

Textile Industry in India – a case of GM Cotton



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Value of Cotton

- Of great symbolic value to our civilizational heritage
- Played a crucial role in our freedom struggle, starting with the 'Swadeshi Movement'
- Cotton is the driving engine for growth of the Textile sector which is the second-largest employer in the country after agriculture
- India has a strong global footprint in cotton yarn and is constantly striving to improve its competitiveness in fabrics and apparel segments

Role of Cotton & Textile Industry in Indian Economy

- ❖ Home grown cotton provides 59% raw material to textile industry
- ❖ 6.5 million cotton farmers and 25 million people engaged in cotton- textile industry
- ❖ Cotton contributes 4.9% to value of agriculture output and 29.1 % of the total textile exports
- ❖ 50-70 lakh bales of raw cotton exported annually

India Textile industry

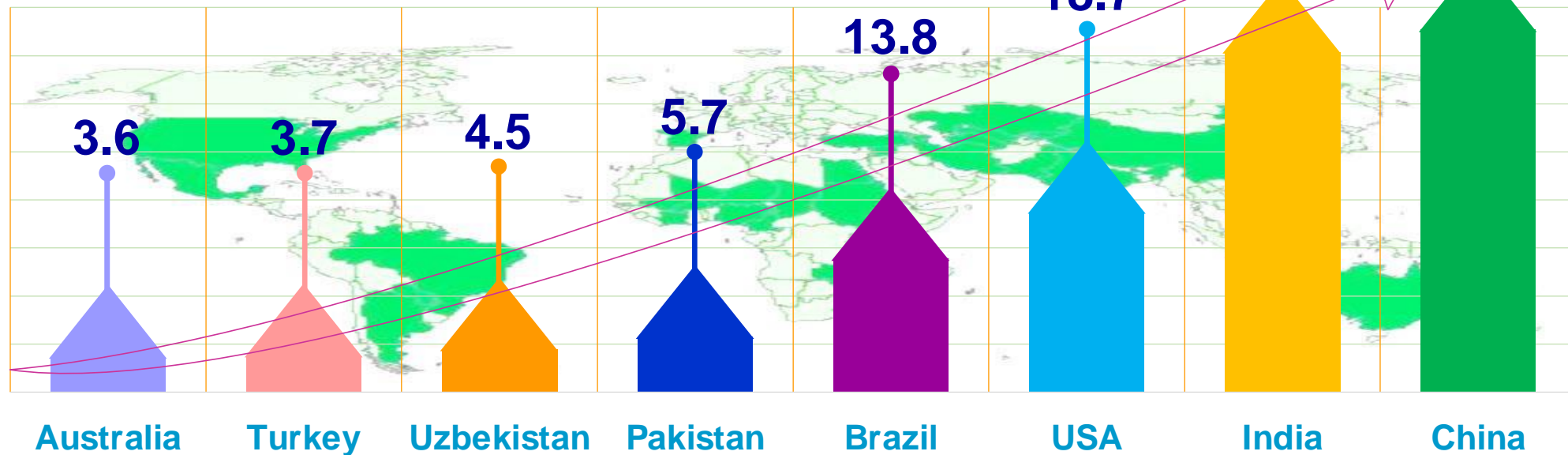
- Second largest employer
- India-Largest exporter of cotton yarn (26.7%)
- Textiles 10% (by value) of the manufactured goods
- ❖ Contribution of textile industry
 - 4 per cent to GDP
 - 14 per cent to industrial production
 - 11 per cent to the country's export earnings
- ❖ Value of textile industry : 150 billion US\$

Cotton Global Scenario

(Source: USDA Report 2021)

- 25.12 Million tonnes of lint annually worth \$12 billion
- Backbone of world textile trade
- White Gold: Economic impact of \$600 billion annually

Million bales
(170 kg each)



GM-Cotton regulatory approval, commercial cultivation and impact in India

GEAC approved genes/events

Commercialized

- cry1Ac/ Mon531 (2002)
- cry1Ac & cry2Ab / Mon15985 (2006)
- cry1Ac/ Event-1 (2006)
- Fused cry1Ab & cry1Ac/ GFM event (2006)

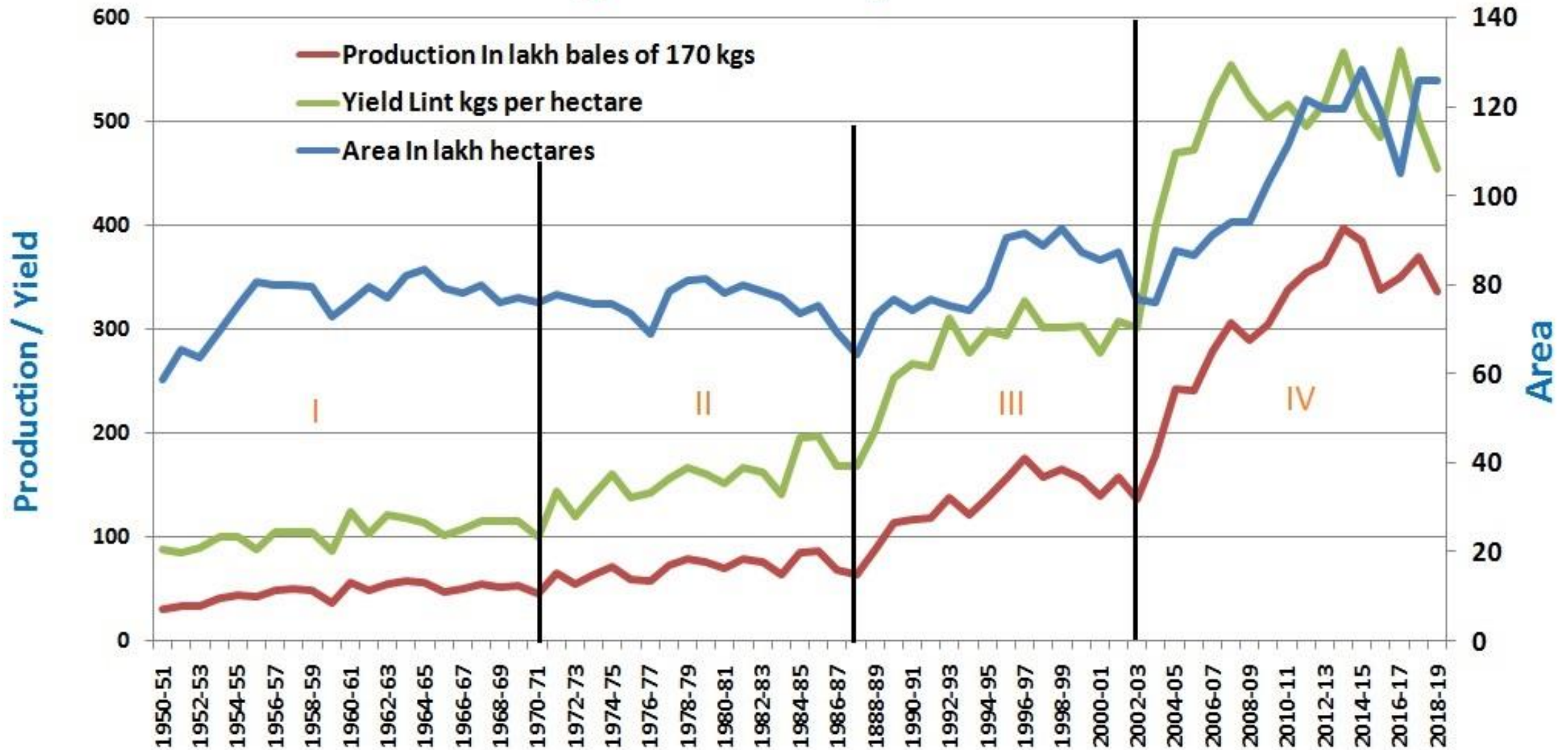
Never commercialized

- cry1C/ MLS-9124 (2009)

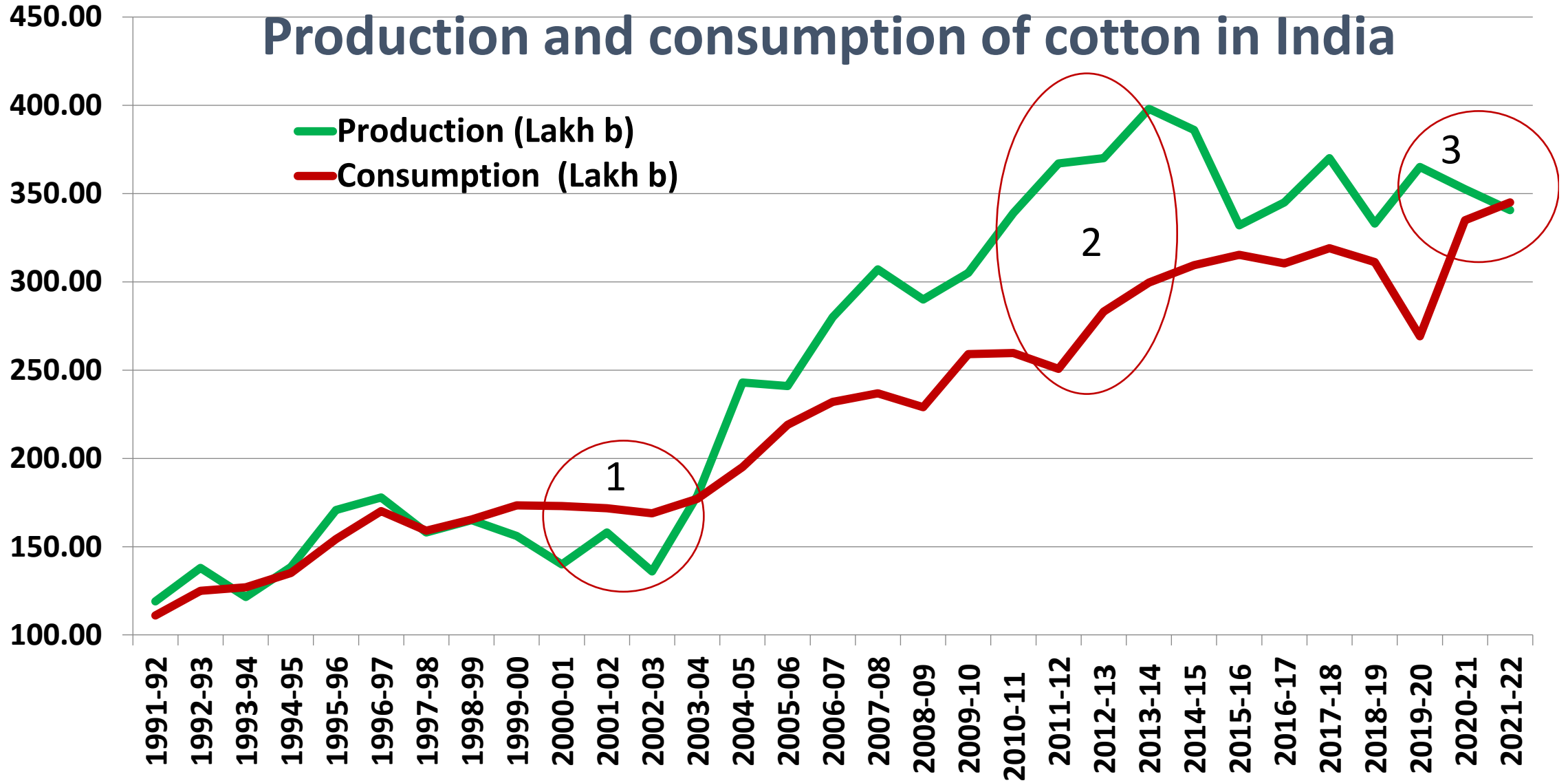
- GM-Cotton credited with both quantitative and qualitative transformation in production
- Between 2004-05 to 2013-14, cotton recorded the highest growth rate (CAGR)
 - 2.78% in area (7.6 to >12.2 m ha)
 - 4.43% in production (136 to 370 lakh bales)
 - 1.82% in yield (300 to 560 kg lint/ha)

Growth of Cotton area, production and productivity in India (since 1950-51)

Cotton area, production and yield in India

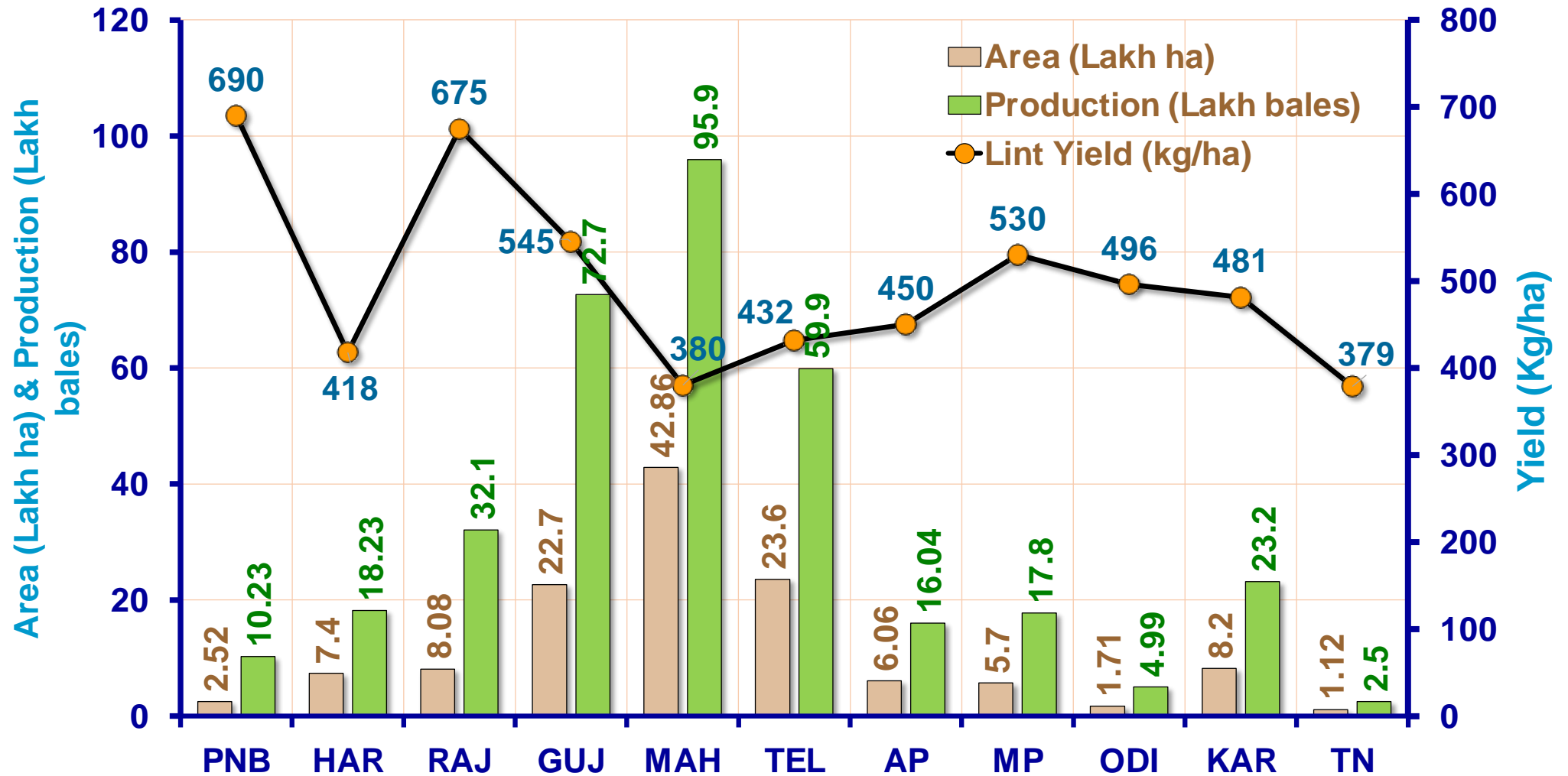


Production and consumption of cotton in India



Cotton Production Scenario

(Source: IndiaSTAT.com)



Bio-safety Regulation in India

- India ratified the Cartagena Protocol on Biosafety on 23rd January 2003 (<http://geacindia.gov.in/india-bch.aspx>)
- Rules and regulations for the stakeholders involved in recombinant DNA research formulated under the **Environment (Protection) Act (EPA) 1986.**
- **Rules 1989** issued for handling GMOs, rDNA products and hazardous organisms in December 5, 1989 “**The manufacture, use, import, export and storage of Hazardous micro-organisms genetically engineered Organisms or cells rules, 1989**” from the Ministry of Environment and Forests, Government of India.

Guidelines and Regulatory Framework in India

- **Recombinant DNA safety guidelines, 1990 Department of Biotechnology (DBT)**
- **Revised Guidelines for Safety in Biotechnology, 1994 DBT**
- **Revised guidelines for research in transgenic plants, 1998 DBT**
- **Guidelines For The Safety Assessment Of Foods Derived From Genetically Engineered (GE) Plants, 2008 DBT**
- **Protocols for Food and Feed Safety Assessment of GE crops 2008, DBT**
- **Guidelines for the Safety Assessment of Foods Derived from Genetically Engineered Plants 2008, ICMR**
- **Guidelines and Handbook for Institutional Biosafety Committees (IBSCs) DBT & BCIL 2011,**
- **Guidelines and SOPs for Confined Field Trials of Regulated Genetically Engineered (GE) Plants 2008, DBT & MoEF**
- **Regulations and Guidelines on Biosafety of Recombinant DNA Research and Biocontainment, 2017, DBT**

Competent Authorities under Rules, 1989

Advisory

Recombinant DNA Advisory Committee (RDAC of DBT)

Regulatory/ Approval Committees

Institutional Biosafety Committee (IBSC)

Review Committee on Genetic Manipulation (RCGM of DBT),

**Genetic Engineering Appraisal Committee (GEAC of
MoEF&CC)**

Monitoring

State Biotechnology Coordination Committee (SBCC)

District Level Committee (DLC)

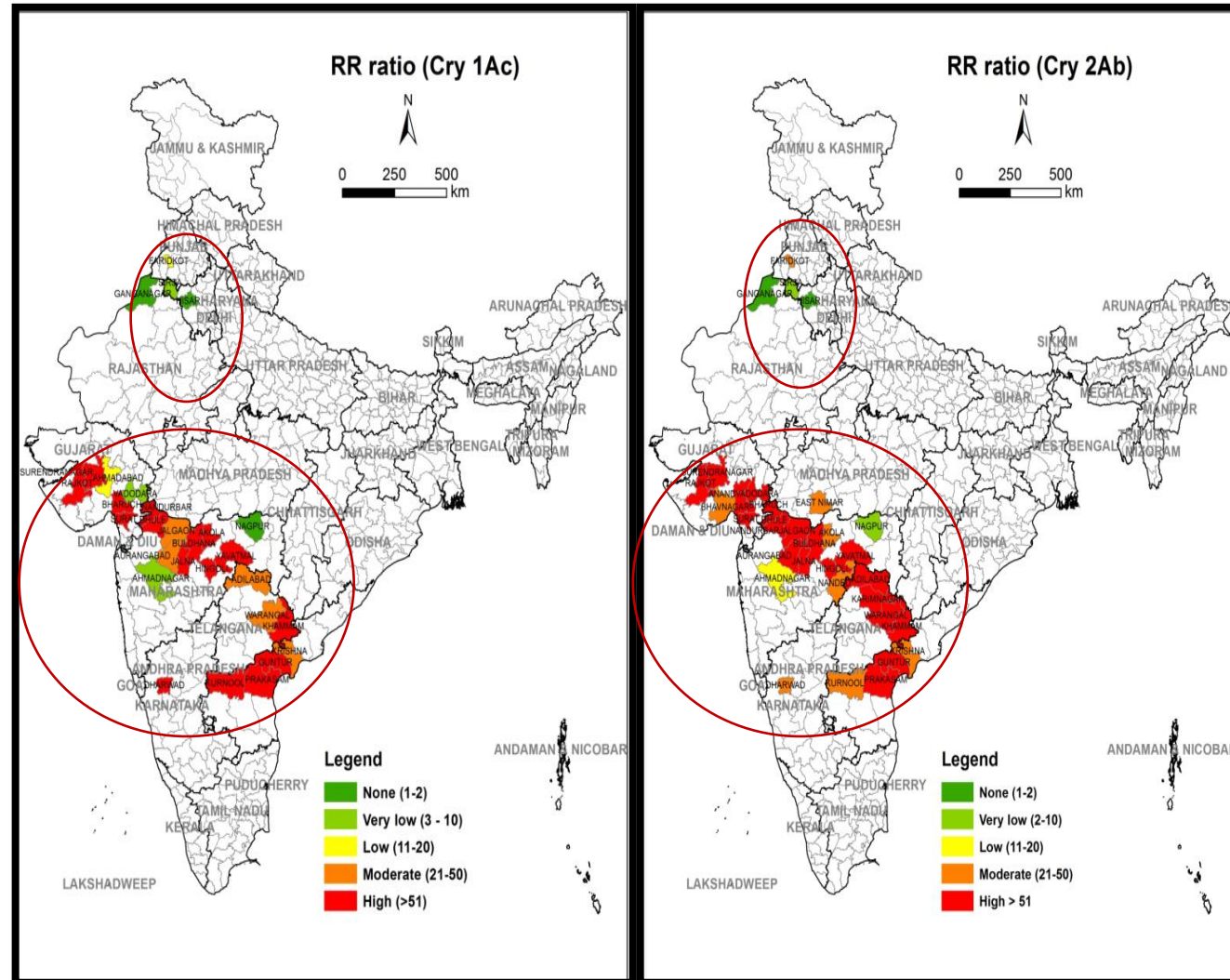
Event Based Approval Mechanism (EBAM) for Bt Cotton Hybrids by GEAC and transfer to ICAR

- EBAM mechanisms has been adopted by GEAC from 2008.
 - As per the system, the Bt cotton hybrid developed by backcrossing using deregulated events are exempted from the biosafety studies as required for new events
- Standing committee constituted by GEAC and serviced by DBT.
- Committee was involved in identification of Bt cotton hybrid/ variety suitable for specific zone based on performance data of particular hybrid over zonal check.
- From 2017 onwards, the task of identification of Bt hybrids/ variety through EBAM has been transferred to ICAR by GEAC
- Multi-location evaluation of Bt cotton hybrids/ varieties mandatory for release by Central Varietal Release Committee (CVRC) and gazette notification by government

Stewardship -management of bollworm resistance to Bt cry toxins

2002	GEAC guidelines made planting of non-Bt seeds in 20% area or 5 perimeter rows by each Bt cotton grower mandatory; separate pack of non-Bt seeds (120 g), farmers do not adopt
2006	BG-II was introduced (stacked Cry1Ac + Cry2Ab)
2009	First report of development of cry toxin resistance in pink bollworm (<i>Pectinophora gossypi</i>), pest outbreak in 2015 in Gujarat
2009	Pigeon pea (<i>Cajanus cajan</i>) approved as refugia to be cultivated in border rows around Bt cotton (GEAC- Proceeding-93)
2016	Surveys indicate inferior quality and non-isogenic version of non-Bt seed in market samples of commercial seed packets (SP) (Kranthi et al., 2017)
2016	Government notifies adoption of refugia-in-bag (single bag) concept for seed packing with non-Bt seed, later relaxes implementation till 2019 to facilitate development of iso-genic non-Bt lines by seed firms
2017	Government notified minimum standard for cry protein expression in genotypes (4 ppm for BG I and 280 ppm for BG II in leaf/square/boll)
2020	RIB adoption is mandatory for seed packing with isogenic version of non-Bt seed (5-10%) mixed along with Bt seed (gene purity 90-95%), testing protocol (work in progress)

Stewardship: monitoring of resistance development in Pink bollworm against Cry toxins



**Monitoring of Cry 1Ac and Cry 2Ab susceptibility in American bollworm,
Helicoverpa armigera populations**

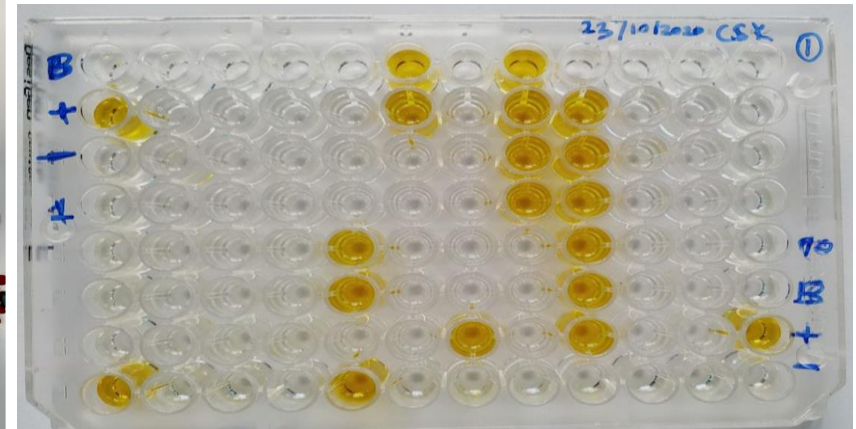
Year	Populations tested (No.)	Resistance ratio range to cry1Ac	Resistance ratio range to cry 2Ab
2017-18	17	25.6-147.0	1.9-25.2
2018-19	21	39.3-183.8	1.1-17.9
2019-20	18	45.6-184.7	2.0-12.5
2020-21	11	18.0-236.0	3.14-13.1
2021-22	19	85.0-287.0	1.95-19.2

Note: RR= LC_{50} value of test population/ LC_{50} value of lab susceptible population

Implementing **Refugia-in-bag (RIB)** Concept

Standardization of protocol for seed testing in RIB packs

- Concept is to mix non-Bt seeds with Bt seed to delay development of insect resistance
- Standardization needed for
 - Mixing of non-Bt seed at the time of packaging
 - Protocol for draw of samples from commercial seed packets from market by seed inspectors
 - Seed sample size for ELISA testing for presence of non-Bt seed within prescribed limits at seed testing labs



RIB concept: mixing, sampling and testing

Stakeholder level	Do's	Don'ts
Seed Company	<ul style="list-style-type: none"> Mix 25 g of isogenic non-Bt refugia seeds in individual packets of Bt seeds (450 g) Dispense both Bt and non-Bt seeds while packaging (recommended) 	Do not mix dissimilar non-Bt seed (phenotype, size etc)
Seed Inspector	<ul style="list-style-type: none"> Mix seed properly after drawl from RIB packet Divide into 3 parts, retain one part of seed sample, send one part to STL for testing and one part to seed company 	Do not discard seed till report cycle is completed
Seed testing lab	<ul style="list-style-type: none"> Adopt quadrant method (hand halving) for mixing and uniformity for drawing seed for testing Draw 45 seeds from each of the quadrant Draw a total of 180 seeds for ELISA testing for both genes 	Do not report failed tests without confirmation

GM Cotton - issues and prospects for sustainability

- Applications for regulatory approval for event (BG II + RRF) under consideration by GEAC
- Management of cry toxin (cry1Ac & cry2Ab) resistant populations of pink bollworm
 - Integrated crop, pest and disease management strategy
 - Area-wide management of Bt resistant populations of pink bollworm by disseminating eco-friendly mating disruption technology (approved by CIB RC)
- High density planting system with early maturing and compact Bt hybrids/varieties in about 3.8 million ha (28% area)
- Integrated crop management, focus on soil health, crop rotation and in-field crop diversity
- BMPs for productivity enhancement and climate resilience a priority in the rainfed tracts of central and southern cotton growing zones

Policy on **Genome editing** unveiled

Exemption of Genome Edited Plants Falling Under the Categories of SDN-1 and SDN-2 from the Provisions of the Biosafety Regulations in India

Ministry of Environment,
Forest and Climate Change
issued a notification on March
30, 2022 to exempt products of
SDN1 and SDN2 (free from
any transgene) from the
provisions of Rules 7 and 11
(both inclusive) of Rules,
1989.

F. No. C -12013/3/2020-CS-III
Government of India
Ministry of Environment, Forest and Climate Change
CS-III (Biosafety) Division
Indira Paryavaran Bhawan
Jor Bagh Road, Ali Ganj
New Delhi-110 003
Date:30thMarch, 2022

OFFICE MEMORANDUM

Sub: Exemption of the Genome Edited plants falling under the categories of SDN1 and SDN2 from the provisions of the Rules, 1989.

The Ministry of Environment, Forest and Climate Change has notified the rules for the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms of Cells, Rules 1989 hereinafter referred as Rule vide No. GSR 1037 (E) dated 5th December 1989, -

2. Rule 20 of the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells Rules 1989 empowers the Ministry of Environment, Forest and Climate Change to exempt an occupier handling a particular microorganism/genetically engineered organism from the application of the provisions of Rule 7 and 11 (both inclusive).

3. Department of Biotechnology, Ministry of Science and Technology; Department of Agriculture Research and Education, Ministry of Agriculture and Farmers Welfare has recommended that the SDN1 and SDN2 Genome Edited Products free from exogenous introduced DNA be exempted from biosafety assessment in pursuance of Rule 20 of the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells Rules 1989. Wherein, the process of genome edited plants to be carried out under containment, until free from exogenous introduced DNA, will be regulated by Institutional Biosafety Committee following guidelines issued by Central government under information to Review Committee on Genetic Manipulation.

-2-

4. Therefore, the Central government hereby exempts the Genome Edited plants falling the categories of SDN1 and SDN2, which are free of exogenous introduced DNA, from the provisions of Rules 7 to 11 (both inclusive) of the above said rules.

5. For such Genome edited plants to be released as new variety, further development and evaluation will be as per other applicable Laws/Acts/Rules.

6. This issues with the approval of Competent Authority.


(Naresh Pal Gangwar)
Additional Secretary
mail id: asnpg.mefcc@gov.in

To

1. Secretary, Deptt. of Biotechnology
2. Secretary, Deptt. of Agriculture & Farmers Welfare
3. Secretary, Deptt. of Agriculture Research & Education
4. Chief Secretary (All States/UTs)

Copy to:

1. PPS to Cabinet Secretary
2. PPS to Secretary, MoEFCC

Thank you