11)

In order to promote and to place secure in the international fibre trade, the National Fibre Policy has been designed with a decadal perspective of 2010-20 by strengthening the existing policy framework and providing institutional and technological support for rapid Fibre growth in the country in the coming decade. The projected growth trajectories imagined under the National Fibre Policy are ambitious and would benefit all stakeholders in the fibre Industry value chain.

The National Fibre Policy seeks to build a strong and vibrant textile industry competent of producing quality cloth at acceptable price, increasingly contributing to enhanced employment provision and competing for an increased share of global market. The Fibre neutral policy seeks to balance the existing disparities within the complete range of fibres by providing additional fiscal and non-fiscal incentives for sustainable growth of all fibres and be competitive in the international market.

The policy framework has been built keeping in mind the potential growth of technical textiles[15] both for domestic and international demands. Special attention has been drawn to promote the lesser known specialty man-made fibres and other natural fibres. The domestic fibre consumption ratio in India at present is 41:59 (FY09) between man-made fibres and cotton, while it is almost 60:40 globally. The global fibre consumption trend in future is likely to further tilt in favour of man-made fibres as there is a limitation to growth of cotton world-wide on account of limited availability of land for cotton cultivation. Given that the future demand is expected to be largely in favour of man-made fibre based textiles; special attention is paid to boost the consumption and production of man-made fibres in India.

Investments needed for modernisation and technology upgradation have been envisaged through continuation of the TUFS scheme while promoting greater downstream integration. The policy also envisages extension of the TUFS scheme to man-made fibres production and technical textiles.

The Handloom Sector plays a vital role in the economy. In terms of employment, the Sector is next only to agriculture and provides employment to the weaker sections of the society, with 86 percent handloom weavers/workers living in rural and semi-urban areas. The National Fibre Policy seeks to address increasing demand for raw materials for handloom weavers, keeping in view the trend in growth rates of the handloom sector.

The key elements of the National Fibre Policy thus include the following:[16]

- Cotton production is envisaged to rise at a growth rate of 4.7 percent from 319 lakh bales in 2010-11 to 483 lakh bales in 2019-20;
- Cotton Consumption is envisaged to increase to 413 lakh bales by 2019-20 with 70 lakh bales being surplus;
- Man-made fibres and speciality fibres domestic demand will rise at a growth rate of 8 percent per annum from 3.9 billion kgs in 2015 to 6 billion kgs in 2020;
- Jute production will rise at a growth rate of 3.6 percent from 94 lakh bales in 2010-11 to 130 lakh bales in 2019-20;
- Wool consumption is projected to nearly double from 114.2 million kgs in 2009-10 to 260.8 million kgs in 2020.

The National Fibre Policy also envisages significant institutional strengthening mechanisms in the form of the following:

- A Inter Ministerial Committee of Secretaries headed by Textiles Secretary to calibrate cotton exports to ensure improved supply chain management for domestic consumption, Electronic data exchange between Customs Department and Textiles Commissioner for monitoring cotton and yarn export shipments;
- Establishment of a Yarn Advisory Board for formulation of a yarn balance sheet to ensure adequate yarn availability for handlooms and garments sector;
- Launching of a Technology Mission on Technical Textiles and creation of centres of excellence in the identified sub groups of technical textiles;
- Creation of a Jute Development Fund for R&D efforts in modern machinery development of Jute sector;
- Adopting a Mission Mode approach and establishing an Inter-ministerial Board for promotion of organic, suvin and ELS cotton sector;
- Restructuring the Central Wool Board on the lines of the Central Silk Board to effectively implement the various schemes and policies and achieve desired objectives;

- A Focus Fibre Focus State approach would be adopted for development of other natural fibres in the country.

The figure below (Figure 4.1) shows the roadmap and strategy of the government of India to help the cotton textile sector to realise its potential.

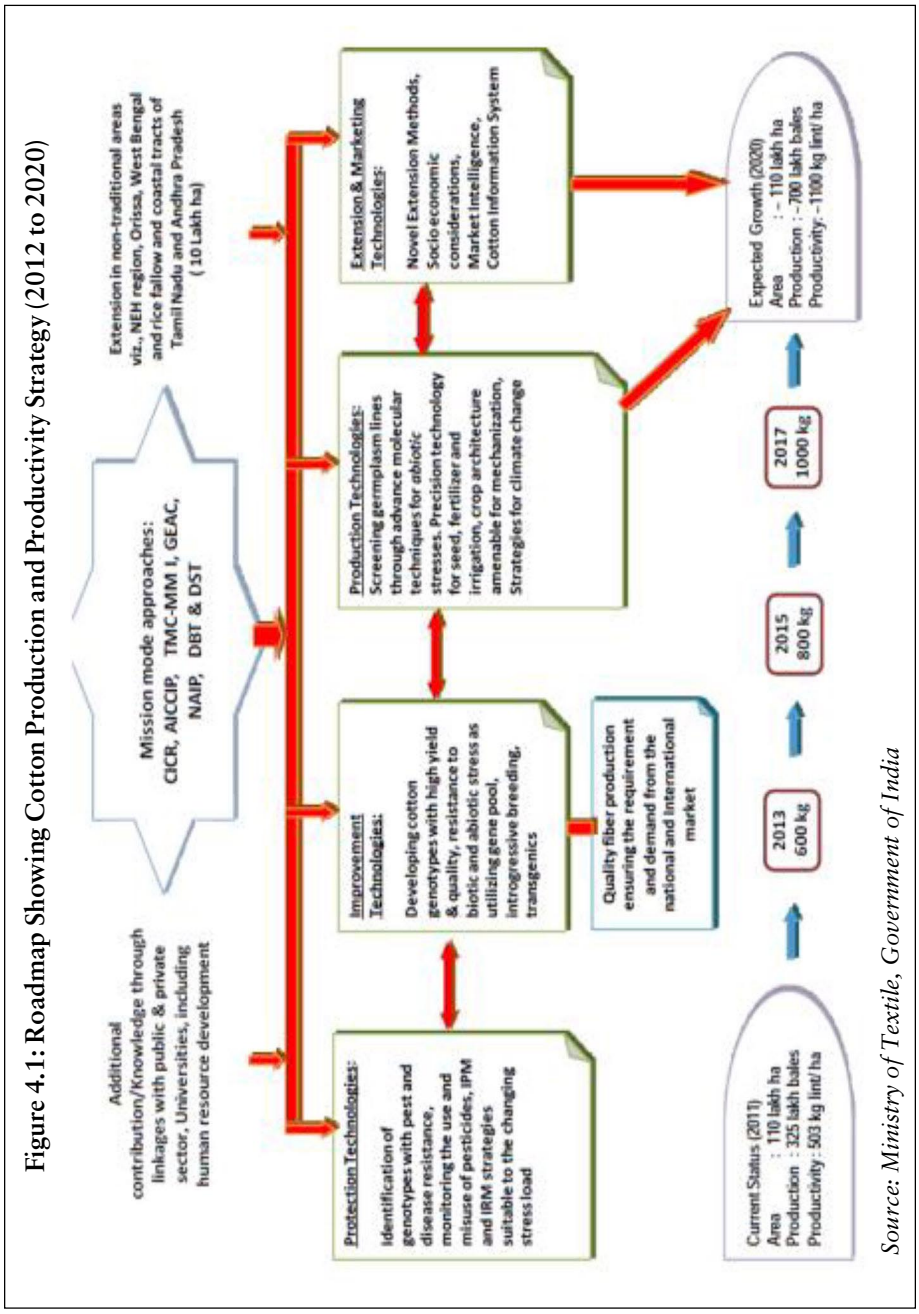


Figure 4.1: Roadmap Showing Cotton Production and Productivity Strategy (2012 to 2020)

Source: Ministry of Textile, Government of India

Investment requirement in cotton textile sector in the light of National Fibre Policy by 2020

In order to capture the additional market (US$150Bn) created for Textile and Apparel by 2020, investments to the tune of Rs. 3,20,000 crores (US$68Bn) across the textile supply chain will be required. The task appears challenging in terms of the size of capital requirements. However, it is expected that the industry with government support and indicated strategy would be able to realise its potential.

Box 4.14: Investment Requirements in Indian Cotton Textile Sector by 2020

Segment	*Additional capacities required*	*Investment required* (Rs. crores)
Spun Yarn	13.6 million new spindles	42,000
	8 million modernised spindles	
Filament Yarn	0.5 billion kg production from modernised capacity	31,000
	4.2 billion kg production from brownfield expansion	
	1.1 billion kg production from greenfield projects	
Weaving	77 thousand new shuttleless looms	37,000
	65 thousand second hand shuttleless looms	
	2 lakhs semi-automatic	
	2.35 lakhs plain	
Knitting	84 thousand new machines	25,000
	56 thousand second hand machines	90,000
Processing		65,000
Garment and made-ups	21 lakhs (for 2 shift working) machines required	30,000
Total		**3,20,000**

Source: Ministry of Textile, Government of India

Conclusion

Indian cotton textile sector is presently facing some serious challenges in terms of shrinking of its traditional market. This is caused by emerging issues such as need for advanced technologies, need for improvement in production and processing practices. Emergence of standards and labelling backed by growing consciousness towards more environmental products appears to have further aggravated the prospects of Indian cotton textile industry.

Sustainable production and consumption is here to stay for longer time to come. It is, therefore, required that Indian cotton textile industry prepares itself for the challenges ahead. This calls for greater innovation in controlling environmental issues that are directly or indirectly connected to production and consumption of cotton textile.

Endnotes

1 While the certificate is a form of communication between seller and buyer, the label is a form of communication with the end consumer.

2 FAO Corporate Document Repository, http://www.fao.org/docrep/006/y5136e/y5136e07.htm

3 International Cotton Association

4 Its texts are developed and maintained by the Codex Alimentarius Commission, a body that was established in early November 1961 by the Food and Agriculture Organization of the United Nations (FAO) and was joined by the World Health Organization (WHO) in June 1962.

5 Revolution in Indian Cotton, Ministry of Agriculture, Government of India

6 MoEF, Background Note on Bt Cotton Cultivation in India

7 Report from the Expert Panel on Social, Environmental and Economic Performance of Cotton Production (SEEP). International Cotton Advisory Committee

8 Central Integrated Pest Management Centre (CIPMC) is the agency that promotes Integrated Pest Management (IPM) system designed to provide long-term management of pests. It is the coordinated use of pest and environmental information with available pest control methods to prevent unacceptable levels of pest damage by the economical means with the least possible hazard to people, property, and the environment. The main goal of IPM is to manage pests and the environment so as to balance costs, benefits, public health, and environmental quality. IPM systems use all available technical information on the pest and its interactions with the environment. The goal is to attempt to plan and manage ecosystems to prevent organisms from becoming pests.

9 The BMP uses Better crop management practices, such as Non-Pesticide Management (NPM), IPM, Integrated Nutrient Management (INM), Integrated Water Management (IWM), which are essentially meant to lessen the burden of inputs, while increasing productiv¬ity to reduce environmental impacts. Source: WWF Report 2012, Cotton Market and Sustainability in India

10 BCI is involved in formation of learning groups, self-assessment, creation of chain of custody in supply chain, no premium for the produce.

11 Source: bioRe India, http://www.bioreindia.com/FactsFigures.aspx

12 Source: http://www.undp.org/content/undp/en/home/presscenter/pressreleases/2012/08/28/farmers-in-india-to-benefit-from-japanese-organic-cotton-business-partnership.html

13 Source: http://www.ifoam.org/about_ifoam/around_world/india.html

14 The constitution of the International Competence Centre for Organic Agriculture (ICCOA) 2003 was the result of initiative by a number of NGOs, farmer organizations, companies, research institutions and government agencies to provide services to the organic farming and organic stakeholders in India. The first Board of Directors was elected from the initial members. Subsequently the centre was registered under the Karnataka Societies Registration Act 1960.

15 Technical Textiles are defined as Textile material and products manufactured primarily for their Technical performance and functional properties rather than aesthetic and decorative characteristics.

16 National Fibre Policy 2010-11

Annexures

Annex 4.1: India's Export of Cotton and Cotton Products to the EU Market
(in $mn)

EU Member Countries	2008-09				2009-10				2010-11			
	Fibre raw cotton (incl cotton waste)	Cotton yarn (incl cotton sewing thread)	Wooven fabrics of cotton	RMG (articles of apparel and clothing accessories)	Fibre raw cotton (incl cotton waste)	Yarn cotton yarn (incl cotton sewing thread)	Wooven fabrics of cotton	RMG (articles of apparel and clothing accessories)	Fibre raw cotton (incl cotton waste)	Cotton yarn (incl cotton sewing thread)	Wooven fabrics of cotton	RMG (articles of apparel and clothing accessories)
UK	1.8	6.27	16.95	1291.48	2.11	4.18	16.41	1281.49	2.37	5.74	24.43	1265.01
Germany	4.71	49.83	17.13	1123.07	4.77	42.36	16.86	1058.95	8.39	64.15	23.74	1050.48
France	0.19	1.23	5.27	792.02	0.25	1.15	5.83	713.95	0.3	2.11	6.16	672.32
Itlay	5.2	79.74	36.21	444.14	5.61	60.93	39.23	411.91	3.82	85.42	63.24	402.83
Spain	0.42	18.92	9.88	501.24	0.13	16.29	6.21	543.23	0.85	26.8	12.11	539.96
Netherland	0.03	4.92	2.31	428.76	0.28	4.97	2.28	404.15	3.74	6.46	3.99	427.9
Belgium	7.13	14.39	15.42	234.17	8.38	14.17	12.5	212.39	5.47	22.5	11.75	296.97
Denmark	0	0.45	1.14	235.42	0	2.23	1.24	240.81	0	2.56	1.03	261.75
Sweden	0	0.55	2.15	108.64	0	0.85	2.52	118.95	0	0.39	1.85	128.32
Portugal	0.27	48.8	16.61	29.58	0.15	57.68	7.52	32	0.82	97.4	16.76	33.53
Poland	0	17.9	3.59	44.54	0.01	23	2.21	34.53	0	37.58	2.66	42.47
Finland	0	1.02	0.88	39.82	0	0.52	0.37	35.02	0	0.45	0.33	41.4
Ireland	0	0	0.03	84.87	0	0.02	0.08	89.96	0	0.08	0.12	53.31
Greece	0.33	5.44	1.71	27.88	0.28	7.26	3.12	21.74	0.77	7.87	2.21	17.46
Czech Republic	0	3.54	5.89	10.99	0	5.14	6.14	9.82	0	4.97	5.95	8.63
Austria	0.02	0.35	4.09	14.43	0	0.18	1.44	18.3	0	0.1	2.55	15.71
Romania	0	0.94	0.29	8.48	0	2.44	0.63	5.06	0	3.85	0.69	4.01
Slovenia	0	5.01	1.22	2.34	0.01	1.92	0.5	2.14	0	2.88	0.52	4.2
Slovak Rep	0	0	0.03	2.11	0	0	0	2.71	0	0.11	0.06	7.68
Estonia	0	0.87	0.18	0.75	0	0.3	0.02	0.51	0	1.27	0	6.51
Bulgaria	0	2.1	0.51	1.92	0	2.08	0.39	0.78	0	3.48	0.87	0.9
Latvia	0	1.54	0.05	0.19	0	1.58	0.05	0.55	0	1.56	0.1	1.14
Lithuania	0	3.53	0.02	0.46	0	3.55	0.04	0.94	0	2.49	0.11	0.68
Hungary	0	0.6	0.14	3.19	0	0.28	0.24	3.23	0	0.1	0.13	3.23
Cyprus	0	0.2	0.22	1.95	0	0.16	0.02	1.66	0	0.01	0.07	1.31
Luxemburg	0	0	0	0.23	0	0	0	0.23	0	0	0	0.14
Total	**20.1**	**268.1**	**141.9**	**5432.7**	**21.98**	**253.24**	**125.9**	**5245.0**	**26.5**	**380.3**	**181.4**	**5287.9**

Source: ITC Trade Map

Annex 4.2: India's Import of Cotton and Cotton Products from the EU Countries

EU Member Countries	2008-09				2009-10				2010-11			
	Fibre raw cotton (incl cotton waste)	Cotton yarn (incl cotton sewing thread)	Wooven fabrics of cotton	RMG (articles of apparel and clothing accessories)	Fibre raw cotton (incl cotton waste)	Cotton yarn (incl cotton sewing thread)	Wooven fabrics of cotton	RMG (articles of apparel and clothing accessories)	Fibre raw cotton (incl cotton waste)	Cotton yarn (incl cotton sewing thread)	Wooven fabrics of cotton	RMG (articles of apparel and clothing accessories)
Itlay	0.21	1.28	19.44	15.98	0.23	1.12	11.33	11.03	0	1.41	12.15	17.04
UK	0	0.03	0.53	12.64	0	0.02	0.39	5.38	0.33	0.14	0.99	7.87
France	0.19	0	2.94	6	0.19	0	2.33	4.45	0.23	0.01	2.05	4.55
Austria	0.04	0.12	0.24	0.07	0	0.35	1.14	0.15	0	0.25	0.61	0.03
Spain	0.11	0.02	0.37	3.53	0.71	0.03	0.26	3.47	1.19	0.02	1.45	9.32
Netherland	0	0	0.42	0.08	0	0	0.24	0.36	0	0	0.66	0.1
Belgium	0	0	0.08	0.7	0	0	0.12	0.78	0	0	0.12	0.14
Denmark	0	0	0.01	0.1	0	0	0	0.82	0	0	0	5.62
Sweden	0	0	0.04	0.04	0	0	0.06	0.01	0	0	0.13	0.02
Poland	0	0	0	0.13	0	0	0	0.04	0	0	0	0.07
Portugal	0	0.09	1.63	0.29	0	0.05	0.64	0.27	0	0.03	0.35	1.09
Finland	0	0	0.02	0	0	0	0	0.01	0	0	0.04	0
Romania	0	0	4.59	0.06	0	0	0	0.04	0	0	0	0.17
Slovenia	0	0	0.11	0	0	0	0.14	0	0	0	0.12	0
Czech Rep.	0	0	0	0	0	0.05	0.02	0.02	0	0.26	0.12	0
Hungary	0	0	0.01	0.3	0	0	0	0	0	0.01	0	0
Greece	5.01	0	1.07	0.02	3.35	0	0.26	0.02	0	0	0.14	0
Ireland	0	0.03	0	0		0	0	0	0	0	0	0.01
Luxemburg	0	0	0	0	0	0	0	0	0	0	0	0
Bulgaria	0	0.05	0.02	0.05	0	0	0	0.01	0	0	0	0.01
Slovak Rep.	0	0	0	0.01	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0	0	0.04	0.01
Luthiana	0	0	0	0.13	0	0	0	0.01	0	0	0	0
Estonia	0	0	0	0.06	0	0	0	0.04	0	0	0	0.02
Germany	0.09	0.2	0.9	2.88	0	0.13	1.1	2.34	0.01	0.28	1.13	4.2
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0
Total	**5.7**	**1.8**	**32.4**	**43.1**	**4.5**	**1.8**	**18**	**29.3**	**1.8**	**2.4**	**20**	**50.3**

Source: ITC Trade Map

5
Sustainability of Cotton Production in India

Experience from the Field

This report presents the opinion and points of concern of stakeholders involved in the cotton value chain from farmers to retailers. The coverage relate to interviewed participants under the survey conducted for this particular study and cover issues on environment and sustainable practices. As indicated earlier, the cotton value chain includes farmers, ginners, spinners, weavers, manufacturer and retailers. The main aim of this report is to understand the impact of chemical and fertiliser used in cotton production on environment and sustainability.

Three major cotton producing states have been selected for the study. These include:

- Andhra Pradesh,
- Maharashtra, and
- Rajasthan

These represent various regions of India: South (Andhra Pradesh), North (Rajasthan), and West (Maharashtra). Within the states, three major cotton producing districts have been identified. These cover:

- Guntur district in Andhra Pradesh
- Yavatmal district in Maharashtra and
- Shri Ganganagar district in Rajasthan

Within each of the selected districts three villages (one from each state) has been included. These are:

- Prathipura in Guntur district of Andhra Pradesh
- Wai in Yavatmal district (Vidarbha Region) of Maharashtra and
- Sahu Wala Goan in Shri Ganganagar district of Rajasthan.

Methodology

To present a holistic picture of the cotton industry, various types of stakeholders who are engaged at various stages of cotton value chain have been included. A specially designed semi-structured questionnaire was prepared for collection of field data. For collection of data from each of the identified villages, random sampling has been used. Beside the objective information, qualitative data also have been gathered. Data have been collected during October 2011 to April 2012. More specifically, the total sample consists of the followings:

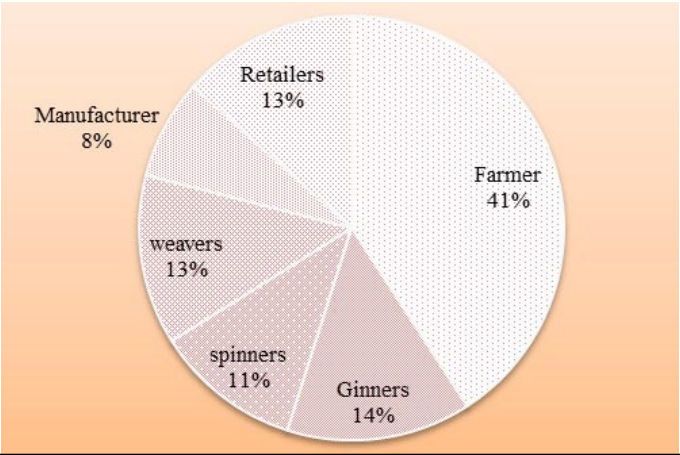
- 183 farmers,
- 63 ginners,
- 50 spinners,
- 58 weavers,
- 34 manufacturer and
- 60 retailers

From each type of respondents, detailed information on socio-economics and farming profile, input use and output produced, costs, and returns were collected using semi-structured questionnaires.

Distribution of Interviewed Stakeholders

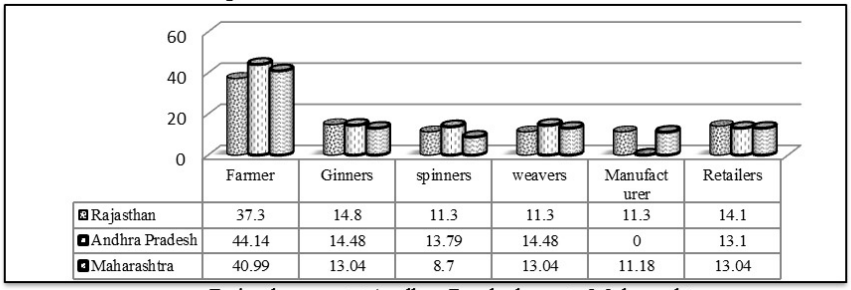
It can be observed from the data presented in Figure 5.1 that out of the total number of interviewed respondents, the majority of the respondents are farmers (41 percent) followed by ginners (14 percent), retailers (13), spinners (11 percent), and Manufactures (8 percent).

Figure 5.1: Percentage Distribution of Interviewed Stakeholders (total sample size 448)



Overall, sample size is distributed as presented in the figure 5.2. In Rajasthan, out of the total sample size, 37.7 percent are farmer, 14.8 percent ginners, 11.3 percent spinners, 11.3 percent weavers, 11.3 percent manufacturer and 14.1 percent retailers. In Andhra Pradesh, 44.1 percent are farmer, 14.18 percent ginners, 13.7 percent spinners, 14.4 percent weavers, 13.1 percent retailers. In Maharashtra, 40.9 percent are farmer, 13.0 percent ginners, 8.7 percent spinners, 13.0 percent weavers, 11.1 percent manufacturer and 13.4 percent retailers.

Figure 5.2: State wise dsitribution of Stakeholders



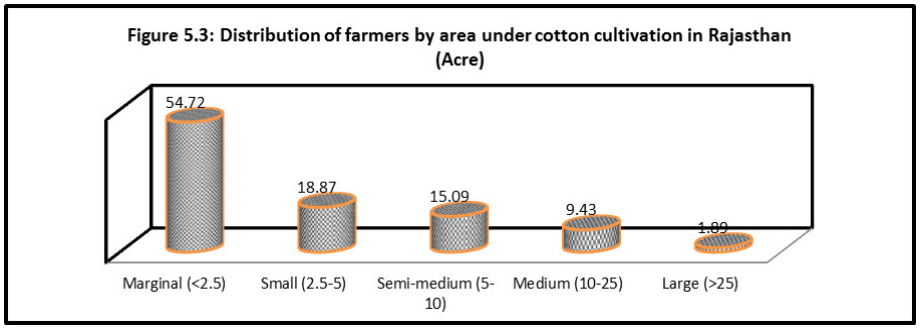
	Farmer	Ginners	spinners	weavers	Manufacturer	Retailers
Rajasthan	37.3	14.8	11.3	11.3	11.3	14.1
Andhra Pradesh	44.14	14.48	13.79	14.48	0	13.1
Maharashtra	40.99	13.04	8.7	13.04	11.18	13.04

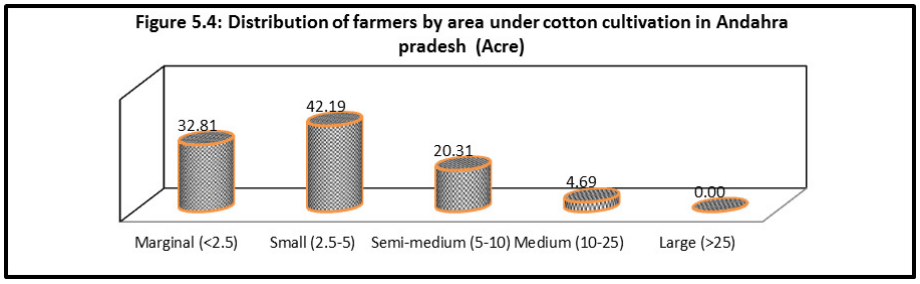
Profile of Interviewed Farmers

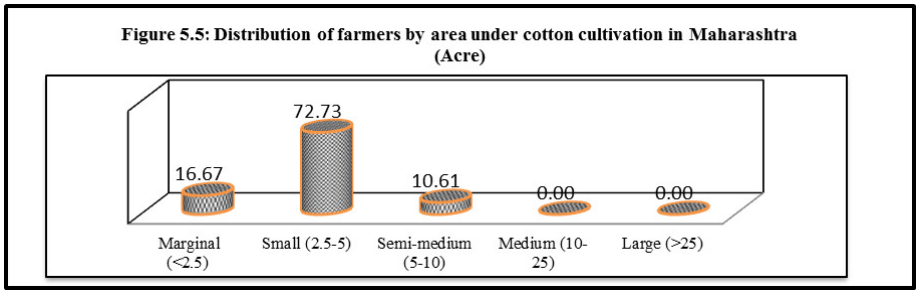
Landholding[1] size also varies from state to state in India and even state from district to district. The data collected from Sahu Wala Gaon from Shri Ganganagar district of Rajasthan (Figure 5.3) show that percentage size of land holding in cotton cultivation is highest in Marginal farmers (54.7) followed by medium (18.8), semi-medium (15.0), small (9.4) and large farmers (1.8) out of the total land holdings in different classification. This, however, may or may not be representative of the average land holding in state of Rajasthan.

In case of Andhra Pradesh Prathipura village (Figure 5.3), shows that it is small farmers who are the most dominant segment and accounts for more than two-fifth of the total. This is followed by marginal farmers with a share of over 32 percent, and semi-medium (a little over 20 percent). Data does not show presence of any large farmer in the village.

In Wai village in Yavatmal district of Maharashtra (Figure 5.4), shows that the percentage share of farmers in Wai Village under Maharashtra State is highest in small farmers (72.7) followed by Marginal (16.6), semi-medium (10.6) and data does not present the presence of medium and large farmer in cotton cultivation out of the total area owned by them during 2010-11.







Stakeholders' Perception on Sustainable Production Practices

Perceptions of different stakeholders as indicated above on various issues relating to cotton cultivation and consumption are delineated below. Perceptions shown hereunder are of farmers, ginners, spinners, knitters/ weavers, manufacturers and retailers. The highlights of their perceptions on issues such as area under cultivation, cost of production, income, yield and productivity, and various other issues relating to sustainability in cotton value chain are included. Perceptions are analysed based on type of stakeholders.

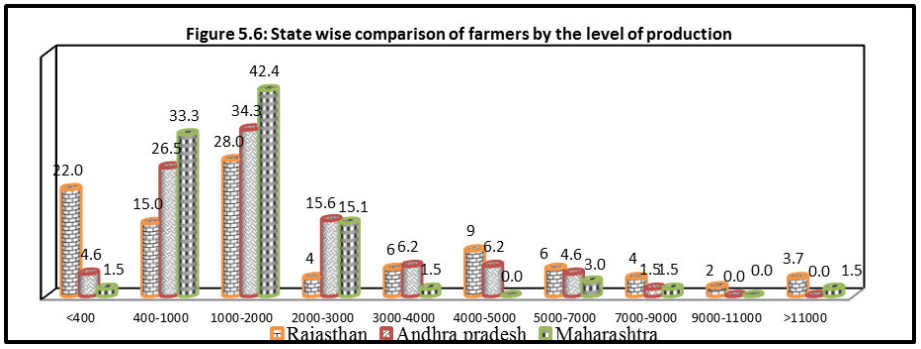
Impact of cotton cultivation on farmers' livelihood

Production of cotton is perhaps the most important source of livelihood for cotton farmers in the selected areas in three states and districts. To analyse impact and contribution of cotton cultivation on farmers' livelihood, the annual production of cotton has been classified under different range starting from 400 to 11000 kg for the research purpose (Figure 5.6). This is to ensure that all farmers, especially those with low production are covered.

It is observed from the data that a major percentage of farmers fall in the range of 400 to 2000 kg in all the three states, implying most of the farmers have lower degree of sustainability from cotton farming, even though they are dependent on this.

At the state level, data clearly shows that in Rajasthan, a majority of farmers (over 28 percent) produce in the range of 1000 to 2000 kg annually. The trend is slightly different for other two states. In case of Andhra Pradesh and Maharashtra, a larger percentage of farmers produce in the range of 1000 to 2000 kg of cotton. Such farmers account for more than two-fifth in Maharashtra and nearly one-third in Andhra Pradesh.

Various reasons can be cited for such differences in total annual production. Area under cotton cultivation and adoption of Bt cotton could probably be the most significant ones.



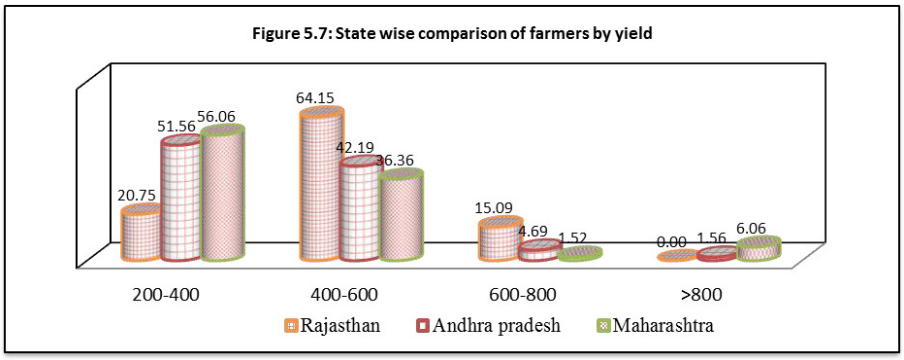
As in the case of production, there is also significant variation in case of productivity (productivity is used to show yield and is derived by dividing total production by area cultivated) per acre across different states. This is, in fact, also reflective of trends in yields in different states of India.

Data gathered from the field clearly demonstrate (Figure 5.7) that in Rajasthan, per acre productivity of most of the farmers are between 400 to 600 kg per acre. As compared to this, the per acre productivity are

recorded to be comparatively low in the same range in Andhra Pradesh and Maharashtra.

The higher productivity in Rajasthan (in the range of 400 to 600 kg) could probably be because of the area chosen for study was mostly irrigated. On the other hand, relatively low productivity in other two states is probably due to the presence of rain-fed area which often suffers from low rain fall. A majority of farmers in these two states indicated productivity in the range of 200 to 400 kg per acre.

What is more important is that over 15 percent of farmers in Rajasthan indicated productivity in the range of 600 to 800 kg per acre. In the last category (yield over 800 kg per acre), about six percent of surveyed farmers in Maharashtra and 1.5 percent in Andhara Pradesh indicated yields in this range.

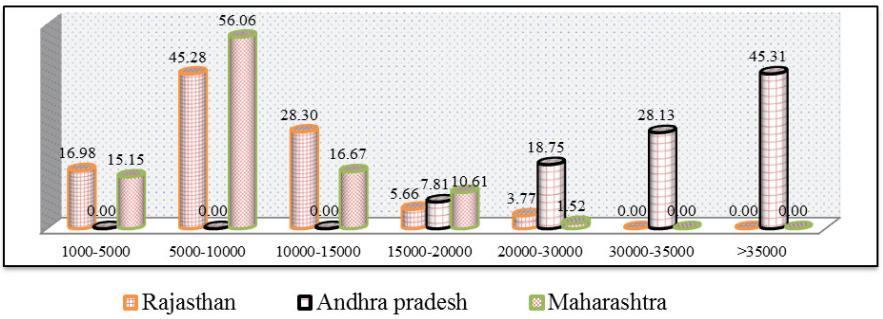


Cost is a very important indicator of sustainability in cotton cultivation. For the research purpose, per acre cost of cultivation has been classified in the range of up to Rs. 5000 to greater than Rs. 35000.

A wide variation in cost of cultivation across the three states is observed. For a majority of farmers in Rajasthan and Maharashtra (over 45 and 56 percent respectively), per acre cost of cultivation is in the range of Rs5000 to Rs10000. On the contrary, per acre cost of cultivation is much larger for a major segment (over 45 percent) of farmers in Andhra Pradesh. Per acre cost works out in the range of over Rs35000 per acre.

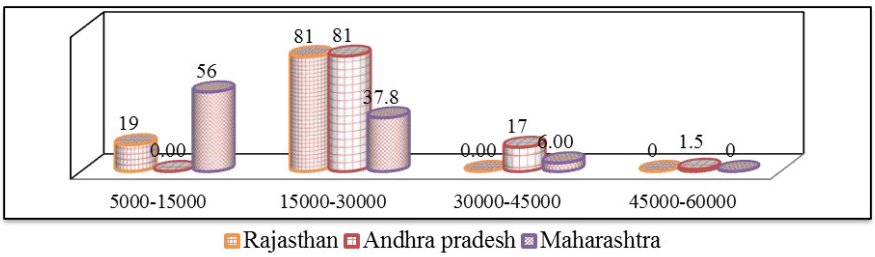
Wide variations in cost of cultivation between Andhra Pradesh and other two states is primarily because of additional cost incurred in the form of land lease payment. The per acre land lease cost is an average of Rs15000 per acre to farmers in Andhra Pradesh. The variations in cost of cultivation of farmers in three villages in three states can be clearly seen in the Figure 5.8.

Figure 5.8: State wise comparison of per acre cost of cultivation



Per acre cost of production does not appear to have any major impact on income (Figure 5.9). Contrary to what was indicted in per acre cost of production, per acre income is in the lowest range for a majority of farmers in Andhra Pradesh. More than half of the farmers earn in the range of Rs. 5000 to Rs. 15000. In comparison to trend in income in Andhra Pradesh, most of the farmers in Maharashtra and Rajasthan (over 80 percent in each of the states) earn in the range of Rs. 15000 to Rs. 30000. There are also some exceptional performances, showing farmers earning in the range of Rs. 45000 to Rs. 60000 in Maharashtra, though this is limited to only 1.5 percent of farmers.

Figure 5.9: State wise comparison of per acre income



The data on production, yield and cost of production clearly demonstrate that these are not uniform across different states of India. While per acre cost is higher for a majority of farmers in Andhra Pradesh, per acre income is higher for a majority of farmers in Maharashtra and Rajasthan. However, one can also say that even within the state, situation can be different.

Relationship between the cost of production on the one hand and the level of production and yield on the other has direct bearing on the

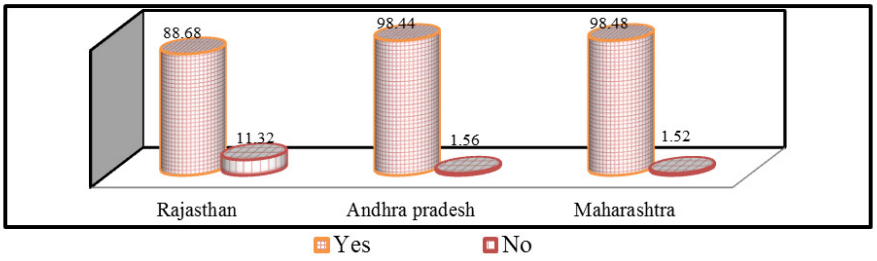
sustainability of lives and livelihood of cotton farmers. Increasing cost of production in the absence of low or negligible increase in production and yield, as reflected by the field data especially from Andhra Pradesh, can have very serious consequences for farmers dependent on cotton farming their livelihood.

Factors impacting livelihood of cotton farmers

There are a number of factors that impact cotton production, yield and income of farmers. These include level of awareness on various issues relating to production and productivity. More specifically, these cover, awareness about type of land suitable for cotton farming, availability of water and management for irrigation, adoption of improved varieties of seeds, such as Bt cotton, and others.

Figure 5.10 presents the issue of awareness about soil type suitable for cultivation of cotton, out of the total sample; a majority of famers indicated their awareness on the same. It is understood that black soil is the most appropriate soil for the cotton cultivation as it contains water for longer period which is necessary for cotton cultivation. Farmers who are aware of suitability of soil for cotton farming are nearly 89 percent in Rajasthan, over 94 percent in Andhra Pradesh, and almost all (98.4 percent) in Maharashtra. These farmers are able to identify characteristic of soil for cotton cultivation.

Figure 5.10: State wise awareness on types of soil suitable for cotton growing

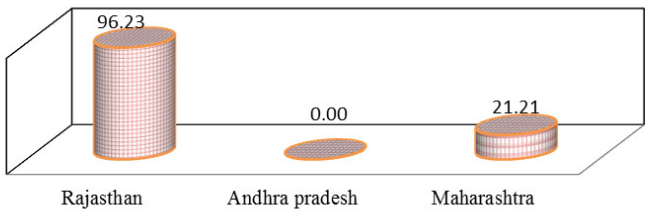


Water availability and its management for irrigation is one of the most important factors that directly influence yield and production. Data received from the field for the three states (Figure 5.11) show wide variations across these. While all the respondents in Rajasthan (Shri Ganganagar district) indicated that the area under cotton cultivation is fully irrigated, in contrast selected cotton area in Andhra Pradesh is totally rain-fed. In case of selected area in Maharashtra, it is observed that it has

both irrigated and un-irrigated areas. However, only a little over 21 percent area is under irrigation. The trends in Rajasthan and Maharashtra, however, do not necessarily imply that irrigation system is used for irrigation of cotton farms. These two areas also show their dependence on rain fall, and irrigation is used only in case of inadequate rain fall.

These are indicative of the fact that in the light of existing situation that cotton farming in Shri Ganganagar of Rajasthan is relatively more sustainable compared to two other areas in Andhra Pradesh and Maharashtra.

Figure 5.11: State wise comparison by area under irrigation

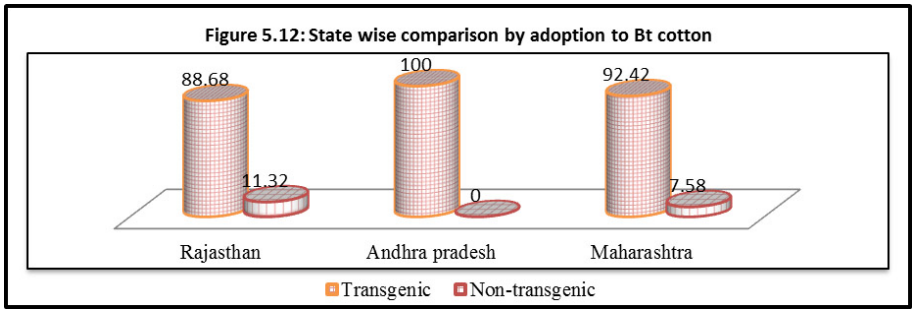


Bt cotton appears to have become a phenomena in all the cotton growing states and areas, irrespective of land size. Out of the three states, while surveyed farmers in selected area of Maharashtra started adopting Bt cotton in 2002-03, surveyed farmers in Andhra Pradesh and Rajasthan started doing so in 2006-07 and 2008-09 respectively.

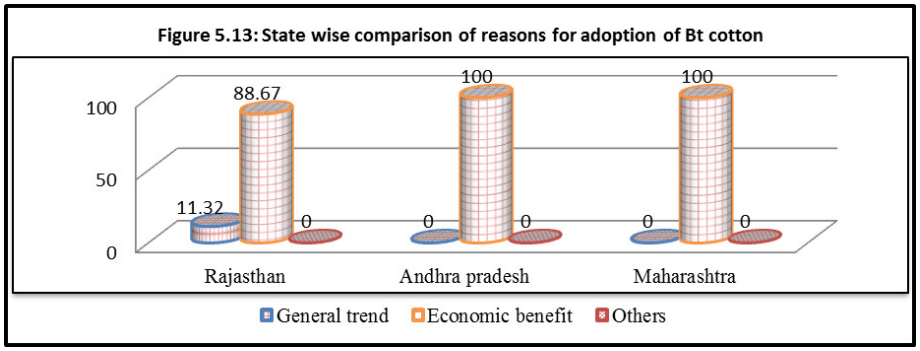
Field data (Figure 5.12) demonstrates that at present only 11.3 percent cotton growers in Rajasthan and 7.5 percent in Maharashtra is growing non-transgenic cotton. This implies that most of the farmers in Rajasthan (more than 92 percent) and Maharashtra (nearly 90 percent) are growing Bt cotton.

The most interesting development has taken place in Andhra Pradesh, where all the farmers in the selected area have adopted Bt cotton. This is also interesting from the point that while all the farmers in the selected ares have adopted Bt cotton, their production as well as the yield appear to be the lowest compared to other two selected areas Rajasthan and Maharashtra.

In this case (Andhra Pradesh), though there is need for further research to establish that adoption of Bt cotton has not helped farmers in raising yield and production of cotton, but it can be argued that rising cost of production can become a serious challenge to lives and livelihood of farmers in this area.



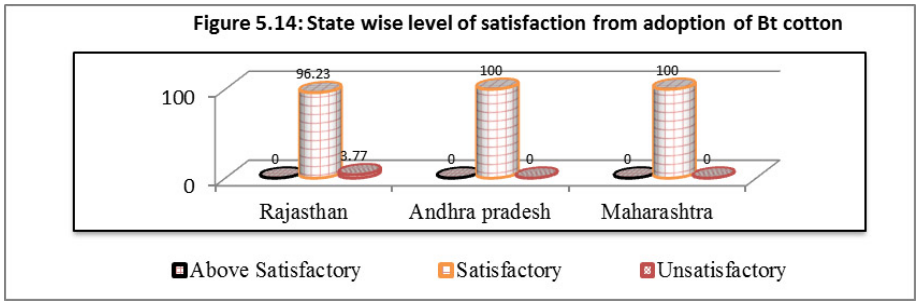
Economic benefit appears to be the single most important reason for all of the farmers in surveyed areas who have adopted Bt cotton. State wise while all the farmers in Andhra Pradesh and Maharashtra (Figure 5.13) indicate that the adoption is primarily because of economic benefits that are expected to emerge from adoption of Bt cotton. Even in Rajasthan, only little over 11 percent farmers indicated that they adopted Bt cotton because of general trend.



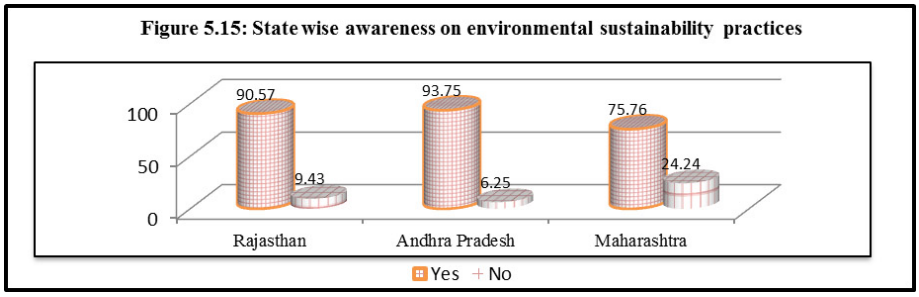
Interaction with the farmers in all the selected areas (Figure 5.14) indicates that most of the farmers are satisfied with adoption of Bt cotton. While in selected areas of Andhra Pradesh and Maharashtra, the satisfaction level is as high as 100 percent; it is relatively low in Rajasthan village at about 96 percent.

Here it needs to be noted that farmers qualified their satisfaction with non-availability of alternative seeds which can replace Bt cotton.

The majority of the farmers among these states are aware of the environmental sustainability practices in cotton production. Awareness about sustainability practices mainly refer to water management, pest management, crop management, soil management etc.



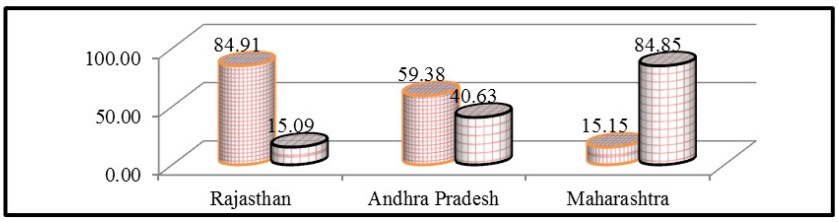
From the data of three different villages in the three states (Figure 5.15) show a high level of farmers' awareness on the issue of environmental sustainability. There are, however, variations across the selected villages. Awareness about environmental sustainability practices is relatively low in Wai village in Maharashtra than two other villages in Rajasthan and Andhra Pradesh.



In case of adoption of environmentally sustainable practices (Figure 5.16), it is observed that a majority of farmers (about 85 percent) in the selected area of Rajasthan have practiced sustainability practices. A major objective is to increase production and reduce cost. As compared to Rajasthan, over 59 percent farmers in Andhra Pradesh and 15.1 percent in Maharashtra have also followed manual practices in cotton production due to environmental concern.

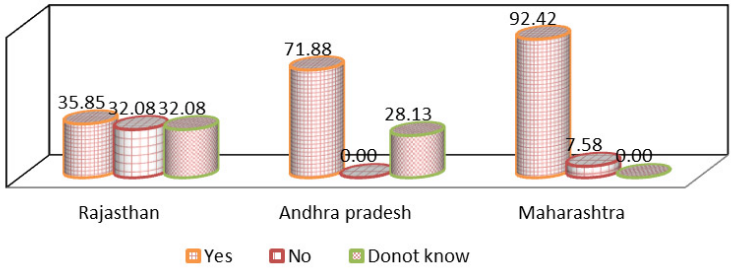
Figures though need to be further investigated, suggest that farmers in Maharashtra are relatively less concerned about the environmental issues than farmers in other two selected areas in Rajasthan and Andhra Pradesh. This is, however, not due to lack of awareness, but might be due to some other constraints, such as financial or technological. Comparing Figure 5.15 with Figure 5.16 makes it clear.

5.16: State wise adoption of environmental sustainability practices



Use of pesticides appears to be impacting cotton production in all the three selected areas. This is reflected by analysis of field data (Figure 5.17). On the issue of impact of use of pesticides on cotton production, more than 9 in ten farmers in Maharashtra, more than 7 in 10 farmers in Andhra Pradesh responded that heavy use of pesticide have adverse impact on cotton production. The percentage is quite low in Rajasthan where less than 4 in 10 farmers answered in affirmative. The figure for Rajasthan appears to bit contradictory as most of the farmers are aware of environmental issues and are also increasingly adopting sustainable practices.

Figure 5.17: Impact of use of pesticides on cotton production



Field data (Figure 5.18) show that the precautionary measures followed by farmers in Rajasthan during the period of spraying pesticides are mostly manual. The precautionary measures followed in Rajasthan include covered face with the old clothes, using hand gloves, eat before spraying, keep the pesticides away from the child, destroy container after use.

Box 5.1: Impact of Erratic Rainfall on Cotton Productivity

There are clear indications that change in weather patterns, especially erratic rainfall, is impacting crop productivity of cotton in different states of India. Farmers in selected villages in Andhra Pradesh and Maharashtra revealed the same.

Parthipadu village coming under Parthipadu tehsil (in Guntur district of Andhra Pradesh) has more than six hundred farmers. Most of the farmers leased farm land for farming purpose with yearly rent in the range of ten to twenty thousand per acre. Cotton (Bt+ American 100 percent) is the second important cash crop after chilly produced by the farmers in the village. The productivity level is usually very high in a normal year (with good monsoon) ranging from 10 to 15 quintal raw cotton per acre.

However, in the current year (when the survey was conducted) a prolonged drought period has reduced the productivity to merely four to five quintal per acre, resulting in a heavy lose to the farmers given a constant and high rental value of the farm land. The cost of growing cotton is as high as INR30, 000-40, 000 per acre in a leased land and INR 15,000 to 25,000 per acre in an owned land.

Wai Village, under Kelapur Taluk (Bidarbha region of Maharashtra) has more than seven hundred farmers. The ratio of large, medium, and small farming households are 3:1:1. Most of the land area is rain fed and only the big farmers are managing to get their water from their own well, small tanks and etc. Cotton (Bt+ American 100 percent) is widely grown in the village. The productivity level is usually high in an irrigated land ranging from 5 to 7 quintal lint per acre.

However, in the current year (when the survey was conducted) a prolonged drought period reduced the productivity to merely four to1.3 quintal lint per acre, resulting in a heavy lose to the farmers given a high cost of production. The cost of growing cotton is as high as INR 10,000 to 15,000 per acre of land. The heavy loss in the current year is associated with low production, low market price and increasing cost of production compared to previous year.

Source: Interaction with farmers during the field survey

As compared to farmers in Rajasthan, farmers of Andhra Pradesh and Maharashtra have different points of view. Some of the farmers in Andhra Pradesh follow manual procedure during the spraying periods but some of them don't follow any precautionary measures. Farmers who do not use precautionary measures believe that until or unless pesticides are powerful, there is no need to follow precautionary measures. According to them, normal pesticide has little or nothing impact on human health.

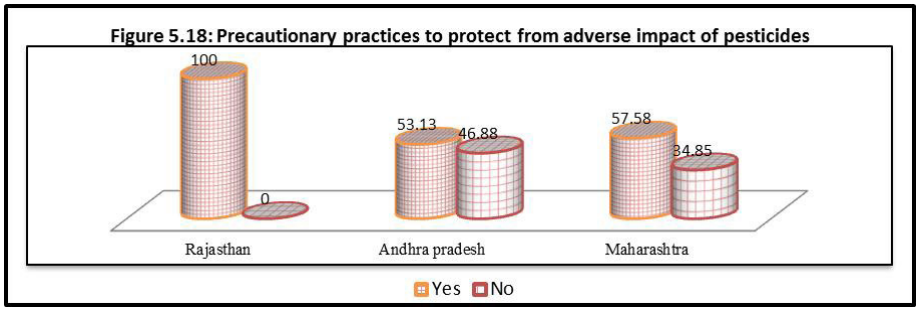
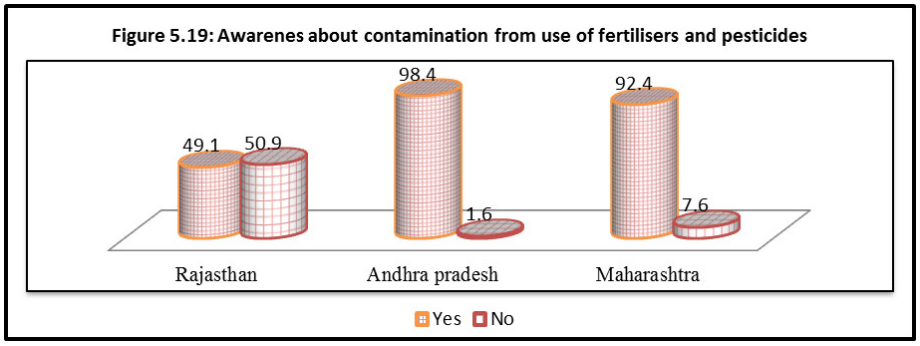
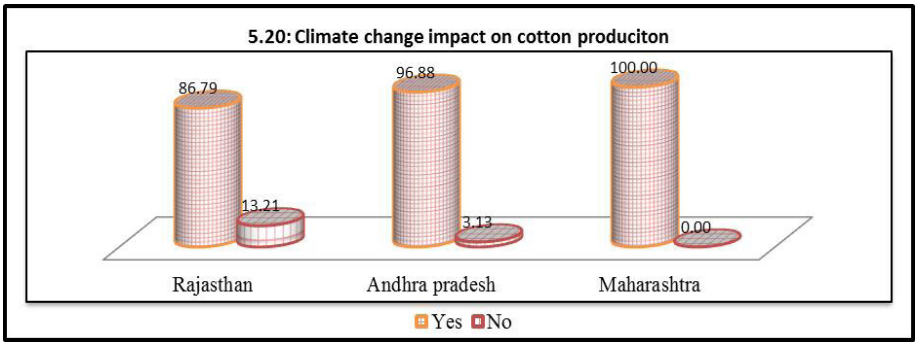


Figure 5.19 presents awareness about contamination from use of fertilisers and pesticides. Most of the farmers in the selected areas of Andhra Pradesh and Maharashtra (over 90 percent in each) indicated their awareness about the impact of use of fertilisers and pesticides on contamination of cotton. Compared to these two states, awareness is much low in Rajasthan (about 50 percent).

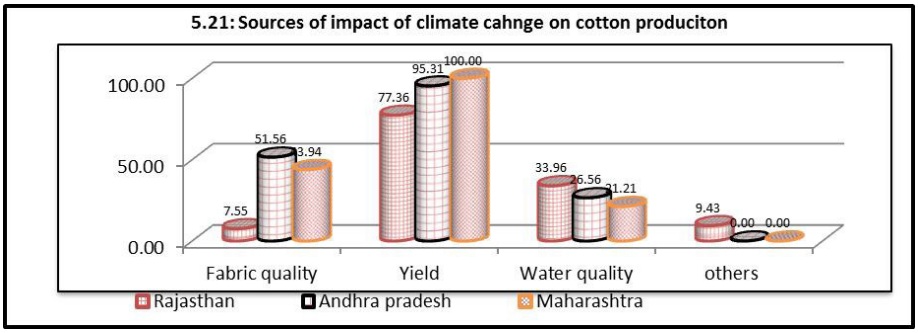
However, interactions with the farmers showed that despite high level of awareness, they pay little attention to this. Farmers appear to be more concerned with ways and means to increase both production and productivity of cotton. This is necessitated by increasing cost of cultivation per acre of cotton and farmers' inability to meet all day to day requirements with limited resources.



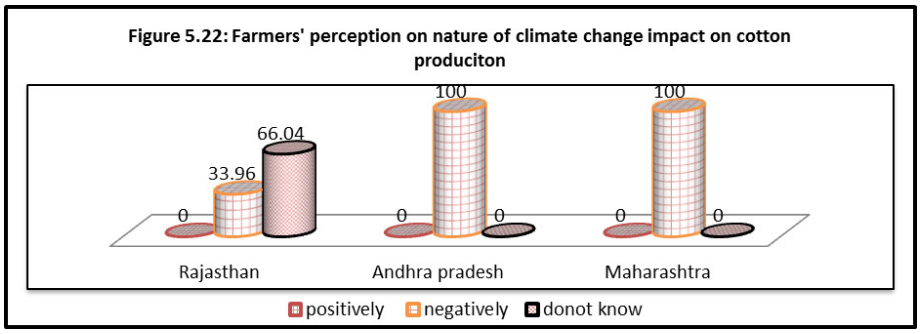
There is clear sign (Figure 5.20) that climate change has impacted cotton production. Most of the farmers in all the three selected areas agreed that climate change is impacting cotton production. The responses are as high as 100 percent in Maharashtra and about 97 percent in Andhra Pradesh. Even in Rajasthan, it is quite high though relatively low at 87 percent farmers who agreed that climate change is impacting cotton production.



Cotton farmers' responses (Figure 5.21) show that climate change impact is being felt in many ways. Some of the most important ones include impact on yields, water quality, and fabric quality. A very high percentage of farmers (over 75 percent) in all the selected areas opined that climate change is impacting cotton yields. In Maharashtra, the percentage of farmers who said that climate change is impacting crop yield is as high as 100 percent. It is also adversely impacting quality of water, said over 20 percent of farmers in each of the selected areas.



Climate change leads to change in surface temperature and precipitation, and these might have impact on cotton production. When confronted with this question, all the farmers in Andhra Pradesh and Maharashtra responded that increase in surface temperature and precipitation have negative impact on cotton production. The situation is some different in case of Rajasthan. Only two third of farmers in the selected area clearly expressed that change in surface temperature and precipitation is negatively impacting cotton production (Figure 5.22). However, there was no indication of any positive impact, as the remaining farmers expressed lack of awareness on the issue.

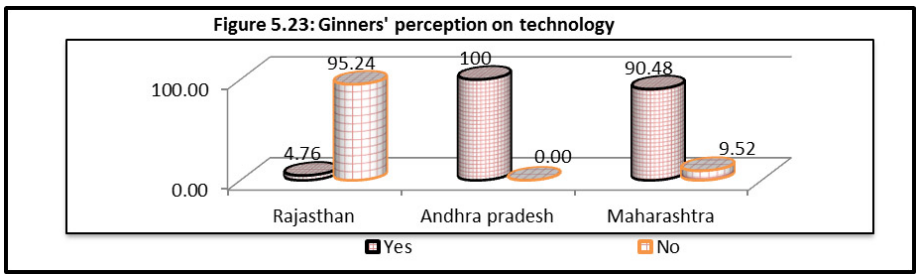


Impact of Cotton on Other Stakeholders

Ginners

Ginners are one of the most important links in the cotton value chain, and therefore, sustainability of people engaged in ginning directly impacts other links in the chain. Sustainability of this link, however, depends on various issues but more on type of technology in use.

Field data (Figure 5.23) shows that most of the interviewed ginners in Andhra Pradesh and Maharashtra (over 90 percent) are using latest available technology for processing of cotton. This is significantly higher than what is observed in Rajasthan, where less than 5 percent ginners are using latest technology.



Ginners in Andhra Pradesh and Maharashtra have higher level of awareness about cotton contamination through chromium in ginning processes. In both the states awareness is higher than 95 percent. Rajasthan, as in the case of use of latest technology is far lagging behind compared. This is reflected by the field data in figure 5.24, which show less than 15 percent ginners being aware of cotton contamination due to use of chromium.

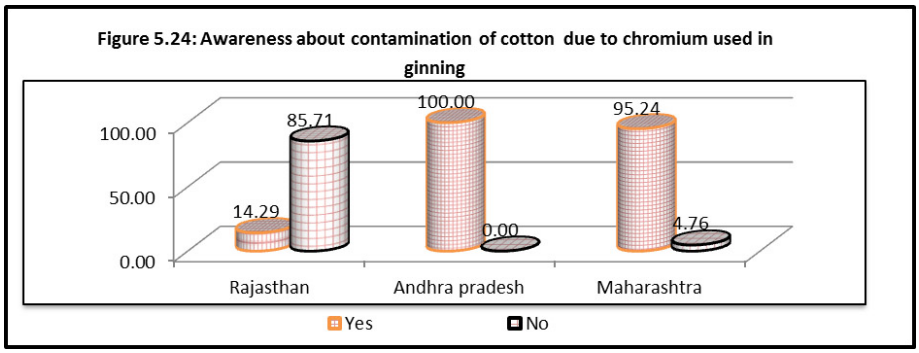
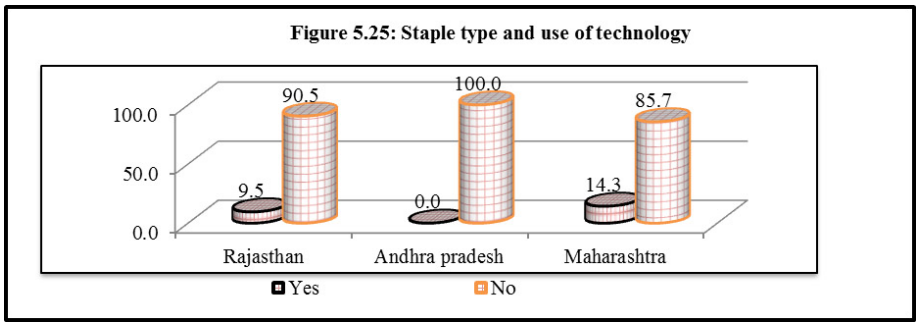
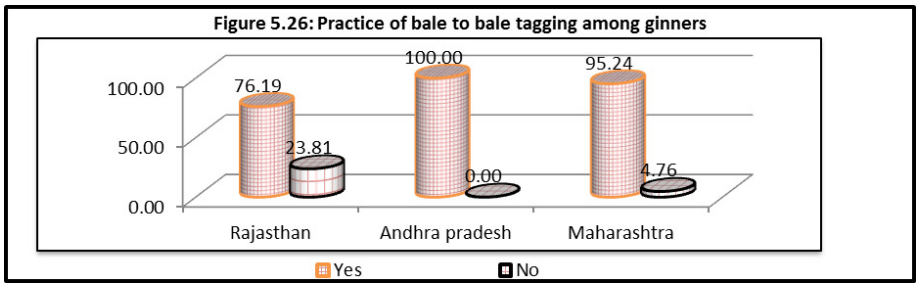


Figure 5.25 presents staple type and use of technology. Staple type does not appear to have any influence on type of technology used by ginners. A negligible or very low percentage of ginning mills in all the surveyed areas use different technology for different types of staples. Those who are not using different technology for different staples are 100 percent in Andhra Pradesh, over 90 percent in Rajasthan and nearly 86 percent in Maharashtra.



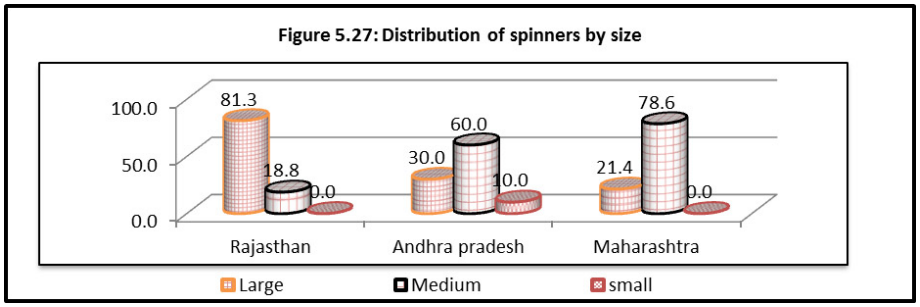
The practice of bale to bale tagging appears to be very common among most of the ginners in the three surveyed areas. The responses of farmer (Figure 5.26) shows that while 100 percent ginners in Andhra Pradesh indicated use of this practice; in Maharashtra also the practice is quite high at over 95 percent. Rajasthan comes last in adoption of this practice with over 76 percent ginners practicing this.



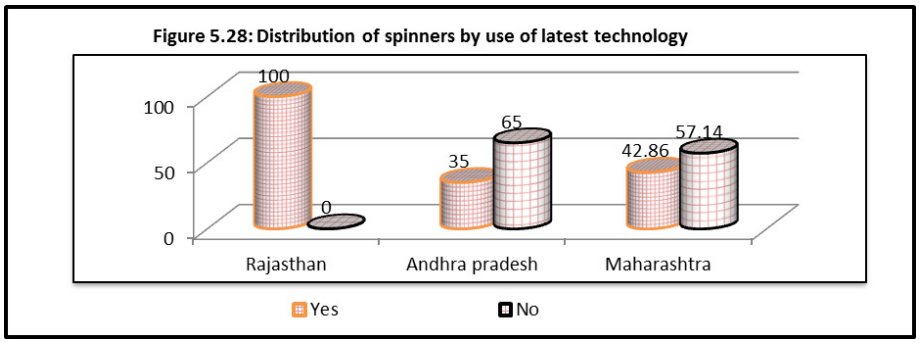
Spinners

Plant size has a direct and deeper impact on livelihood of people directly or indirectly associated with the sub-sector. The impact is linked to number of people directly or indirectly employed and their families. This was the main purpose of covering both small and big plants under the study.

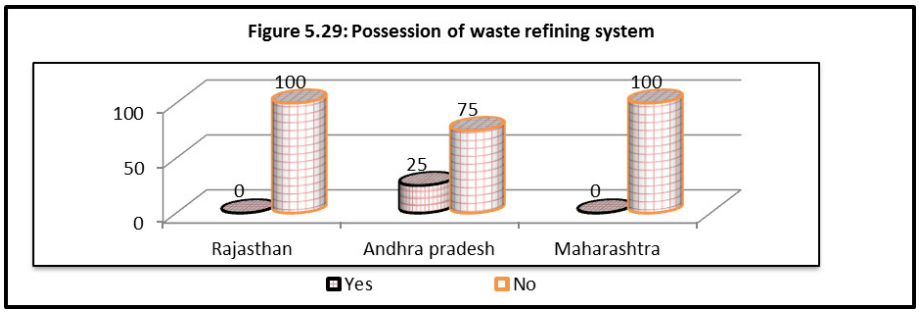
The plant size of spinners in three different states is presented in the Figure 5.27. More than 81 percent large farm recorded in Rajasthan. In comparison, the big plants in Andhra Pradesh are 30 percent and in Maharashtra it is over 21 percent. Medium plant size in Rajasthan, Andhra Pradesh and Maharashtra are 19 percent, 60 percent and 79 percent respectively. Small plants are covered only in Andhra Pradesh (10 percent of the total).



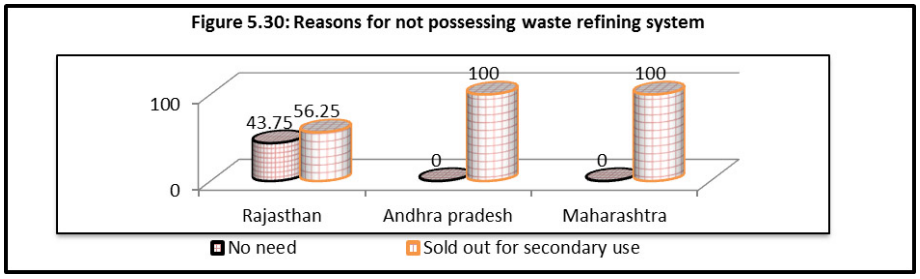
The percentage share of use of latest technology from three states is presented in the Figure 5.28. Rajasthan is leading in terms of use of latest technology. All the surveyed spinning mills (100 percent) are using latest technology for processing of cotton. In comparison, use of latest technology is found to be significantly low in case of Andhra Pradesh and Maharashtra where only 35 percent and 43 percent spinning mills are using latest technology.



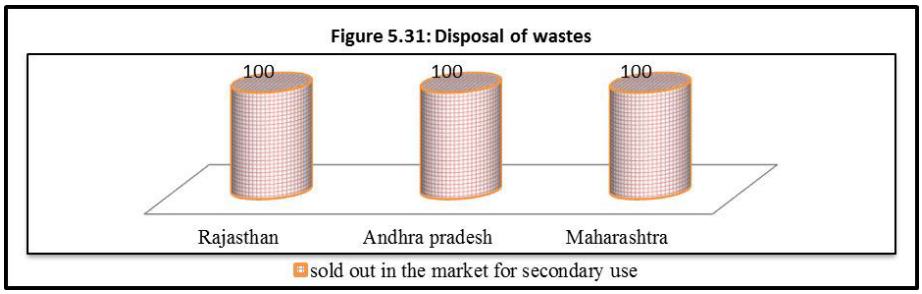
Possession of waste refining system does not appear to be associated with size of the spinning mills. Field data (Figure 5.29) reflect that most of the surveyed spinning mills do not have waste refinery system. In two states namely Rajasthan and Maharashtra, none of the surveyed mills possess waste refinery system. Andhra Pradesh appears to be the best performing states in this respect. Data reflects existence of waste refinery system in 25 percent cases.



The data collected for the use of refinery system in three states have been presented in the figure 5.30. Different reasons are cited for non-possession of waste refining system by spinning mills. Responding to the questions on reasons why they don't have refinery system, nearly 44 percent of those interviewed in Rajasthan responded that there is no requirement of refinery system in Rajasthan. Compared to Rajasthan, all the respondents in Andhra Pradesh and Maharashtra (100 percent in each) said that they sell out the waste products for secondary use and therefore there is no requirement of waste refinery system.

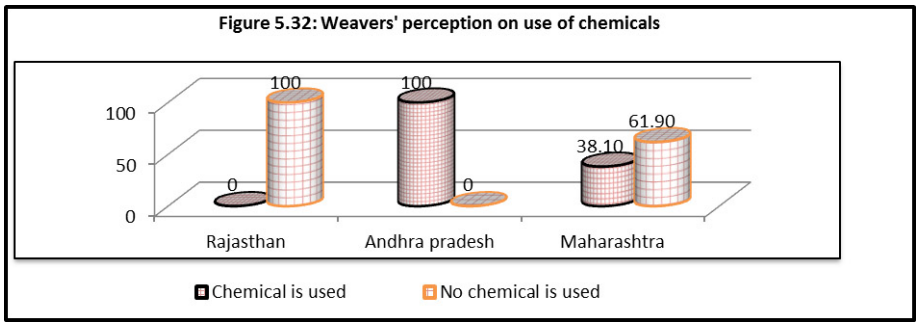


Views of the most of the respondents presented in the Figure 5.31 are of the opinion that no effluents are generated during the process of spinning. In case of generation of effluents during the spinning process, they are sold in the market for secondary use like making bed etc. Common response is found in all the places during the survey periods.

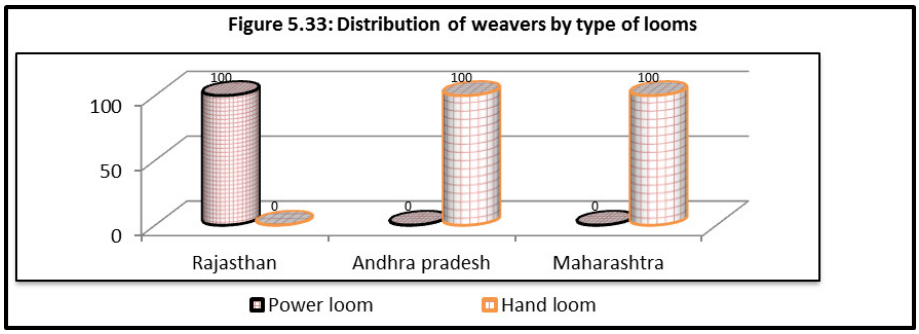


Weavers

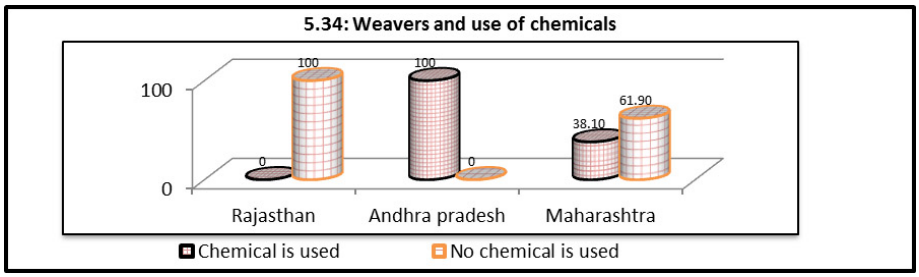
The main comment found in three states (Figure 5.32) in weaving sector is totally different with each other's. While all respondent in Rajasthan opined that no chemical is used in weaving process, in Andhra Pradesh almost all have responded that chemical is used in the weaving process. In the case of Maharashtra, mix responses are observed. Over 60 percent of those interviewed said that chemical is not used while 31 percent indicated use of chemical in the weaving process.



Weavers in Rajasthan (Figure 5.33) appear to be fully dependent on power looms for processing of cotton. Andhra Pradesh and Maharashtra present a totally contrasting picture. All the interviewed weavers in these two states indicated their full dependence on hand looms.



Different types of weaving systems are observed among interviewed weavers in different states. Field data presented in the Figure 5.34 indicates that while weavers in Rajasthan do not at all use chemicals in processing of cotton. Observations from weavers of Maharashtra are quite different. While about 66 percent weavers use chemical, the remaining 34 percent don't use any chemical.



Manufacturer and retailers

Chemical has become a very sensitive input in processing and transformation of cotton into fabric. Contrary to what is understood generally, a big percentage of manufacturers[2] (Figure 5.35) indicated that chemical is hardly used in the manufacturing processes. More than 65 percent respondent in Rajasthan and more than 94 percent in Maharashtra said that chemical is not used in the manufacturing process. As per the field data, only 34 percent in Rajasthan and 5 percent in Maharashtra said that chemical is used in the manufacturing process.

Major types of chemical used in manufacturing process include soda, salt, IDI colour, vegetable, silicon and organic chemical which have little or no impact on environment.

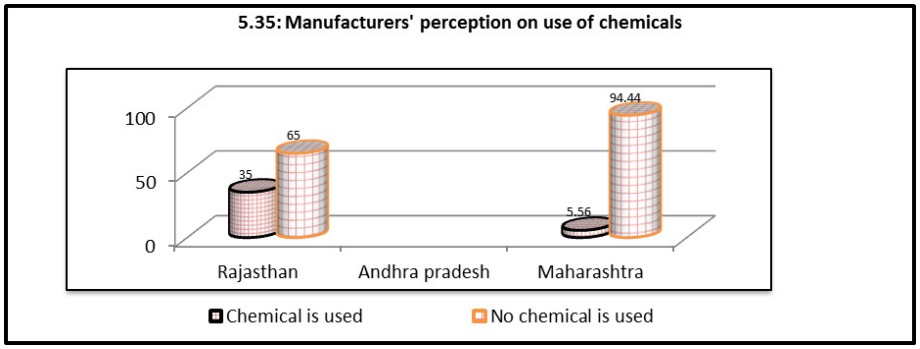


Figure 5.36 represents awareness of manufacturers on regulatory framework of India which prescribes overall guidance on use of chemicals and other sustainability issues. Almost all the manufacturers surveyed in the research indicated that they are fully aware of the regulatory framework in textile and clothing sector in India.

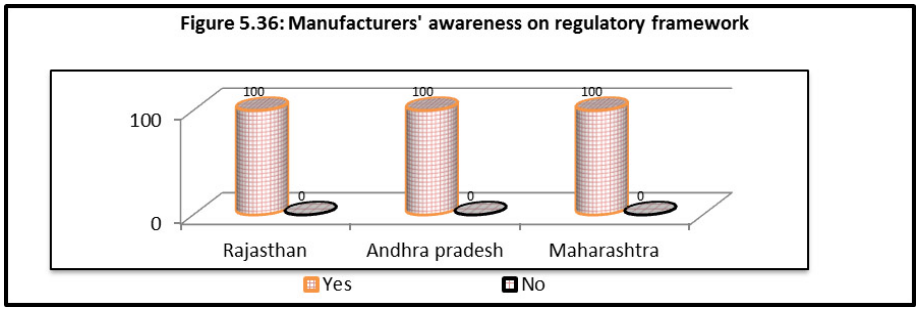
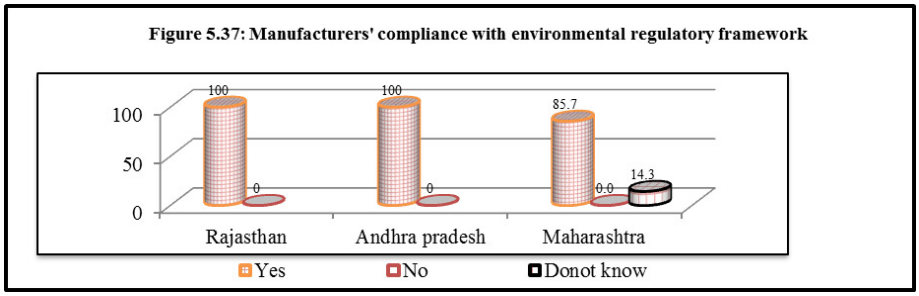
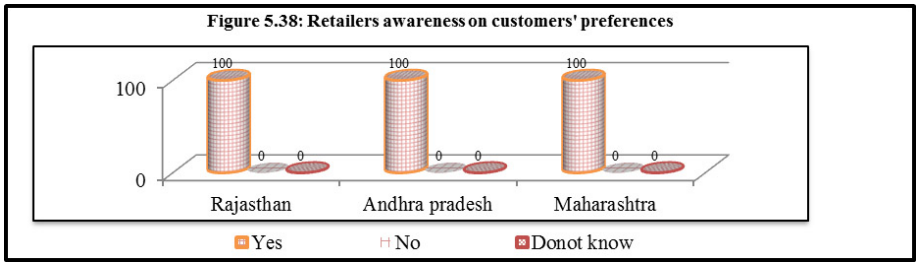


Figure 5.37 shows that manufacturers appear to be fully complying with environmental regulatory framework of the government of India. All the surveyed manufacturers in both Rajasthan and Andhra Pradesh indicated full compliance, whereas nearly 86 percent manufacturers in Maharashtra indicated the same.



Retailers are the final link to consumers in cotton supply chain. They also appear to be the least polluting of all the stages of cotton supply chain. Questions posed to them are, therefore, quite different compared to other stakeholders, and it is confined mainly to their awareness on changing consumption patterns and preferences of consumers.

Figure 5.38 presents the response to question on whether customer care for clothes manufactured in compliance with environmental standards, all the retailers surveyed responded in affirmative, and agreed that customers are now increasingly becoming conscious of manufacturers' compliance with environmental standards.



Overall as far as livelihood of ginners, spinners, weavers and manufacturer are concerned, it appears that they are not very much concerned with supply and demand of cotton or about the shortage of labour, they are more concerned about the fluctuating export-import policies of Government. During the interactions, they also indicated that government intervention to some extent affects their plan. Due to government fluctuating export-import policies they are unable to make their long-term plan. According to them, Government policies should be made for a minimum of at least two years so they can make their future plan.

Box 5.2: Economics of Cotton Cultivation in Vidarbha Region of Maharashtra

Farmers in Wardha and other regions of Vidarbha predominantly grow hybrid cotton. Some farmers, however, continue to grow the 'desi' or local cotton but these are a minority. The principal source of the hybrid seeds is private companies although there are some varieties supplied by the Punjab Rao Deshmukh Agricultural University located in Wardha and by the Gujarat government. All the hybrid seeds available are priced between Rs. 300 to Rs. 450 per 450 gm bag. This odd size is standard here although packages of 750 gm. are also sold.

The farmers need about 1 kg of seed per acre which works out to a cost of Rs. 700 to Rs. 900 per acre depending on the variety. One can take an average of Rs. 800 per acre. Pesticide sprayings work out to another Rs. 1000 per acre. Wardha and almost all of Vidarbha is rainfed so the yields are lower compared to the irrigated areas in Punjab and Haryana. The average cotton yields are around 3 quintals per acre in this region. The farmers here are demanding a monopoly pricing system because cotton prices have been plummeting these past few years, the whole situation being exacerbated by the government's ad hoc decisions to import cotton, causing cotton prices to crash further.

In this situation, two new varieties of cotton, one legal and the other illegal have become available to farmers. The Mahyco –Monsanto varieties are roughly priced at Rs. 1600 per bag. The economics in this case, will work out as follows: cost of seed per acre will go up to Rs 3200. If pesticide use is reduced because of the Bt toxin, say even by as much as a dramatic 60 percent, savings on pesticide will work out to Rs.600 per acre. The yield will not be affected much since Bt cotton has not been bred to confer a yield advantage but the advantage of disease resistance. The main reason the yields will not go up in any significant way is because of the lack of irrigation facilities. So the economics of Mahyco-Monsanto's Bt cotton look very unfavourable for the farmer. A total outlay of Rs. 3600 (3200 for seed + 400 for pesticide) as against Rs.1800 per acre in the old system (800 for seed + 1000 for pesticide). This means an increased net outlay of Rs. 1800, which is exactly double. This increased cost cannot be made up by higher yield, for the reasons explained above.

In other words, Bt cotton which tend to reduce cost as there is less application of pesticides, might not contribute in raising income and profitability of small farmers, especially in the rain fed areas.

Source: http://www.genecampaign.org/Publication/Article/BT%20Cotton/BtCOTTON-Economics.pdf (emphasis added)

Relationship between Area under Cultivation, Income, Cost and Sustainability Issues

Relationship between area under cultivation and adoption of sustainable practices

There does not appear to be any clear relationship between areas under cultivation on the one hand and adoption to Bt farming on the other. This is clearly reflected by the field data. In case of Andhra Pradesh, it is observed that all the surveyed farmers irrespective of different land sizes have adapted to Bt farming. This is in slight contrast to surveyed farmers in other two states Maharashtra and Rajasthan where there are variations in adaption to Bt farming. However, even in these two cases, it is difficult to derive any trend.

Since adaption to Bt cotton is not related to area under cultivation, one can argue that increased adaption to Bt cotton makes the production system relatively more sustainable compared to conventional farming as it helps farmers to protect crops from pesticides, which in a way support increase in productivity.

Table: 5.1: Relationship between Area under Cultivation and Adoption of Bt Cotton (%)

Area Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Transgenic		Transgenic		Transgenicn		Transgenic	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
0.5-1 Acre	100	0	100	0	81.25	18.75	86.36	13.64
1- 2.5 Acre	100	0	100	0	92.31	7.69	97.44	2.56
2.5- 5 Acre	100	0	89.58	10.42	80	20	91.76	8.24
Above 5 Acre	100	0	100	0	100	0	100	0
Total	**100**	**0**	**92.42**	**7.58**	**88.68**	**11.32**	**93.99**	**6.01**

In response to question on whether satisfaction derived from application of Bt cotton is above satisfactory, satisfactory or not satisfactory, most of the farmers in all categories in all the surveyed areas opined that the results obtained from Bt cotton is satisfactory. Though none of the farmers said results *not satisfactory*, there are very few who indicated satisfaction level *above satisfactory*.

A major factor behind high level of satisfaction is absence of any alternative to Bt cotton. Farmers indicated to redesign their approach once alternative to Bt cotton is available in the market.

Table 5.2: Relationship between Area under Cultivation and Level of Satisfaction from the Bt Cotton

Area Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Level of Satisfaction		Level of Satisfaction		Level of Satisfaction		Level of Satisfaction	
	Above	*Satisfactory*	*Above*	*Satisfactory*	*Above*	*Satisfactory*	*Above*	*Satisfactory*
0.5-1 Acre	0	100	0	100	18.75	81.25	13.64	86.36
1- 2.5 Acre	0	100	0	100	23.08	76.92	7.69	92.31
2.5- 5 Acre	0	100	10.42	89.58	20	80	8.24	91.76
Above 5 Acre	0	100	14.29	85.71	0	100	2.7	97.3
Total	**0**	**100**	**9.09**	**90.91**	**15.09**	**84.91**	**7.65**	**92.35**

On an average, over 86 percent farmers in all the surveyed areas are aware of sustainable practices. This, however, is not common across farmers with different land size and in different states. In case of states, it is observed that while more than 90 percent of farmers in Andhra Pradesh and Rajasthan are aware of sustainable practices, only 76 percent surveyed farmers in Maharashtra indicated their awareness.

Table 5.3: Relationship between Area under Cultivation and Awareness about Environmentally Sustainable Practices

Area Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness on sustainable practices		Awareness on sustainable practices		Awareness on sustainable practices		Awareness on sustainable practices	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
0.5-1 Acre	75	25	100	0	88.28	18.75	81.82	18.18
1- 2.5 Acre	94.12	5.88	88.89	11.11	100	0	94.87	5.13
2.5- 5 Acre	96.3	3.7	70.83	29.17	100	0	82.35	17.65
Above 5 Acre	93.75	6.25	85.71	14.29	85.71	14.29	89.19	10.81
Total	**93.75**	**6.25**	**75.76**	**24.24**	**90.57**	**9.43**	**86.34**	**13.66**

Consistent with the trend in awareness, all surveyed farmers in Rajasthan indicated that they take precautionary measures to ensure greater sustainability when using pesticides. In comparison, the percentage of farmers who take precautionary measures in Andhra Pradesh and Maharashtra is significantly low – about 72 percent farmers in Andhra Pradesh and 58 percent in Maharashtra adopt this practice. What is,

however, more interesting is that when one compares land sizes, the percentage is relatively much higher in case of farmers with lowest land size.

Table 5.4: Relationship between area under Cultivation and Precautionary Measure in Use of Pesticide

Area Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Precautionary Measure		Precautionary Measure		Precautionary Measure		Precautionary Measure	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
0.5-1 Acre	75	25	100	0	100	0	95.45	4.55
1- 2.5 Acre	58.82	41.18	66.67	33.33	100	0	74.36	25.64
2.5- 5 Acre	81.48	18.52	54.17	45.83	100	0	68.24	31.76
Above 5 Acre	68.75	31.25	57.14	42.86	100	0	78.38	21.62
Total	**71.88**	**28.13**	**57.58**	**42.42**	**100**	**0**	**74.86**	**25.14**

About 82 percent surveyed farmers indicated their awareness about soil and water contamination due to use of pesticides. Across the states, a bigger percentage of surveyed farmers in Andhra Pradesh (over 98 percent) appear to be aware of soil and water contamination, compared to surveyed farmers in other two states.

Table 5.5: Relationship between Area under Cultivation and Awareness about Contamination of Soil and Surface Water Resulting from Use of Pesticide

Area Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness about Soil & Water contamination		Awareness about Soil & Water contamination		Awareness about Soil & Water contamination		Awareness about Soil & Water contamination	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
0.5-1 Acre	100	0	100	0	81.25	18.75	86.36	13.64
1- 2.5 Acre	94.12	5.88	88.89	11.11	46.15	53.85	76.92	23.08
2.5- 5 Acre	100	0	93.75	6.25	20	80	87.06	12.94
Above 5 Acre	100	0	85.71	14.29	35.71	64.29	72.97	27.03
Total	**98.44**	**1.56**	**92.42**	**7.58**	**49.06**	**50.94**	**81.97**	**18.03**

Awareness level on climate change and its impact on cotton production is very high. Over 95 percent of surveyed farmers in all the surveyed states indicated that they are aware of climate change and its impact on cotton production. This is one issue on which farmers in all categories show almost similar response in three states, with average observed in the range of 94 percent to 96 percent.

Table 5.6: Relationship between Area under Cultivation and Awareness on Impact of Climate Change on Cotton Production

Area Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness on Climate Change Impact		Awareness on Climate Change Impact		Awareness on Climate Change Impact		Awareness on Climate Change Impact	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
0.5-1 Acre	100	0	100	0	93.75	6.25	95.45	4.55
1- 2.5 Acre	88.24	11.76	100	0	100	0	94.87	5.13
2.5- 5 Acre	100	0	100	0	60	40	95.29	4.71
Above 5 Acre	100	0	100	0	85.71	14.29	94.29	5.41
Total	**96.88**	**3.13**	**100**	**0**	**86.79**	**13.21**	**95.08**	**4.92**

Impact of sustainable practices adopted by peers on other cotton producers is not visible from the field data. Most of the surveyed farmers in all the states indicated that they are not sure of doing so. This is true for most of the farmers with different land size.

There are, however, some exceptions to this. Nearly one-tenth of the surveyed farmers in Rajasthan agreed to follow sustainable practices of their peers. The percentage rises to nearly one-fifth in case of farmers owning land in the range of 1-2.5 acres.

Relationship between level of income and adoption of sustainable practices

Two distinct observations can be deduced from the data gathered from the field. While in case of Andhra Pradesh, it is observed that income level does not have any impact of adaption to Bt cotton; in case of Rajasthan, there appears to be a clear linkage. It is observed that adaption to Bt cotton increases with increase in income levels. Combining data of all the surveyed farmers, however, demonstrate that adoption to Bt cotton is positively linked to income levels, implying that bigger areas under cultivation of cotton show greater adaption to Bt cotton.

Table 5.7: Relationship between Area under Cultivation and Impact of Adoption of Sustainable Production Practices by Peers on other Producer

Area Classification	Andhra Pradesh			Maharashtra			Rajasthan			India (selected three states)		
	Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer		
	Yes	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*
0.5-1 Acre	0	0	100	0	0	100	0	6.25	93.75	0	4.55	95.45
1- 2.5 Acre	0	0	100	0	0	100	23.08	0	76.92	7.69	0	92.31
2.5- 5 Acre	0	0	100	0	0	100	10	40	50	1.18	4.71	94.12
Above 5 Acre	0	0	100	0	0	100	14.29	7.14	78.57	5.41	2.7	91.89
Total	**0**	**0**	**100**	**0**	**0**	**100**	**11.32**	**11.32**	**77.36**	**3.28**	**3.28**	**93.44**

Table 5.8: Relationship between Income Level and Adoption of Bt Cotton

Income classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Transgenic		Transgenic		Transgenicn		Transgenic	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	100	0	60	40	80	20
15-25k	100	0	83.33	16.67	80	20	86.96	13.04
25-50k	100	0	92.31	7.69	100	0	95.74	4.26
Above 50k	100	0	93.75	6.25	93.75	6.25	96.12	3.88
Total	**100**	**0**	**92.42**	**7.58**	**88.68**	**11.32**	**93.99**	**6.01**

Most of the surveyed farmers across all income categories indicated satisfaction from adaption to Bt cotton, though vary few indication satisfaction level to be above satisfactory level. Combined data for all three states show that farmers satisfied with Bt cotton increases with increase in income levels. At the state level, all the surveyed farmers in Andhra Pradesh indicated that they are satisfied with adaption to Bt cotton, though none of them indicated satisfaction above satisfactory level. As compared to Andhra Pradesh, in other two states Maharashtra and Rajasthan, some farmers also indicated satisfaction to above satisfactory level.

Table 5.9: Relationship between Income Level and Level of Satisfaction from the Bt Cotton

Income classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Level of Satisfaction		Level of Satisfaction		Level of Satisfaction		Level of Satisfaction	
	Above	*Satisfactory*	*Above*	*Satisfactory*	*Above*	*Satisfactory*	*Above*	*Satisfactory*
less than 15k	0	100	0	100	40	60	20	80
15-25k	0	100	16.67	83.33	20	80	13.04	86.96
25-50k	0	100	7.69	92.31	16.67	83.33	6.38	93.62
Above 50k	0	100	9.38	90.63	9.38	90.63	5.83	94.17
Total	**0**	**100**	**9.09**	**90.91**	**15.09**	**84.91**	**7.65**	**92.35**

At the aggregate level, income level appears to have direct influence on awareness about environmentally sustainable practices. Data show that higher the level of income, higher the level of awareness. At the state level, however, distinct variations are observed. In case of Andhra Pradesh, relatively higher percentage of surveyed farmers with income level of Rs15000 to Rs25000 appear to be aware of environmentally sustainable practices, compared to farmers in other states within this income category. In other income categories, responses do not lead to any trend.

Table 5.10: Relationship between Income Level and Awareness about Environmentally Sustainable Practices

Income classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness on sustainable practices		Awareness on sustainable practices		Awareness on sustainable practices		Awareness on sustainable practices	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	66.67	33.33	100	0	80	20	80	20
15-25k	100	0	83.33	16.67	80	20	86.96	13.04
25-50k	93.33	6.67	69.23	30.77	100	0	80.85	19.15
Above 50k	94.87	5.13	78.13	21.88	93.75	6.25	89.32	10.68
Total	**93.75**	**6.25**	**75.76**	**24.24**	**90.43**	**9.43**	**86.34**	**13.66**

At the aggregate level about 75 percent surveyed farmers across all income groups in all the three states indicated that they take precautionary measures while using pesticides. At the disaggregated level, income levels do not appear to have any significant influence on practice of precautionary measures. At the state level, however, there are variations. While all the surveyed farmers in Rajasthan indicated taking precautionary measures, it is quite low in two other surveyed states, with surveyed farmers in Maharashtra showing only about 58 percent taking such measures.

Table 5.11: Relationship between Income Level and Precautionary Measure in Use of Pesticide

Income classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Precautionary Measure		Precautionary Measure		Precautionary Measure		Precautionary Measure	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	66.67	33.33	50	50	100	0	80	20
15-25k	85.71	14.29	66.67	33.33	100	0	86.96	13.04
25-50k	66.67	33.33	57.69	42.31	100	0	65.96	34.04
Above 50k	71.79	28.21	56.25	43.75	100	0	75.73	24.27
Total	**71.88**	**28.13**	**57.58**	**42.42**	**100**	**0**	**74.86**	**25.14**

Field data on awareness on soil and surface water contamination from the use of pesticides does not show any clear relation with income levels. At the aggregate level, a larger percentage of surveyed farmers with income level in the range of Rs25000 to Rs50000 show indicated awareness about contamination of soil and surface water as a result of use of pesticides in the field. This is followed by farmers in the income range of less than Rs15000, in which case 90 percent surveyed farmers indicated their awareness on the same. What is, however, surprising is that surveyed farmers in the upper income bracket (above Rs50000) show the lowest level of awareness on the same.

Table 5.12: Relationship between Income Level and Awareness about Contamination of Soil and Surface Water Resulting from Use of Pesticide

Income Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness about Soil & Water contamination		Awareness about Soil & Water contamination		Awareness about Soil & Water contamination		Awareness about Soil & Water contamination	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	100	0	80	20	90	10
15-25k	85.71	14.29	100	0	80	20	86.96	13.04
25-50k	100	0	96.15	3.85	83.33	16.67	95.74	4.26
Above 50k	100	0	87.5	12.5	28.13	71.88	73.79	26.21
Total	**98.44**	**1.56**	**92.42**	**7.58**	**49.06**	**50.94**	**81.97**	**18.03**

Combined analysis of data from all the three surveyed states reflects a very high level of awareness on impact of climate change on cotton production. Over 95 percent surveyed farmers gave a clear indication that they are aware of such impact. Across different income categories, a higher percentage of farmers with income in the range of Rs25000 to Rs50000 are aware of same compared to farmers in other income categories. Awareness is found to be the lowest in lowest income group (with income less than Rs15000).

Table 5.13: Relationship between Income Level and Awareness on Impact of Climate Change on Cotton Production

Income Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness on Climate Change Impact		Awareness on Climate Change Impact		Awareness on Climate Change Impact		Awareness on Climate Change Impact	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	100	0	80	20	90	10
15-25k	85.71	14.29	100	0	100	0	95.65	4.35
25-50k	93.33	6.67	100	0	100	0	97.87	2.13
Above 50k	100	0	100	0	81.25	18.75	94.17	5.83
Total	**96.88**	**3.13**	**100**	**0**	**86.79**	**13.21**	**95.08**	**4.92**

Income level does not appear to have much impact on farmers towards adaption of environmentally sustainable practices introduced or followed by their peers, especially in states of Andhra Pradesh and Maharashtra. Even in case of Rajasthan, it is observed that only about 16 percent of the surveyed farmers indicated their willingness to follow the same. This is, however, restricted to farmers in the income group of Rs2500 to Rs50000 and above. This implies that peer influenced sustainable initiatives might not gain greater acceptance of other farmers.

Table 5.14: Relationship between income level and impact of Adoption of Sustainable Production by Peers on Other Producer

Income Classification	Andhra Pradesh			Maharashtra			Rajasthan			India (selected three states)		
	Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer		
	Yes	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*
less than 15k	0	0	100	0	0	100	0	20	80	0	10	90
15-25k	0	0	100	0	0	100	0	0	100	0	0	100
25-50k	0	0	100	0	0	100	16.67	0	83.33	2.13	0	97.87
Above 50k	0	0	100	0	0	100	15.63	15.63	68.75	4.85	4.85	90.29
Total	**0**	**0**	**100**	**0**	**0**	**100**	**11.32**	**11.32**	**77.36**	**3.28**	**3.28**	**93.44**

Relationship between cost of production and adoption of sustainable practices

Cost of cultivation does not appear to have much impact on the adoption of Bt cotton specially in the case of Andhra Pradesh. The entire farmer in Andhra Pradesh has adopted Bt cotton irrespective of their costs. The reason could be either economic benefit, general trend of both. In the case of Maharashtra, it is observed that adaption of Bt cotton has direct influence on cost of cultivation. Field data clearly establish this fact. It is found in Maharashtra that as the level of adoption increases, the cost also increases. The increasing cost of cultivation might be responsible for non-adaption of Bt cotton in over 11 percent of cases.

Table 5.15: Relationship between Cost Level and Percentage Adoption of Bt Cotton

Cost classification	Andhra Pradesh Transgenic		Maharashtra Transgenic		Rajasthan Transgenicn		India (selected three states) Transgenic	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	100	0	82.61	17.39	88.24	11.76
15-25k	100	0	81.25	18.75	75	25	80	20
25-35k	100	0	92.31	7.69	100	0	94.74	5.26
Above 35k	100	0	96.55	3.45	100	0	99.05	0.95
Total	**100**	**0**	**92.42**	**7.58**	**88.68**	**11.32**	**93.99**	**6.01**

The entire farmer in Andhra Pradesh is satisfied with the adaption of Bt cotton. In two other states, Maharashtra and Rajasthan, some percentage of surveyed farmers have also shown their satisfaction to be above satisfactory level. This satisfaction is, however, conditional to non-availability of alternative seeds to Bt cotton. This implies that farmers can shift to other seeds, if they find a suitable alternative. It was clearly indicated by farmers in course of their interaction with the research team.

Table 5.16: Relationship between Cost Level and Level of Satisfaction with the Adoption of Bt Cotton

Cost classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Level of Satisfaction		Level of Satisfaction		Level of Satisfaction		Level of Satisfaction	
	Above	*Satisfactory*	*Above*	*Satisfactory*	*Above*	*Satisfactory*	*Above*	*Satisfactory*
less than 15k	0	100	12.5	87.5	17.39	82.61	14.71	85.29
15-25k	0	100	18.75	81.25	37.5	62.5	24	76
25-35k	0	100	7.69	92.31	14.29	85.71	10.53	89.47
Above 35k	0	100	3.45	96.55	0	100	0.95	99.05
Total	**0**	**100**	**9.09**	**90.91**	**15.09**	**84.91**	**7.65**	**92.35**

Level of cost and awareness about the environmental sustainability practices is not directly related to each other, as reflected by the field data. There are significant variations in level of awareness across different cost categories. However, at the aggregate level more than 89 percent of surveyed farmers indicated that they are aware of environmentally sustainable practices.

Interactions with farmers also indicated that farmers appear to be more concerned about their total cost and total income. Environmental sustainable practices, which significantly depend on the level of education, implementation of government policies and age of the farmer, do not appear to be their focus area.

Table 5.17: Relationship between Cost Level and Awareness about Environmentally Sustainable Practices

Cost classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness on sustainable practices		Awareness on sustainable practices		Awareness on sustainable practices		Awareness on sustainable practices	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	75	25	86.96	13.04	85.29	14.71
15-25k	100	0	75	25	100	0	84	16
25-35k	100	0	61.54	38.46	100	0	73.68	26.32
Above 35k	93.22	6.78	82.76	17.24	86.67	13.33	89.52	10.48
Total	**93.75**	**6.25**	**75.76**	**24.24**	**90.57**	**9.43**	**86.34**	**13.66**

Except in the case of Rajasthan, awareness on sustainable practices does not have much impact of taking precautionary measures. Though surveyed farmers in Andhra Pradesh and Maharashtra have high level of awareness, a lower percentage of them take precautionary measures while using pesticides. This discrepancy might be because of various reasons, including but not limited to income constraint.

Precautionary measures taken by farmers include manual practices like using hand gloves and old clothes for covering exposed parts of their bodies during the course of spraying pesticides.

At the aggregate level, over 81 percent of farmers appear to be aware of contamination of soil and surface water resulting from use of pesticides. At the state level, data reflect that more than 92 percent of surveyed farmers in Andhra Pradesh and Maharashtra are aware about the contamination of soil and surface water resulting from use of pesticide. The level of awareness is much lower in case of Rajasthan, where less than 50 percent surveyed farmers are aware of soil and surface water contamination from use of pesticides.

Table 5.18: Relationship between Cost Level and Precautionary Measure in Use of Pesticide

Cost classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Precautionary Measure		Precautionary Measure		Precautionary Measure		Precautionary Measure	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	100	0	100	0	100	0
15-25k	100	0	50	50	100	0	68	32
25-35k	0	100	15.38	84.62	100	0	36.84	63.16
Above 35k	71.19	28.81	68.97	31.03	100	0	72.24	24.76
Total	**71.88**	**28.13**	**57.58**	**42.42**	**100**	**0**	**74.86**	**25.14**

Table 5.19: Relationship between Cost Level and Awareness about Contamination of Soil and Surface Water Resulting from Use of Pesticide

Cost Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness about Soil & Water contamination		Awareness about Soil & Water contamination		Awareness about Soil & Water contamination		Awareness about Soil & Water contamination	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	100	0	69.57	30.43	79.41	20.59
15-25k	100	0	93.75	6.25	25	75	72	28
25-35k	0	100	92.31	7.69	57.14	42.86	78.95	21.05
Above 35k	100	0	89.66	10.34	26.67	73.33	85.71	14.29
Total	**98.44**	**1.56**	**92.42**	**7.58**	**49.06**	**50.94**	**81.97**	**18.03**

Cost of production does not have any influence on farmers' awareness on climate change and its impact on cotton production. Overall, more than 95 percent of the surveyed farmers are expressed their awareness about impact of climate change on cotton production at the aggregate level. At the state level, more than 95 percent surveyed farmers in Andhra Pradesh and Rajasthan indicated their awareness on climate change impact. Even in Rajasthan, more than 86 percent surveyed farmers indicated their awareness on the issue.

Table 5.20: Relationship between Cost Level and Awareness on Impact of Climate Change on Cotton Production

Cost Classification	Andhra Pradesh		Maharashtra		Rajasthan		India (selected three states)	
	Awareness on Climate Change Impact		Awareness on Climate Change Impact		Awareness on Climate Change Impact		Awareness on Climate Change Impact	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
less than 15k	100	0	100	0	95.65	4.35	97.06	2.94
15-25k	100	0	100	0	75	25	92	8
25-35k	0	100	100	0	71.43	28.57	84.21	15.79
Above 35k	98.31	1.69	100	0	86.67	13.33	97.14	2.86
Total	**96.88**	**3.13**	**100**	**0**	**86.79**	**13.21**	**95.08**	**4.92**

Cost of cultivation does not reflect any relation with the adoption of peer-led sustainable practices by other producers. The responses of most of the farmers in all three surveyed areas do not show any willingness to adapt sustainable production practices being introduced or followed by their peer groups. The response was almost common in all the selected states. Only exception observed is in case of Rajasthan, where over 11 percent of farmers indicated that they might follow sustainable practices being adapted by their peers.

Table 5.21: Relationship between Cost Level and Impact of Adoption of Sustainable Production by Peers on Other Producer

Cost Classification	Andhra Pradesh			Maharashtra			Rajasthan			India (selected three states)		
	Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer			Adoption of peer-led sustainable practices by other producer		
	Yes	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*	*Yes*	*No*	*Don't Know*
less than 15k	0	0	100	0	0	100	8.7	4.35	86.96	5.88	2.94	91.18
15-25k	0	0	100	0	0	100	12.5	25	62.5	4	8	88
25-35k	0	0	100	0	0	100	0	14.29	85.71	0	0	100
Above 35k	0	0	100	0	0	100	20	13.33	66.67	2.86	2.86	94.29
Total	**0**	**0**	**100**	**0**	**0**	**100**	**11.32**	**11.32**	**77.36**	**3.28**	**3.28**	**93.44**

Some Empirical Evidence towards Sustainability in Cotton Production

Regression Equation

As indicted above, the study has been conducted in Prathipura village in Guntur district in Andhra Pradesh, Wai village in Yavatmal disstict of Vidarbha region[3] in Maharashtra and Sahu Wala Goan in Shri Ganganagar district in Rajasthan. A randomly selected sample of 183 farmers at places mentioned above was covered. The sample size consisted of 172 adopters of Bt cotton and 11 non-adopters. The survey was conducted during October 2011 to April 2012. The information from farmers was collected on their experience with Bt cotton and non-Bt cotton through a specially designed semi-structured questionnaire. Specifically the information gathered included adoption of Bt cotton, area under cotton cultivation, cost of cultivation, income, use of fertiliser and pesticides, irrigation facility available for the cotton cultivation. For empirical analysis, Ordinary Least Square (OLS) have been used.

The data collected from the field survey on cotton production, the following empirical model was constructed to analyse the impact of adoption of Bt cotton on annual cotton production.

$$\text{Production} = b_0 + b_1\text{Total Income} + b_2\text{Area} + + b_3\text{Total Cost} + b_4\text{Irrigation} + b_5\text{Fertiliser} + b_6\text{Bt or Non-Bt cotton} + Ui \quad \ldots\ldots\ldots (2)$$

Table 5.22: Summary Statistics

Variable	*Observation*	*Mean*	*Standard Deviation*	*Min*	*Max*
Total Income	183	78632.04	84612.55	5687.5	539000
Area	183	4.270492	3.708737	0.5	28
Total Cost	183	81765.03	81719.31	4000	450000
Irrigation (Dummy)	183	0.371585	0.484554	0	1
Fertiliser	183	193.9563	219.2452	90	1625
Bt or Non-Bt cotton (Dummy)	183	.9071038	.2910833	0	1

Table 5.23: OLS Estimate of the Effect of Adoption of Bt Cotton on Production

Variable	*Coefficient.*	*Standard deviation.*	*t*	*P>|t|*
Constant	-333.535	83.96322	-3.97	0.00
Total Income	0.023816	0.000826	28.83	0.00*
Area	103.3824	15.86135	6.52	0.00*
Total Cost	-0.00102	0.000671	-1.53	0.129
Irrigation (Dummy)	0.552075	41.49445	0.01	0.989
Fertiliser	-0.54525	0.174024	-3.13	0.002*
Bt or non-Bt cotton (Dummy)	47.15664	40.33715	1.17	0.244
F(7,175)	3124.18			

*Note: * represent significance at 1 percent level*

Regression Analysis

The dependent variable in the equation (2) is the estimate of effect of adoption of Bt cotton on cotton production. The objective of regression analysis is to examine the relationship between adoption of Bt cotton and annual production of cotton. If the farmer has adopted Bt cotton, the production of cotton will increase.

The regression results show that the adaption of Bt cotton resulted in increase in annual production of cotton by 47.1 unit and it is not significant. For a unit increase in the level of income, the production of cotton will increase by 0.023 units and it is significant at 1 percent level. Irrigation is positively associated with the annual cotton production. For one unit increase in irrigation, annual production of cotton will increase by 0.55 units. For one unit decrease in fertiliser, the production of cotton will increase by 0.54 units and it is significant at 1 percent level of significance. And for one unit decrease in cost, the annual production of cotton will increase by 0.001 units. Only three variable, total incomes, area under cotton cultivation and per acre fertiliser used in cotton production is significant at 1 percent level of significance.

Conclusion

Various parameters of sustainability which directly and indirectly influence cotton production in India have been analysed in this chapter.

Some of these include adoption of improved variety of seeds, such as Bt cotton, awareness on environmental sustainability and climate change impacts, influence of peer groups on adoption of environmentally sustainable practices. Analysis of data collected from the field establishes that on most of the parameters, cotton farming in India appears to be sustainable, especially because farmers are aware of various issues in cotton production that impact its sustainability. This, however, does not mean that farmers are taking appropriate steps to address these sustainability issues. Farmers' awareness on different parameters of sustainability is shown below (Box 5.3).

Box 5.3: What Makes Cotton Farming in India is Sustainable?

Parameters	***Score (based on stakeholders' responses, in %)***
Adoption of improved variety of seeds	94
Awareness about environmental sustainability	82
Awareness about contamination of soil and surface water	86
Awareness about impact of climate change	95
Precautionary measures to reduce adverse impact of cotton production on human health and environment	74
Influence of peer groups on adaption to sustainable practices	1

Source: Field survey

What is more important is that area under cultivation, income level and cost do not appear to have much impact on many of the parameters, which in turn implies that cotton farming in India will continue to be sustainable and will be much affected by these parameters.

Various issues, however, remain *(see Annex 5.1 for major issues faced by different types of stakeholders in the cotton supply chain)*. Some of the most important ones include low yield and productivity, lack of irrigation facilities, contamination of soil and surface water due to use of fertiliser and pesticides, inadequate dissemination of environmental friendly technology, and others. Fortunately for the sector, government of India has taken a number of initiatives to address the above issues.

One can hope that increasing sustainability practices as being adopted by cotton growers (as is reflected by the field data), coupled with

government initiatives to help farmers raising productivity and greater dissemination of environmental friendly technology, the overall situation will become more sustainable and will be strengthened. What is needed is a holistic approach towards promotion of a sustainable cotton regime in India.

Endnotes

1 The Indian government classifies farmers as marginal, small, semi-medium, medium or large farms as follows: a marginal farmer is defined as cultivating agricultural land up to 1 hectare (or 2.5 acres). A small farmer is defined as cultivating between 1 hectare and 2 hectares' (i.e. less than 5 acres). Semi- medium farmers are cultivating between 2 to 4 ha (5 to 10 acres), medium farmers are cultivating between 4 to 10 ha and large farmers more than 10 ha.

2 No response to this question was received from manufacturers in Andhra Pradesh.

3 Vidarbha region in Maharashtra comprises of Nagpur, Amravati, Chandrapur, Akola, Wardha, Buldhana, Yavatmal, Bhandara, Gondia, Washim,and Gadchiroli districts.

Annex 5.1:

Major Issues Raised by Different Stakeholders during Field Visit

Stakeholders	*Issues/concerns raised during the field visit*
Farmers	• Due to higher costs of seeds, fertilisers and pesticides, there is no profit in cotton farming. • Bt cotton seed should be banned because it is economically unviable for farmers, especially small and marginal farmers. Farmers have *desi* seeds and use of these needs to be strengthened. • Lack of proper irrigation, scarcity of labour and lack of knowledge about the use of pesticide and fertiliser is big problem for the farmer. • Farmer in Rajasthan wants to shift from cotton production to Kino product due to higher cost and less income. • Cotton prices should be based on the expenses incurred in cotton cultivation.
Ginners	• Government policies, financial problem, cotton quality, too much government intervention and frequently power supply cuts, labour problem, lab problem are some of the most critical issues faced by ginners. • Government policies should be at minimum for five years • We are aware about the environmental issues but cost factor stop them to go for that. • We try to maintain eco-friendly quality of products

Contd...

Spinners	• Government policies and lack of government support to adopt latest technology, labour problem, and export-import policies of government are major issues faced by us. • Cost factor make adoption of eco-friendly technology unviable for us. • We need better market mechanism (pricing) to do business. • Some opined that we don't think eco-friendly product is necessary in India because consumers are looking for cost factor. • The issues of market regulation should be phased out and free market forces should decide business. Only then we can go for eco-friendly technology. • The big boss sitting in the government offices drag out money in their pocket, therefor, eco-friendly is slow here.
Weavers	• Scarcity of labour due to low wage rate, marketing and financial problem, and power supply problem are major issues. • Other sectors are relatively better off, as they are getting more support from the government in comparison to this industry. • Acute lab problem lead us sometimes to stop producing. • Many indicated that they are producing eco-friendly product.
Manufacturers	• Excise duty, fluctuation in export-import policies of the government, out-dated technology, power problem, high interest rate and government policies in favour of large industry are big hurdle for the manufacturing industry. • Local tax system (octroi) particularly in Maharashtra has greater impact on the industry.
Retailers	• Government policies, export-import policies, people have indifferent view about the quality of product and defective product are returned to the source unit.

6
Towards a Sustainable Cotton Regime

Recommendations

Sustainable cotton production holds immense potential for the lives and livelihoods of millions of people directly or indirectly associated with it. It has the potential to provide livelihood and many other socio-economic benefits to the stakeholders along its value chain. Presently, the sector suffers from various issues emerging from unsustainable practices as highlighted in the preceding chapters. And, these issues continue to hamper the progress of the sector despite some significant initiatives taken by the Central and State Governments.

To remove these obstacles, a more holistic policy framework covering both growers and other stakeholders in the value chain is required to supplement and complement the existing ones. Such policies or other initiatives need to be based on ground level situation with inbuilt features to improve both livelihoods and address the ecological issues emerging from soil erosion, land degradation, water depletion and contamination.

Following are the recommendations that emerge from the study.

Building of capacity for environmentally sustainable production

There are clear evidences to suggest that despite having a good level of awareness on issues which directly or indirectly impact cotton production, farmers find it difficult to take measures to address the same. Further, it needs to be ensured that production practices being adopted by cotton farmers in India are in line with internationally recognised sustainable practices.

To improve ground level situation, there is need for capacity building of farmers, especially small and marginal farmers to help convert their knowledge on sustainable practices to ground action. This can be achieved

through a package of appropriate economic incentives and social protections to farmers enabling them to adopt more sustainable practices.

Awareness of global sustainable practices among Indian farmers also needs to be generated. This can help farmers to raise their competiveness in the global market.

Increased investment in environmentally friendly cotton production technologies

One of the most serious problems faced by cotton farmers in India is low crop yield and low yield implies low income and then low investment. There is now increased need for the development and wider dissemination of more efficient and environmental-friendly cotton technologies to meet growing demands of sustainability standards in the international market. Such technology development and its dissemination need to be based on analysis of the long-term sustainability implications.

Strengthen regulation on the use of toxic chemicals

Use of chemicals at different stages of cotton value chain is proving to be a hindrance to competitiveness of cotton from India in international market. This requires formal phasing out of such toxic chemicals associated with cotton production and textile processing through a stringent monitoring and regulation at the regional and sub-regional levels.

Promoting the use of cotton by-products and recycling

Farmers are facing sustainability challenges due to increasing cost of production and low yield crop yield. This can be to some extent addressed by taking a focused initiative to promote the comprehensive use of cotton by-products such as stalks and cotton seeds and waste cotton apparel through the provision of tax incentives for enterprises reaching specified usage levels and investing in by-product utilisation technologies.

Develop a national information strategy on cotton sustainability

Climate change impact on cotton production is real. One can also say cotton production impact climate change through use of chemical (fertiliser and pesticides). There is need for understanding the impact of climate change on cotton production and vice versa. It can be done through building an information base on the sustainability impacts of Indian cotton production, processing and consumption. The information system should have inbuilt characteristics to track social and environmental indicators across foreign and national cotton production and textile manufacturing sources.

Use of ecological farming practices to maximise the local resource use

A number of current production practices are based on indigenous knowledge and focus on building soil biological productivity. Non-pesticidal management, organic soil management, community seed banks, soil moisture management, etc., have already proven to be useful. These should be further promoted and existing initiatives should be strengthened.

Partnerships with local NGOs and other community associations

Partnership between various governmental and non-governmental agencies at the district level could be created to implement programmes. An alliance of public sector research organisations, extension agencies, departments dealing with rural livelihoods and farmers groups and CSOs at the national level should be formed and engage on sustainable agriculture/organic/natural/ecological farming.

Adoption of workers' training and awareness programmes

Workers along the cotton value chain should be trained on the safety procedures for receiving, storing, and mixing chemical and other hazardous inputs. The workers should be informed of the environmental impacts of chemicals and the most harmful chemicals to the environment. The training and awareness programmes could include handling of chemicals, correct procedures for spaying of chemicals and other safe use of chemicals along value chain.

In addition, policies regarding receipt, storage, and mixing should be established. This training could also help in keeping wastage at minimum and could encourage workers to suggest other improvements which reduce pollution.

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Questionnaire for the Field Survey

Questionnaire on Cotton Value Chain in India from Environmental Sustainability Perspectives

This questionnaire will be executed to a sample of cotton farmers in three villages (in the state of Andhra Pradesh, Maharashtra and Rajasthan). A sample of small, medium and big farmers will be selected from these villages. Sampling of the rest of the value chain will be done after collecting data from cotton farmers.

I. Farmers

1) What is your total area (in acres) under cultivation? Cotton Cultivation Area ( ) Other Cultivation Area ( )

2) What is your total annual cotton production? Production (kg) Productivity (kg/acre)

3) What is your total annual cost of cotton production? Please specify. Rs.....

4) What is your total annual income from cotton production? Rs.....

5) Can you identify few characteristics of soil under cotton cultivation? Yes: 1 No: 2 ( )

6) If coded 1 in Q5, then please specify them.

1……..…….	4……..….	7……..….
2…….....	5…….....	8……...…….
3…….....	6…….....	9……...…….

7) Is your cotton cultivation rain-fed or irrigated? Rain-fed: 1; Irrigated: 2; Both: 3 ( )

8) How do you manage water availability issues for cotton cultivation? Please specify them.

1……..…….	4……..….	7……..….
2…….....	5…….....	8……...…….
3…….....	6…….....	9……...…….

9) What types of cotton seeds you sow for cultivation?
Transgenic: 1; Non-transgenic: 2; Both: 3 ( )

10) If you sow transgenic cotton seeds, then which year you started GM cultivation?
2002-03 ( ) 2005-06 ( ) 2008-09 ( )
2003-04 ( ) 2006-07 ( ) 2009-10 ( )
2004-05 ( ) 2007-08 ( ) 2010-11 ( )

11) What made you shift from non-transgenic cultivation to GM cultivation?
General Trends: 1; Economic Benefits: 2; Others: 3 ( )

12) Can you please rate your level of satisfaction with Bt cotton?
Above Satisfactory: 1; Satisfactory: 2; Unsatisfactory: 3 ( )

13) Are you aware of environmental sustainability practices (such as water management, pest management, crop management, soil management etc) in cotton cultivation? Yes: 1; No: 2 ( )

14) If coded 1 in Q13, then have you practiced such mechanisms in cotton production? Yes: 1; No: 2 ( )

_ If coded 1 in Q 14, then why have you practiced such mechanisms? Please provide a brief reasoning.
……
……

_ If coded 2 in Q 14, then why haven't you practiced such mechanisms? Please provide a brief reasoning.
……
……

15) Many species of beneficial insects, which help keep the insect pest population in place, are killed by the heavy utilisation of pesticides. Do you feel that this has an adverse impact upon cotton production in India?
Yes: 1; No: 2; Don't Know: 3 ( )

16) Do you follow precautionary measures while spraying pesticides?
Yes: 1; No: 2 ( )

17) If coded 1 in Q 16, then what precautionary measures do you follow? Please specify them.
1……. 3…… 5……..
2……. 4…… 6…….

18) If coded 2 in Q 16, then why don't you follow precautionary measures? Please provide a brief statement.
……
……

19) Do you know that pesticides and fertilizers used in cotton cultivation not only contaminate soil but also surface water? Yes: 1; No: 2 ( )

20) If coded 1 in Q 19, then do you follow any precautionary measures? Yes: 1; No: 2 ( )

21) If coded 2 in Q 20, then why don't you follow precautionary measures? Please provide a brief statement.
……
……

22) Have you ever felt that climate change (such as erratic rainfall patterns, increased temperatures, etc.) has affected cotton production? Yes: 1; No: 2 ( )

23) If coded 1 in Q 22, then how has climate change affected cotton production?
Fabric Quality: 1; Yield: 2; Water Quality: 3; Others: 4
Specify (……)

24) Increases in surface temperature and precipitation might alter the breeding pattern for some insects/pests. How has this affected the cotton production? Positively: 1; Negatively: 2; Don't Know: 3 ( )

25) Say you adopt environmental sustainability practices in cotton production. How will this change the perception of other stakeholders in cotton value chain? Or will they abide by environmental regulatory framework? Yes: 1; No: 2; Don't Know: 3 ( )

II. Ginners

1. Are you using the latest ginning technology? Yes: 1; No: 2 ( )

   If coded 1 in Q 1, then what technology are you employing and why? Please provide a brief statement.
   ……
   ……

   If coded 2 in Q 1, then why aren't you employing the latest technology? Please provide a brief statement.
   ……
   ……

2. Do you know about hazards of chromium lint contamination in lint cotton during ginning process?
   Yes: 1; No: 2 ( )

3. After ginning, what mechanisms you follow for cleaning up residues (such as leaf trash, sticks, foreign matter, etc.)?
   ……
   ……

4. Do you use varying technology for different types of cotton staples?
   Yes: 1; No: 2 ( )

5. Do you practice bale to bale tagging of fibre attributes?
   Yes: 1; No: 2 ( )

6. How do you manage water availability issues for cotton ginning? Please specify them.
   1……. 4…….....…7…..……
   2……. 5…….. 8……..……..
   3……. 6……9……..……..

III. Spinners

1) What is your plant size? Please specify. ……

2) Are you employing the latest technology? Yes: 1; No: 2 ( )

   If coded 1 in Q 2, then what technology are you employing and why? Please provide a brief statement.
   ……
   ……

   If coded 2 in Q 2, then why aren't you employing the latest technology? Please provide a brief statement.
   ……
   ……

3) What is the annual order of cotton fibres for your spinning mill? Types Percentage of Total Order
   Short Staple: ( ); Medium Staple: ( );
   Long Staple: ( ); Extra Long Staple: ( )

4) Do you have your own waste refinery system? Yes: 1; No: 2 ( )
   If coded 1 in Q 4, then what type of waste refinery system do you have? Please explain.
   ……
   ……

   If coded 2 in Q 4, then why don't you have waste refinery system? Please explain.
   ……
   ……

5) Where do milling effluents go? Please specify.
……
……

6) How do you manage water availability issues for cotton spinning? Please specify them.
1……. 4…… 7…..……
2……. 5…….. 8……..
3……. 6…… 9……..

IV. Weavers & Knitters

1. What oils and chemicals do you use during weaving and knitting process? Please list them.
1……. 4…… 7……..……
2……. 5…….. 8……..……
3……. 6…… 9……..

2. What mechanisms do you use for weaving and knitting? Power Looms: 1; Hand Looms: 2 ( )

3. If you are using power looms, then are they technically efficient?
Yes: 1; No: 2; Don't Know: 3 ( )

4. If coded 1 in Q 3, then why are they technically efficient? Please give a brief reason.
……
……

5. If coded 2 in Q 3, then why aren't they technically efficient? Please give a brief reason.
……
……

6. If you are using hand looms, then are you planning to switch to power looms? Yes: 1; No: 2 ( )

7. Have you ever felt shortages of cotton fibres during any of your years of plant operation?
Yes: 1; No: 2 ( )

8. How do you take care of waste products? Please specify.
……
……

9. How do you manage water availability issues for weaving and knitting?

Please specify.
1……. 4…….. 7……..……
2……. 5…….. 8……..
3……. 6……..9……...

V. Manufacturers

1. What chemicals do you use for dyeing and printing? Please list them.
   1……. 4……. 7……
   2……. 5……... 8…….
   3……. 6……. 9……..

2. Are you employing energy efficient technology in the manufacture of clothes? Yes: 1; No: 2 ( )

3. Please explain the waste management system at your site.
   1……. 4……. 7…..……
   2……. 5……... 8…..……
   3……. 6……. 9……..

4. Is your manufacturing company domestic-oriented or foreign-oriented?
   Domestic-oriented: 1; Foreign-oriented: 2; Both: 3 ( )

5. How do you manage water availability issues? Please specify them.
   1……. 4……7…..……
   2……. 5…….. 8…..……
   3……. 6……..9……...

VI. Retailers

1. Are you aware of environmental regulatory framework in textiles & clothing sector? Yes: 1; No: 2 ( )

2. If coded 1 in Q 1, then are your clothing suppliers/manufacturers complying with environmental regulatory framework?
   Yes: 1; No: 2; Don't Know: 3 ( )

3. Do customers care for clothes manufactured in compliance with environmental standards?
   Yes: 1; No: 2; Don't Know: 3 ( )

4. How do you manage your waste products? Please specify.
……
……
……

ISBN 978 81 8257 186 0

₹250/US$25

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