



Organic Cotton Breeding Opportunities and Challenges

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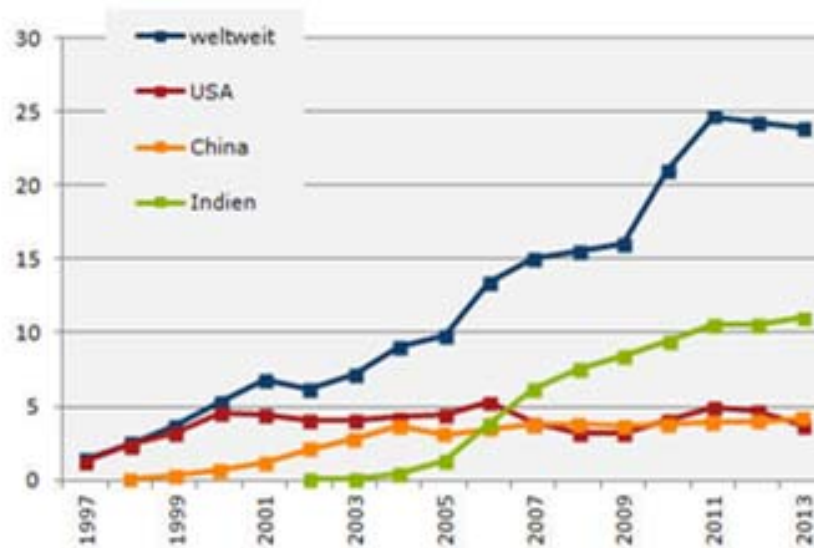
Meeting Point Organic right from the start! biofach Messe Nürnberg organic breeding
exhibition

Nürnberg, 16th February 2018

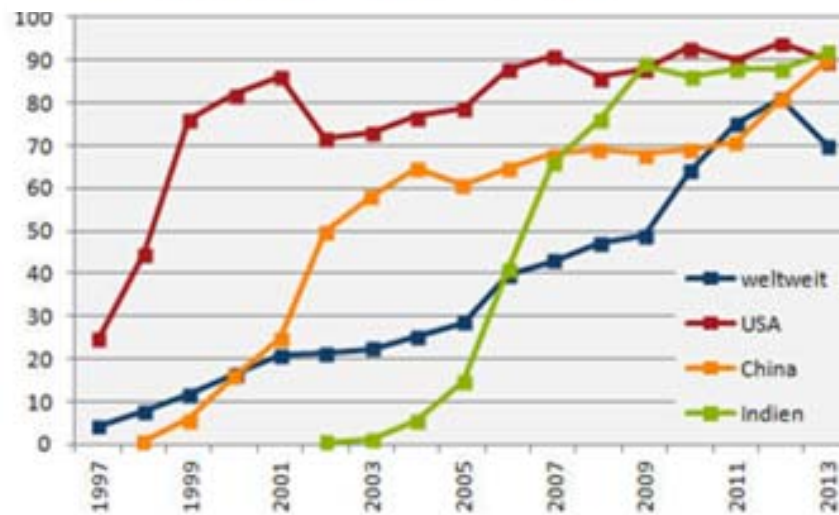
Challenges organic cotton in India

- India has been the largest organic cotton producer, 10 years ago India supplied 80% but dropped now to 56%, with a decrease of 20% from 2014/15 to 2015/16!!!
- Organic cotton in India is less than 2%, while genetically modified Bt cotton reached 95% in less than 10 years
- Public breeding and seed multiplication were neglected
- Local non-GM seed supply were eroded
- Commercial seed companies have limited interest in non GM cotton (higher production risks, risk of Bt contamination, small demand)
- High dependency on global seed company holding Bt licence resulting in high seed price and concentration on high input agriculture (high level of fertilizer, pesticide, irrigation)
- Breeder's seed is already contaminated with Bt, causing Bt contamination throughout the cotton value chain

Area under GMO cotton of main producing countries



Anbauflächen gv-Baumwolle in Millionen Hektar



Anteil gv-Baumwolle an der Anbaufläche eines Landes in Prozent

Challenges of Organic Cotton in India

Reduced interest of farmers to grow organic cotton:

- Reduced yield & longer picking periods compared to Bt cotton
 - Improvement of organic cotton cultivation (composting, irrigation, systemic plant protection, resilient cultivars)
 - Market development for other crops in cotton rotation
- Other labels like BCI are more attractive, easier to achieve
- Other crops become more attractive (market price, time till sale, risk of contamination, availability of seed in time)

Competition with other labels like BCI (Better Cotton Initiative) introduced in 2010

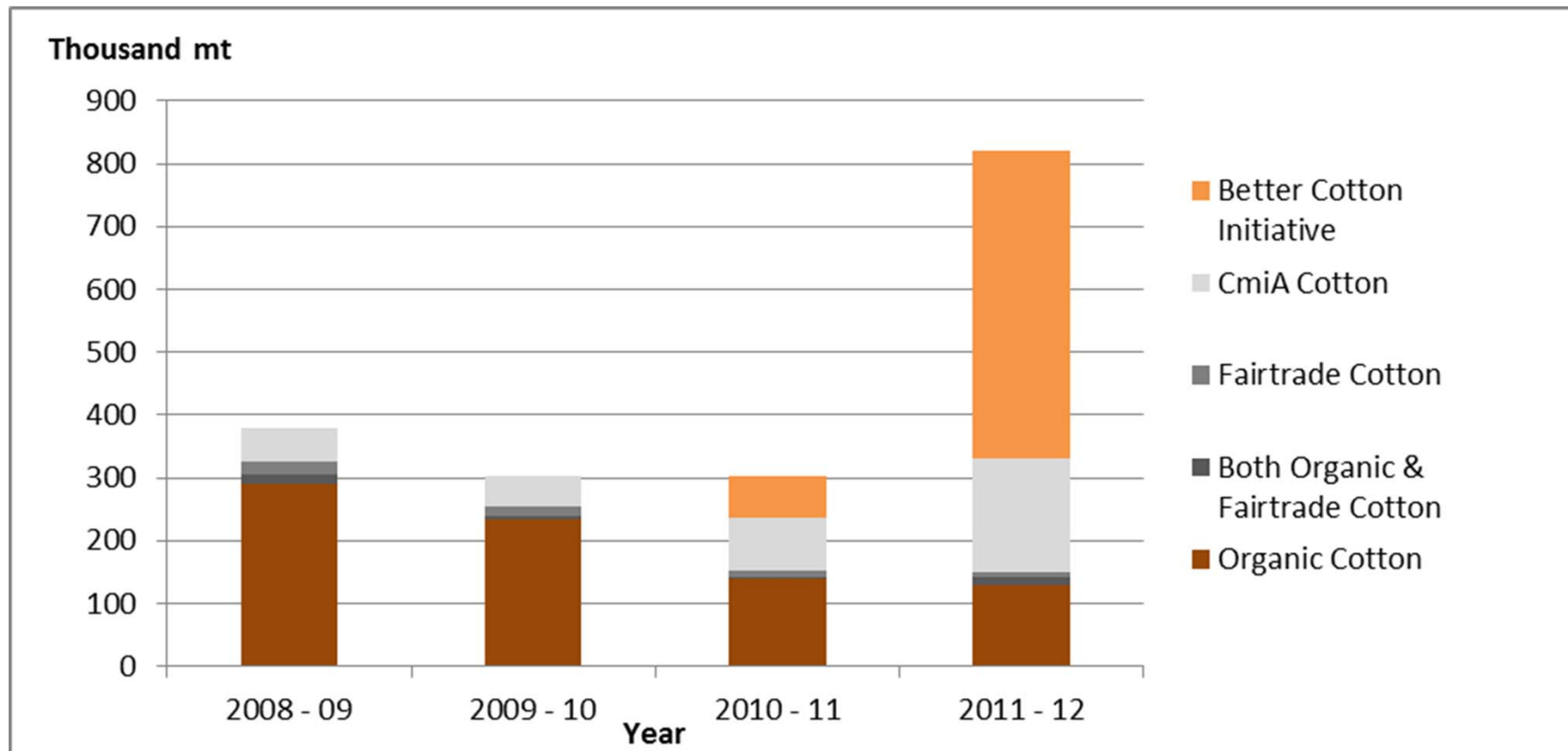
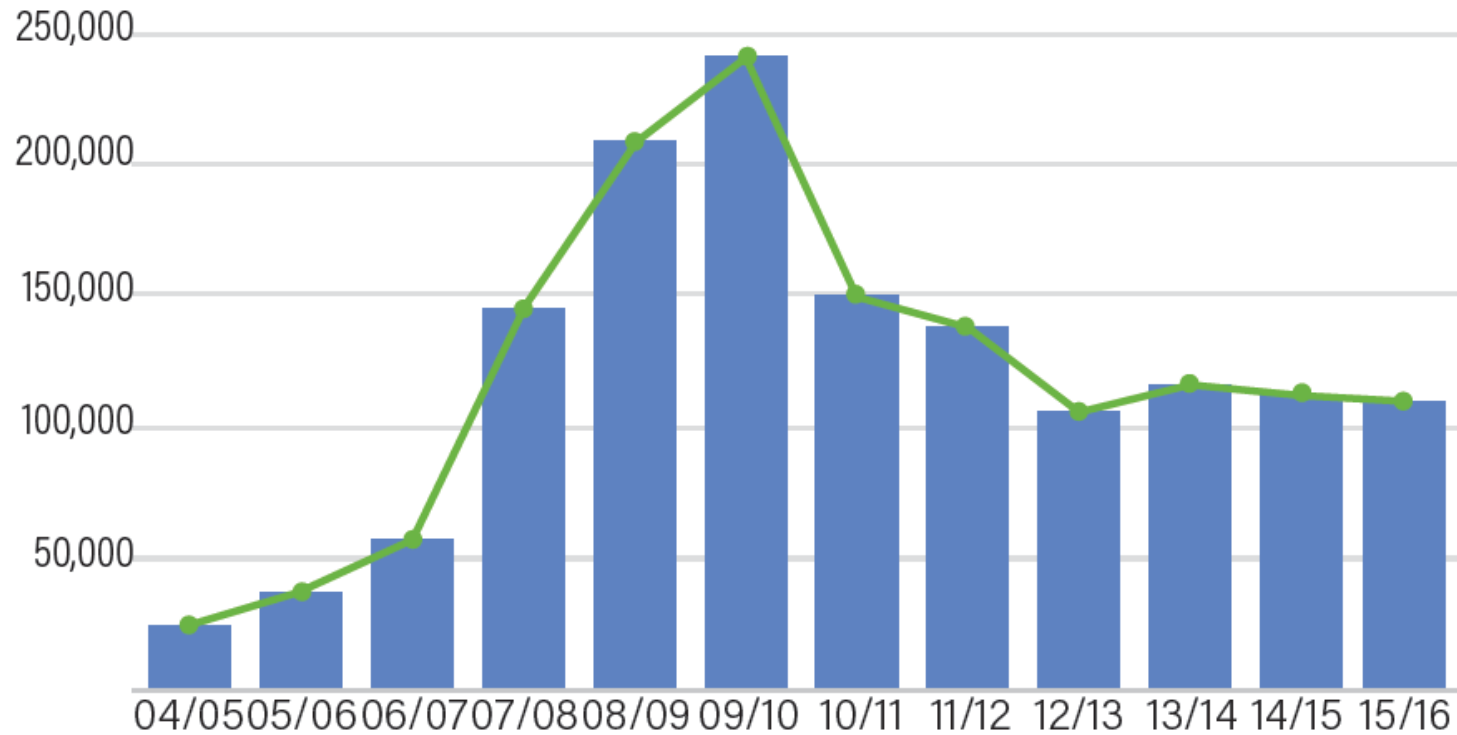


Figure 1: Sales of different sustainable cotton labels, source Warrik (2013)

Organic Cotton Production on global level

Global Fiber Production Trend (MT)



Textile Exchange: Organic Cotton Market Report 2017

Cultivated cotton species in India

Gossypium hirsutum

Upland cotton
tetraploid



Gossypium barbadense

Pima /
Egyptian cotton
tetraploid



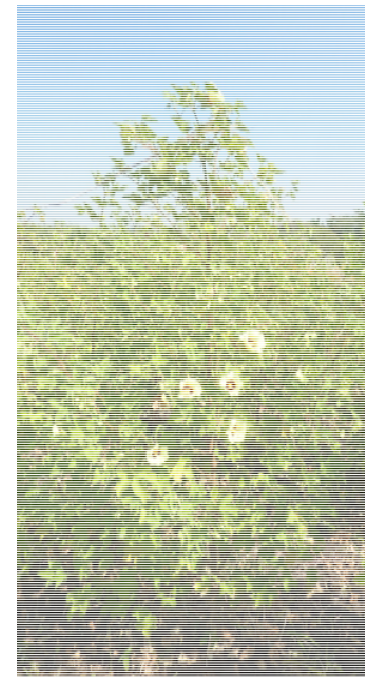
Gossypium arboreum

Desi cotton
diploid

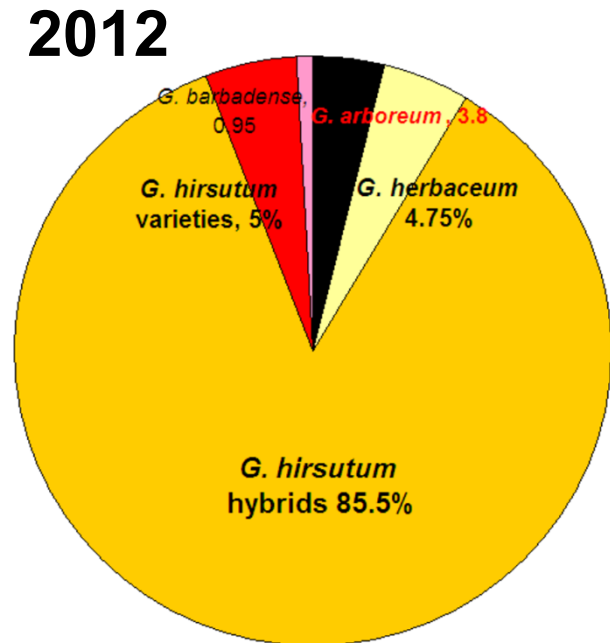
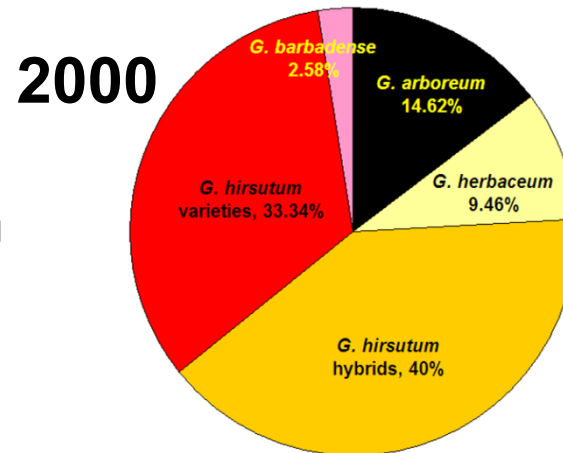
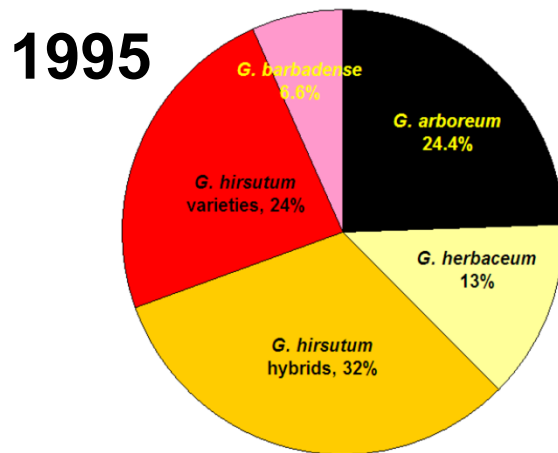
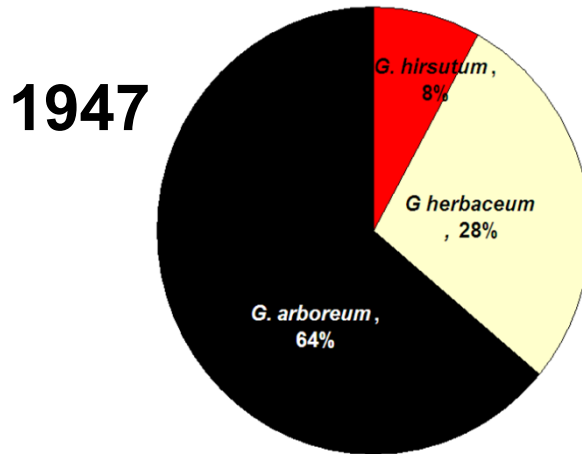
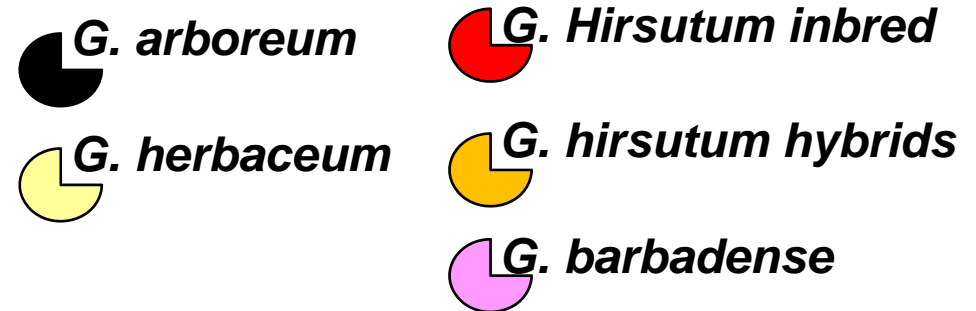


Gossypium herbaceum

Desi cotton
diploid



Change of cultivation area in different cotton species in the last decades in India



Prof. Dr. R. W. Bharud, Mahatma Phuke Agricultural University Rahuri, MA
All Indian Cotton Improvement Project

First Steps: The Dharwad Declaration

National Workshop June 21st 2011: «Disappearing non-GM cotton - ways forward to maintain diversity, increase availability and ensure quality of non-GM cotton seed» Dharwar Declaration

Jointly organized by bioRe India Ltd., FiBL Switzerland, University of Agricultural Sciences Dharwad including main stakeholders

To combine forces for immediate action and support of:

- Collaboration & Exchange, e.g. private public partnership
- Desired Policy Changes, e.g. establishing GM-free zones
- Evaluation and multiplication of existing cotton cultivars under organic and low-input conditions
- Establishing and optimizing the non-GM seed chain
- Continuous improvement of non-GM cultivars



How can organic cotton be safeguarded in India?

Shortterm action: Secure seed supply

- Establish Networks with public and private cotton stakeholders that share the same interests (Dharwad declaration)
- Training & Capacity building of organic cotton growers in on farm cultivar testing and seed multiplication
- On-Station and On-Farm Cultivar Testing together with Farmers for suitability of cultivars under diverse local smallholders' organic growing conditions

Mid- and longterm action: Improve cotton cultivars adapted to organic farming

- Collection and utilization of the full Diversity of the cotton germplasm, especially the more robust endemic Desi cotton (*G. arboreum*) and adapted *G. hirsutum* inbred varieties & public hybrids
- Establishing decentralized participatory cotton breeding programs focusing on the growing conditions of organic cotton producers

→ Farmers regain Seed Sovereignty of high quality cotton germplasm



GREEN COTTON

Decentralized Participatory Cotton Breeding for Organic and Marginal Growing Conditions in India

In collaboration with Partner Organisations:

- bioRe Association
- Chetna Organic
- University of Agricultural Science Dharwad

Timeframe: 2013 – 2016 (option for prolongation)

Supported by Mercator Foundation Switzerland



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Goals and Objectives of Green Cotton

- › **Safeguarding the future seed supply of non-GM cotton crucial for the organic cotton production and textile industry**
 - › Improving yield stability & fibre quality and adaptation to local growing conditions by decentralized selection on non GM cotton in the target environment

- › **Promoting genetic diversity in the field with special focus on the utilization of tradition Desi cotton germplasm to get prepared for climate change**
 - › Performing specific crosses with desi cotton for organic and marginal growing conditions

- › **Enabling farmers and farmer organisations to retain seed sovereignty to become more independent from high input costs**
 - › Initiation of participatory breeding involving farmers in selection
 - › Training of farmers → certified farmer breeders for selection & seed propagation

bioRe

Organic cotton
cooperation
in Madhya Pradesh
&

Chetna Organic

Organic cotton
producer cooperation
in Orisha
&

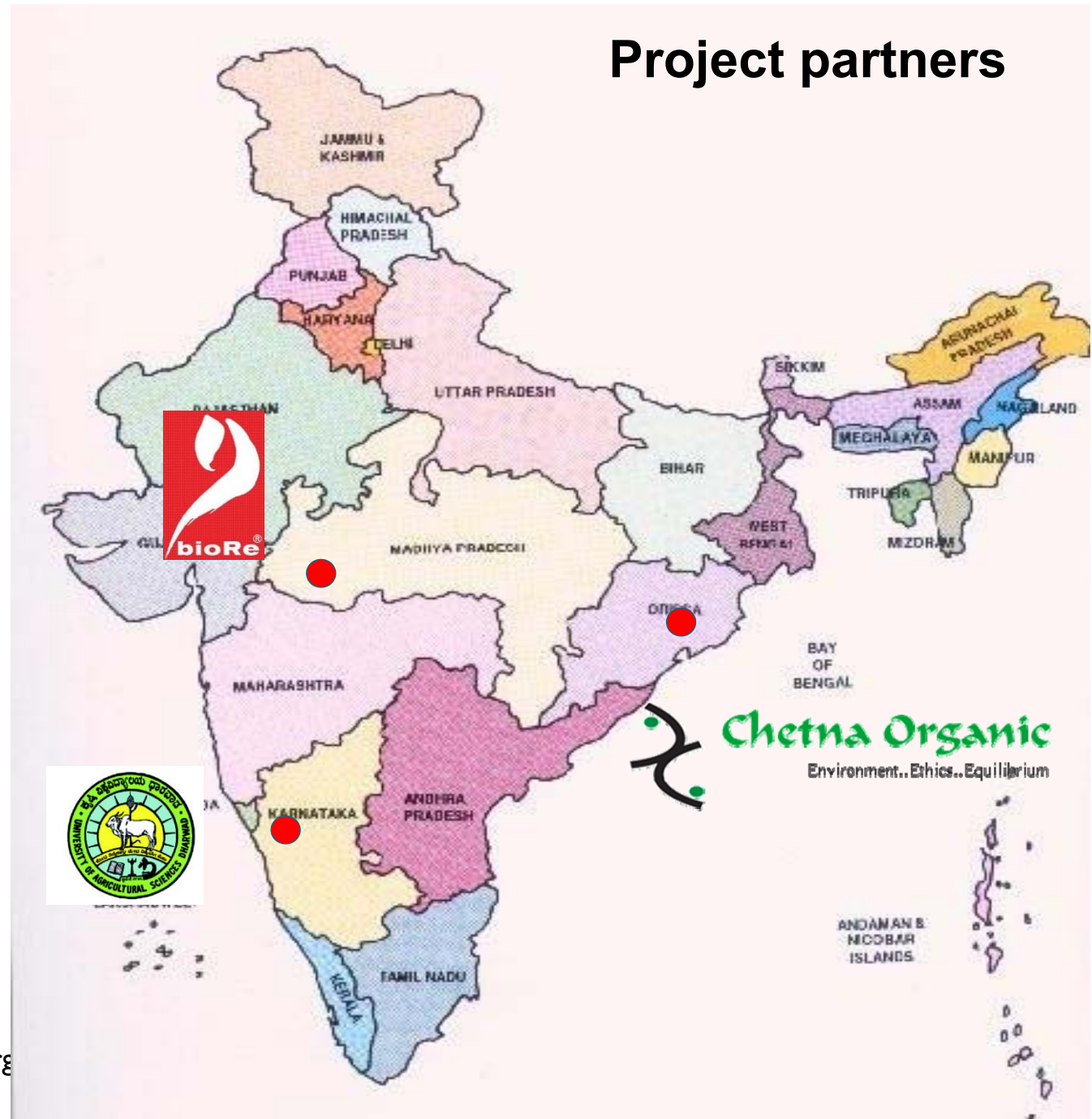
University of Agricultural Science (UAS) Dharwad

in Karnataka
&
FiBL

FiBL

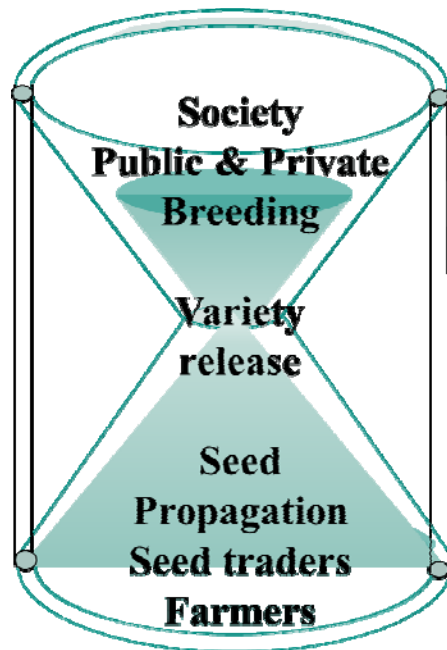
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Project partners



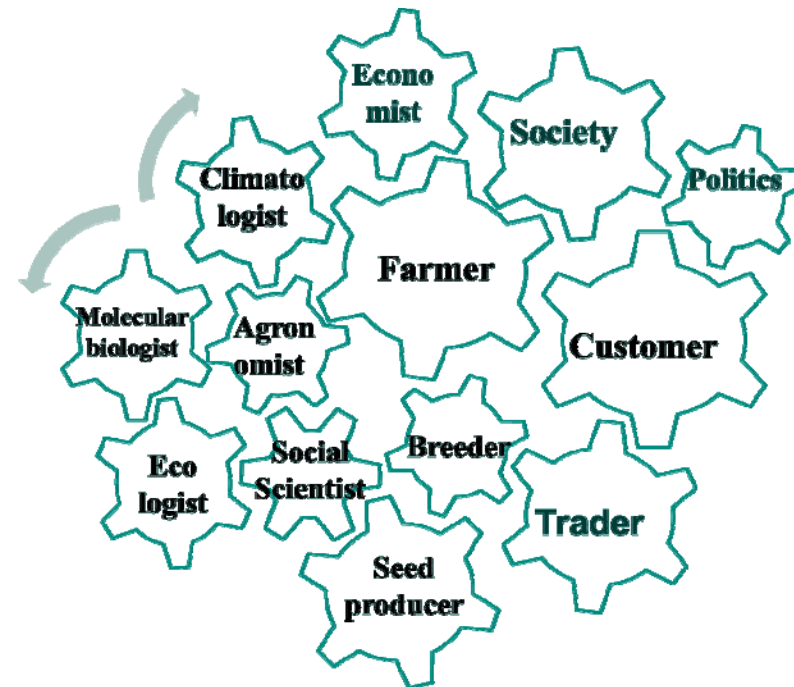
Participatory Cultivar Evaluation and Participatory Breeding as a viable Alternative to Seed Monopoly

Formal plant breeding and seed supply



**One Way
Information:
Scientist**
↓
**Extension
Service**
↓
Farmer

Participatory plant breeding and seed multiplication



Capacity buiding



Involve farmers in selection criteria, cultivar testing & selection, breeding activity

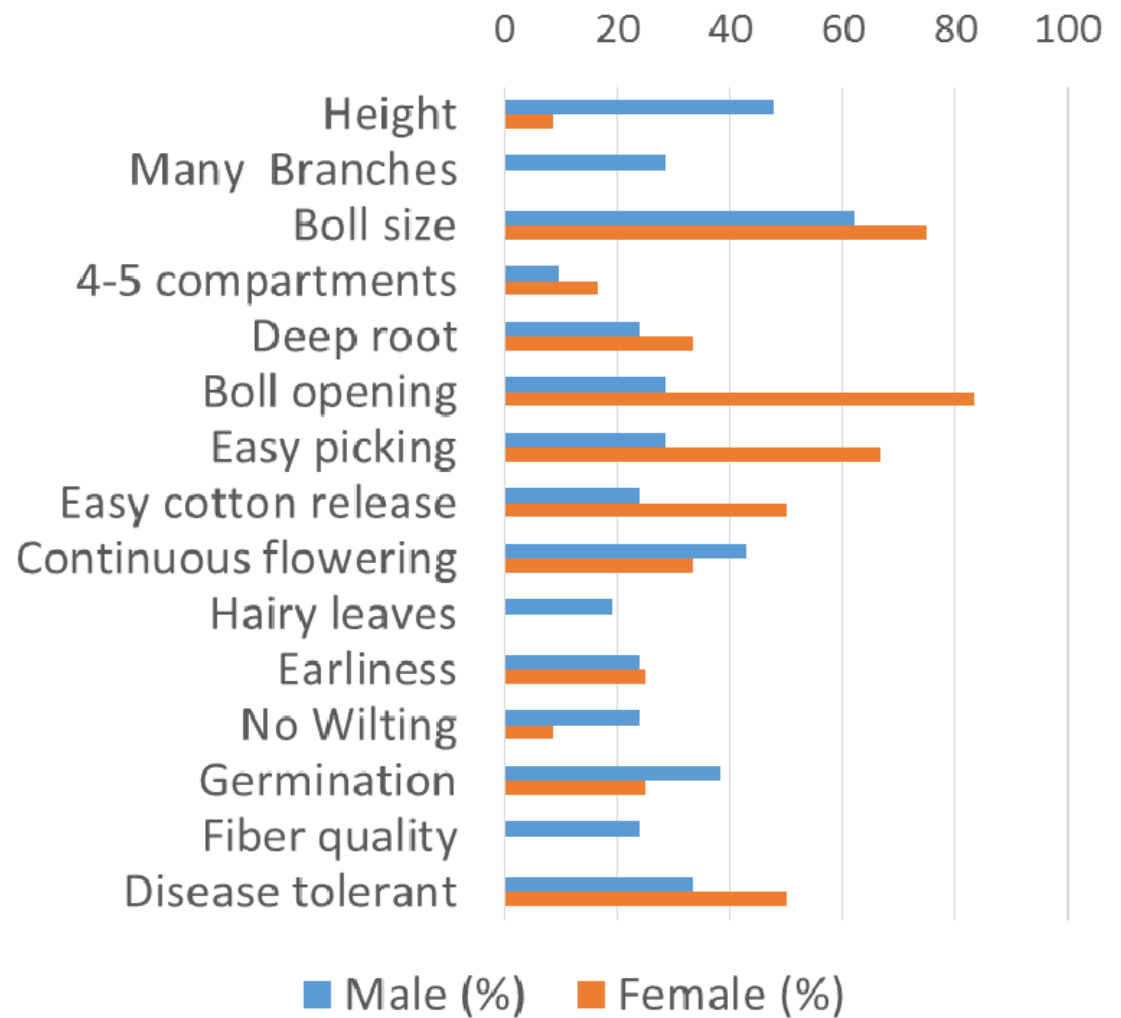
Cultivar selection



Single plant selection



Priority of Traits for Farmers



New crosses of *G. arboreum*

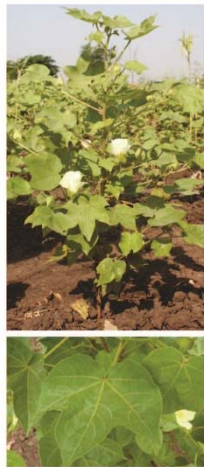


Fig. 1 *G. hirsutum*
4x hybrid



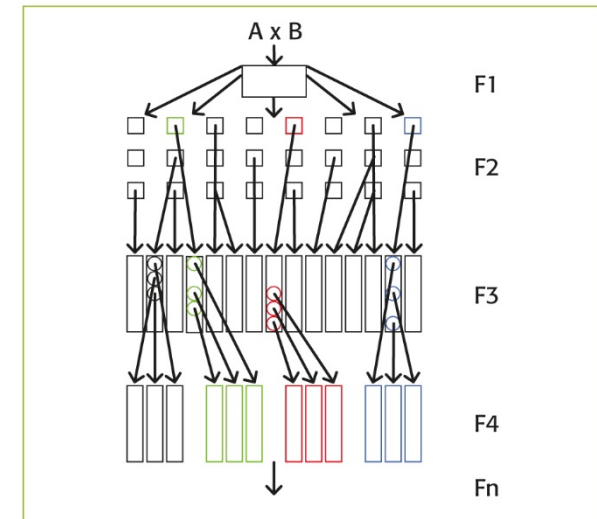
Fig. 2 *G. hirsutum* x
barbadense 4x hybrid



Fig. 3 *G. arboreum*
2x varietal line



Phänotypische Selektion im Feld



Collection of desi cotton *G. arboreum*

2013

Intra crosses & multiplication of offspring

2013/14

Single plant selection in F2

2014/15

Single plant selection in F3

2015/16

Single plant selection in F4

2016/17

testing of best lines for yield & fiber quality

2017/18

Selection of locally adapted advanced lines

Observation trials of advanced breeding lines of *G. hirsutum*, *G. arboreum* at Kasrawad by BioRe

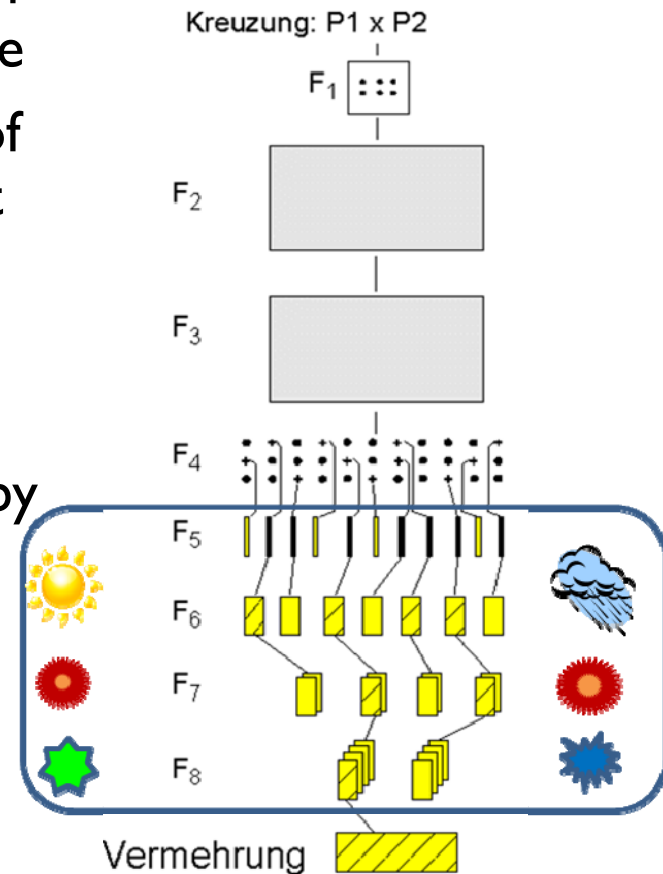
Observation trials of advanced breeding lines of *G. hirsutum*, *G. arboreum* and *G. barbadense* at Odisha by Chetna organic

Selection of best lines for further evaluation in the following years

On station trails at several locations managed by breeder at each region

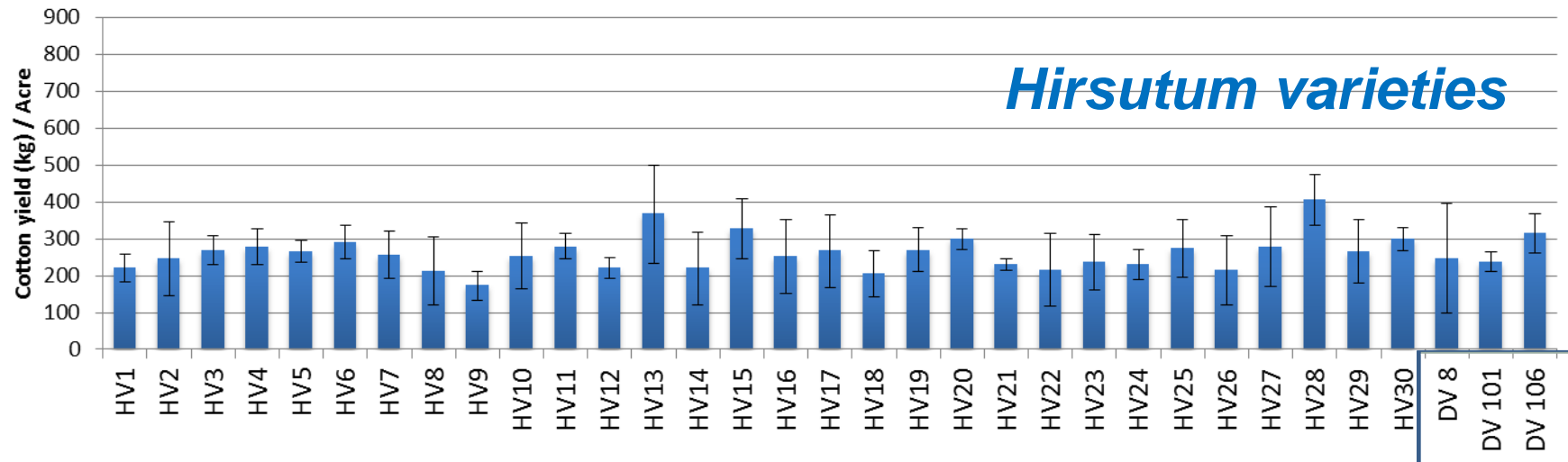
On farm trials managed by instructed farmers

Pilot cultivation of best selections

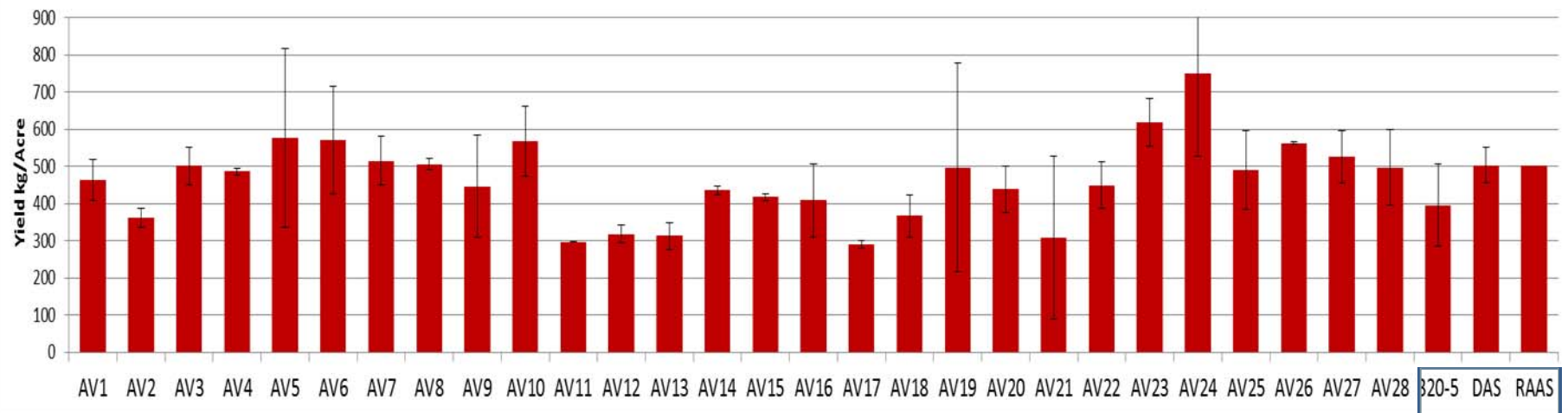


Madhya Pradesh Light Soil Trial rainfed 2013/14

GCP LST Hirsutum 2013/14 (Rep. I&II) Cotton yield (kg) / Acre



GCP LST (R-I&II) Cotton yield (kg) / Acre *Arboreum varieties*



Arboreum Cotton

- Later and longer fruiting
- Tall and branching plants, hanging capsules, opening often not sufficient, more difficult picking
- Only 3-4 compartments per capsule, hirsutum has 4-5
- Seed weight is less, and therefore less attractive for farmers as they are paid per kg seed cotton (more profitable for ginners due to higher ginning out turn)
- In general less capsules can be collected per hour, therefore workers prefer hirsutum cotton to pick (higher salary per day)



> seed price of Ambika 12 6000 Rps/kg
of Arb. varieties 100 Rps/kg

> adjust plant spacing to soil type
to culture

> HST: HV > HH ≥ HV
> ST: HV > HH ≥ HV ↙ only half of yield
↳ reduce spacing of hybrids in light soil

> Arb Saha 113 easy picking like hybrid Ambika 12
↳ silanom cutworm tolerant

> 3205 good picking

> extension can organise field trials
with larger area 50-100 rows



Plan for conservation - multiplication

Village : Bhimdonga

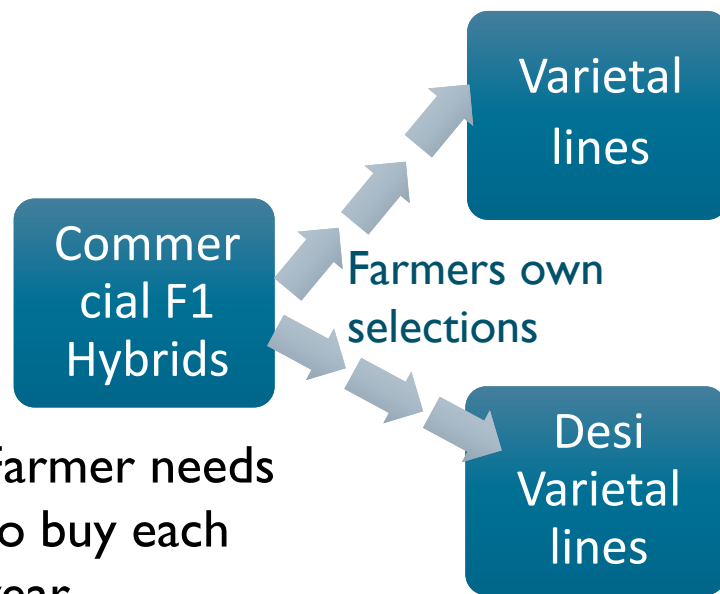
Manikeswari group

Ma lakmi seed bank

Farmer name	Low land	Low land conservation	Multipli cation	Up land	Upland conservation	Multipli cation
Deepu	1	2 rows 5 var paddy	0.1 acr 2 var paddy	2	10 var millets	0.2 acre 2 var redgram
Dhano	2	2 rows 10 var paddy	1 acr 5var paddy	2	1 Var of upland crops like oils seeds, cotton	1 var cotton seed multipl



Farmers own seed



Farmer needs to buy each year

Chetna Cooperatives & Seed banks
Procure 400 kg of varietal seed cotton & gin

200 kg of locally suitable varieties stocked for 100 certified organic farmers.

Farmers can use their farm saved seed



Pondur Hill cotton value chain to create income

- 100 % Handmade cotton value chain of traditional cotton, white and coloured cotton
- Farmer gets yield of 4-5 q/acre with inter crops like pulses
- Farmer sells the cotton for 2500 Rps /quintal
- Gin & Spin – by hand make one hank earn 100 Rps /day
- Weaver few metres – 100 Rps /day



Conclusions

Organic Sector has to take responsibility for its own seed supply and breeding need to be done under organic conditions

Priorities for optimal traits are quite different between breeders, farmers, also between female vs. male farmers, and the textile industry, to be successful ALL aspects must be considered

Under low fertility and rainfed conditions traditional *G. arboreum* have much higher yield than *G. hirsutum*. Introgression lines of *G. arboreum* can meet good fiber quality, but picking time is increased. Inbred lines can outyield hybrids under less favorable conditions.

A broad range of genotypes is needed to cover the different growing systems and pedoclimatic conditions & demands of textile industry. Breeding is indispensable to cope with climate change and new pest & diseases evolving

Cultivation (e.g. plant density) need to be adjusted to each cultivar, therefore breeding must go hand in hand with improvement of plant management and anticipated future trends like mechanical harvest

A global marketing strategy to communicate added value of organic cotton is needed!!!!

Seeding the Green Future

Local partners

Organic cotton growers organisations:

- **Chetna Organic**: involved in Green Cotton participatory breeding since 2013
- **Pratibha Synthex**: started with on station breeding
- **Cotton Connect**: link to many organic growers associations
- **ASA**: hosting the Organic and Fair Cotton Secretariat focused on MP

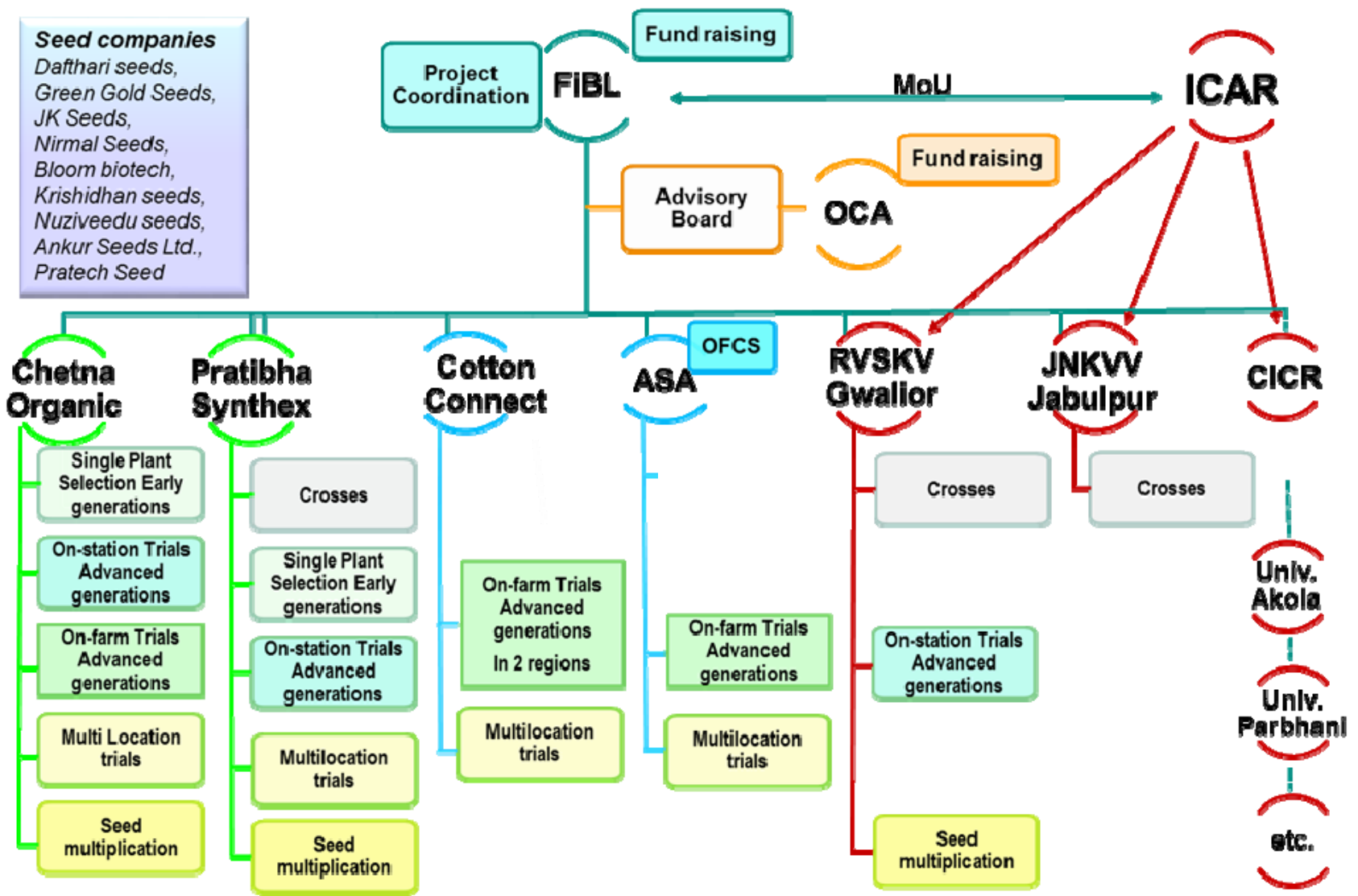
Public institutions and universities:

- **RVSKV Gwalior university – Khandwa College**: testing for truthfully labeled seed under organic conditions, seed multiplication, crosses

Commercial seed companies providing non GM seed on contract basis: Dafthari seeds, Green Gold Seeds, JK Seeds, Nirmal Seeds, Bloom biotech, Krishidhan seeds, Nuziveedu seeds, Ankur Seeds Ltd, etc.

Seeding the Green Future

Project Governance



Importance of International Cooperation

Textile Exchange:

- annual Organic Cotton Market Report
- established 2012 Organic Cotton Round Table
- with annual meetings the task force Seed & Soils



Organic Cotton Accelerator:

Pooling resources of international textile brands to support

- cotton breeding projects in India
- develop business models and sourcing practices that secure the integrity of organic cotton supply chain





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Research Institute of Organic Agriculture

EXCELLENCE FOR SUSTAINABILITY

Research Institute of Organic Agriculture
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«Seeding the Green Future»

Participatory breeding for Securing Organic Cotton and Genetic Diversity

Phase I: January 2017 till March 2018

Amritbir Riar & Monika Messmer

amritbir.riar@fibl.org ; monika.messmer@fibl.org



1.4.2017 Kick-off Meeting Bhopal



Jointly organized by Textile Exchange OCRT Seed & Soils Task Force
&

FiBL as integral part of the breeding project

With the kind support of

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GREEN COTTON

FiBL

www.fibl.org

Monika.Messmer@fibl.org

Hamburg 7th October 2016

Linking Seed & Breeding Initiatives on global scale

- Capacity building to empower organic farmer organisations
- Sharing of information, knowledge, practices, testing protocols
- common R&D projects
- Status quo analysis of available species and cultivars
- Focus on biodiversity and adaptation to climate change
- Exchange of seeds: among partners, between countries? Open source seeds, farmer owned seeds
- Maintenance breeding with quality system to avoid GMO contamination
- Scholarship, Training, institutional exchange
- Political lobbying for organic cultivar testing
- Linking stakeholders, partner recruitment
- Develop business plan for breeding and seed production
- Common fundraising to approach different brands, Crowd funding

FiBL's mission

- Promote and improve the organic sector in India and beyond
- Improve availability of high quality organic cotton seed
- Enable farmers to select cultivars adapted to their local situation
- Enable long term participative cotton breeding programs to promote performance and resilience of cotton adapted to climatic change (flooding, drought, new pest pressure)
- As breeding is a continuous task and needs minimum 10 year from the first cross to the final cultivar we need to join forces to combat the monopoly we observe in the seed and pesticide sector



**Thanks a lot for your attention and
to all who have supported
the cotton seed projects so far**



For more information:
www.greencotton.org



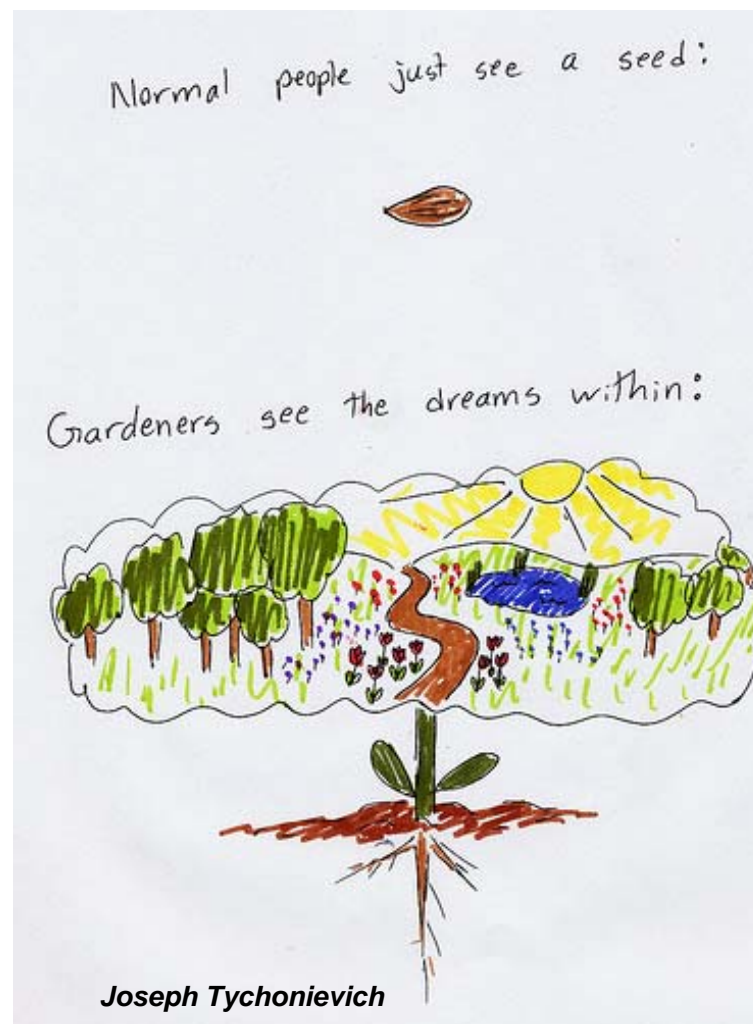
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MOTION M61 (2017) Organic Textiles: Fibre Production and Processing to be Covered by Appropriate Standards

Textiles advertised/labelled 'organic' and made with organic fibres produced according to recognized standards (e.g. IFOAM Family of Standards), should also be processed to a standard (endorsed by IFOAM - Organics International) that prohibits hazardous and residual inputs according to a clear procedure.

IFOAM acknowledges that such standards should cover the whole supply chain (as is the case with food). Stating the organic fibre content ("contains X% organic cotton"), e.g. through the Organic Content Standard by Textile Exchange, is a relevant step.

IFOAM will communicate this to stakeholders and engage with them for the widespread adoption of a whole-chain-approach (chain of custody) to labelling organic textile products

