Seed Security among Organic Cotton Farmers in South India

Supervised by:

Prof. Dr. Volker Hoffmann
Stuttgart-Hohenheim, Germany
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Summary

In the last two years, India has become the top organic cotton producer in the world and the number of organic cotton projects has been continuously increasing throughout the country. At the same time, by 2010, 80% of the country’s cotton areas are covered with genetically modified (GM) cotton. The most burning issue for organic projects has become the supply of non-GM seeds for farmers, since both the private and the public sector has given up the production of non-GM cotton seeds and transgenic seeds are forbidden to be used in organic agriculture all over the world. Under such circumstances, the number of years for organic cotton projects is counted.

The present research has aimed at finding out how is the situation of seed supply in the two largest cotton producing states of South India and to understand that in case of limited access and/or availability of seeds, how seed security could be ‘reclaimed’ and ensured for organic cotton farmers for the long-term.

Nine organic cotton projects have been identified in Karnataka and Andhra Pradesh, all of which were visited. Questionnaires were prepared for the project coordinators to find out details of their cotton production, seed procurement, and about concerns and future plans of each and every project. Besides, semi-structured interviews were carried out with about 45 farmers from these projects, as well as group discussions in few villages with the presence of both GM and organic farmers. Furthermore, semi-structured and structured interviews were completed with several NGOs, representatives of private seed companies, agriculture departments, universities, research institutes, state seed corporations as well as a national public institute to understand the causes behind the scarcity of non-Bt (Bacillus thuringiensis) seeds, and to try to offer recommendations for the step-out of the present crisis path for organic cotton projects.

The qualitative data gathered during the research has enabled an understanding of the perception of organic farmers and project leaders regarding the problems around seed supply. It has helped to identify all relevant actors in the cotton seed supply and the measures that are currently under implementation. It has further helped to point out the weaknesses and understand which strategies could potentially benefit organic cotton projects on the long run.

Seed security entails both the dimension of access and of availability and requires a well balanced stable seed system for the distribution of seeds. Without these aspects, seed insecurity arises. To determine whether seed security exists among organic cotton projects in South India, first of all, it is necessary to understand how the cotton seed sector is built up, which actors are present in the public, private and civil sectors in the two states (Chapter 3). Secondly, the availability of non-Bt cotton variety and hybrid seeds has to be researched to get a clearer view on the status quo of seed supply (Chapter 4). Only after having understood the role of main actors and which seeds they are currently providing for does the study present the nine organic cotton projects and the results on their actual use of cotton seeds in the two states of South India (Chapter 5).

The results of the study have indicated that open-pollinating varieties are still present in Karnataka, whereas they are completely absent in Andhra Pradesh. Non-Bt hybrids have only been available from one public institution in Karnataka, whereas in Andhra Pradesh...
one private company could supply non-Bt seeds. Both these sources have stopped producing non-Bt seeds and only sell seeds to organic projects from old stock. None of them have an interest in continuing supplying these seeds, since the market is almost completely dominated by Bt seeds.

Six projects were analysed in mainly two districts of Karnataka: organic cotton has been produced on about 3240 acres (1310 ha) by about 1210 farmers in 2009/10. Three of the projects have relied on the yearly purchase of non-Bt hybrid seeds (DCH-32) from the Karnataka State Seed Corporation, two others have been using an old, local variety called Jayadhar since many years, and one has its own organic seed production programme with a variety called Surabhi. The three projects found in Andhra Pradesh have covered an area of about 26 100 acres (10 523 ha) and involved 11 776 farmers in the 2009/10 growing season. They have all relied on non-Bt hybrid seeds exclusively from one private source: Nuziveedu Seeds Pvt Ltd, except for one of the projects, which also purchased seeds from a public source from Maharashtra.

Overall, both the missing public sector and overwhelming presence of private sector in Andhra Pradesh, and the absence of public and private sector in Karnataka leads to seed insecurity (Chapter 6). Although the seed insecure situation has been manifested itself in the two states to different degrees (less severe in Karnataka due to a still active civil sector) by 2009/10, the possibility still exists to reverse this to a stable, seed secure status and thereby continue the organic cultivation of this fibre crop. However, not with the existing seed systems (i.e. dominance of private companies, ignorance of public sphere and unorganised civil sector) and not more than few years is left to save the organic cotton sector.

Seed insecurity is further exacerbated by the fact that genetic and physical contamination of organic cotton from GM cotton poses a continuous risk. Several measures are used by organic cotton projects to prevent contamination, consisting mostly of cultural measures like buffer zones, crop rotations and isolation distances (Chapter 7). Yet one of the most problematic issues for farmers is the fulfillment of the isolation distance requirement (50-100 m) prescribed by cotton projects between Bt and organic cotton fields: very often this is not realistic due to the overwhelming presence of Bt fields and the small acreages of plots.

While organic project leaders consider the unavailability of non-GM seeds the most important current problem related to seeds, own seed production is viewed to be the best way out of seed insecurity. Several projects have taken some steps towards this direction to ensure a stable supply of sufficient quantity, quality seeds. Measures have to be taken at three levels: seed production level (e.g. take control of seed production); cotton production level (e.g. no organic cotton growing if Bt neighbours are unavoidable, buffer zone of 3-5 rows, isolation distance of at least 50-100 m); and processing level (separate ginning for organic cotton; segregate transport and storage between GM and organic cotton). At the current political situation, when the government has not yet shown much interest in stepping in the seed supply crisis and ensure that India’s current status as the top organic cotton producer in the world is not undermined by further scandals, organic projects have to rely on grassroots’ level efforts such as participatory plant breeding and NGO-promoted seed production as the only way forward to reclaim seed sovereignty and ensure the integrity of organic cotton production.
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1 hectare (ha) = 2.48 acres (a);
1 quintal (q) = 100 kg; 1 lot = 17 000 kg;
1 Euro = 68.79 Rs (as of November 2009 – oanda.com);
1 lakh = 100 000; 1 crore =10 million
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<tr>
<td>APEDA</td>
<td>Agricultural and Processed Food Products Export Development Authority</td>
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<tr>
<td>APSDA</td>
<td>Andhra Pradesh State Department of Agriculture</td>
</tr>
<tr>
<td>APSSDC</td>
<td>Andhra Pradesh State Seed Development Corporation</td>
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<tr>
<td>Bt</td>
<td>Bacillus thuringiensis</td>
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<td>CB</td>
<td>Certification Body</td>
</tr>
<tr>
<td>CICR</td>
<td>Central Institute of Cotton Research, Nagpur</td>
</tr>
<tr>
<td>CRC</td>
<td>Cotton Research Centre, Hebbali</td>
</tr>
<tr>
<td>CSA</td>
<td>Central for Sustainable Agriculture, Hyderabad</td>
</tr>
<tr>
<td>DCD</td>
<td>Directorate of Cotton Development, Mumbai</td>
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<tr>
<td>GEAC</td>
<td>Genetic Engineering Approval Committee</td>
</tr>
<tr>
<td>GM(O)</td>
<td>Genetically Modified (Organisms)</td>
</tr>
<tr>
<td>GOTS</td>
<td>Global Organic Textile Standard</td>
</tr>
<tr>
<td>IC</td>
<td>In-conversion</td>
</tr>
<tr>
<td>ICRA</td>
<td>Institute of Cultural Research and Action</td>
</tr>
<tr>
<td>ICS</td>
<td>Internal Control System</td>
</tr>
<tr>
<td>ICAR</td>
<td>Indian Council of Agricultural Research</td>
</tr>
<tr>
<td>ISAAA</td>
<td>International Service for the Acquisition of Agri-biotech Applications</td>
</tr>
<tr>
<td>KSDA</td>
<td>Karnataka State Department of Agriculture</td>
</tr>
<tr>
<td>KSSC</td>
<td>Karnataka State Seed Corporation</td>
</tr>
<tr>
<td>KVK</td>
<td>Krishi Vignan Kendra</td>
</tr>
<tr>
<td>MACS</td>
<td>Mutually Aided Cooperative Society</td>
</tr>
<tr>
<td>NPM</td>
<td>Non-Pesticide Management</td>
</tr>
<tr>
<td>NPOP</td>
<td>National Programme for Organic Production</td>
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<tr>
<td>OE</td>
<td>Organic Exchange</td>
</tr>
<tr>
<td>OFMPAGA</td>
<td>Organic Farmers and Medicinal Plants Aromatic Growers Association</td>
</tr>
<tr>
<td>OPV</td>
<td>Open Pollinating Varieties</td>
</tr>
<tr>
<td>S.K.S.</td>
<td>Savaiyava Krishikara Sangha</td>
</tr>
<tr>
<td>UAS</td>
<td>University of Agricultural Sciences, Dharwad</td>
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1 Introduction

Cotton (Gossypium spp.) is grown in more than 100 countries on 33 million hectares (ha), with China, India and USA being the leaders of cotton production. India is the world's second-largest cotton producer, accounting for 29% of world cotton area and 20% of world production (OE 2008). In India, G. arboreum, G. hirsutum, G. herbaceum and G. barbadense cotton species are cultivated in several states of the north (Punjab, Haryana), west (Gujarat, Maharashtra) and the south (Andhra Pradesh, Karnataka, Tamil Nadu). Cotton production has a history that goes back to thousands of years and it is India’s most important export crop and provides employment directly or indirectly to 60 million people (SUNDARAM et al. 1999, JAMES 2007).

Yet the past eight years totally reshaped the Indian cotton scenery: with genetically modified (GM) cotton seeds being approved, the vast majority of cotton is transgenic today. At the same time, many farmers opt for organic agriculture and projects after projects have popped up with the main purpose of supplying organic (and often fair trade) cotton to meet the increasing demand mainly from the West. Conventional or organic is often the main question when discussing which farm management method benefits more economic, environmental, health and social related aspects of agriculture, however not in India and not in the cotton sector. The question has to be rephrased in offering a choice rather between transgenic or organic. The conventional, non-GM cotton sector is at the edge of extinction in India.

The overall aim of this thesis is to find out how seed security can be ensured for organic cotton production on the long-term in two states of South India. To achieve this end, it is necessary is to shed light on the seed delivery systems for organic cotton production.

Even though it was not the objective, throughout the research it was impossible to ignore and avoid discussions with farmers, consultants, governmental employees, agriculture experts on the implications of the by-now almost entirely GM cotton production. Although the thesis does not attempt to compare the two biologically and ethically opposite agricultural management methods, one thing is clear: the further increase in GM coverage of the cotton market in India means the death sentence of the organic cotton sector. Whether organic cotton farmers are still seed secure, or to frame it less ambitiously, the possibility still exists to maintain organic cultivation of this fibre crop with the existing seed systems is at the core of this thesis. In case of an affirmative answer the thesis tries to investigate which urgent decisions and actions are needed to secure the organic cultivation of cotton.
1.1 Problem Statement

“Organic produce and genetically engineered produce are mutually self-excluding commodities. A country can chose to go either way for a given product but not both. But that does not stop the Government of India from bumbling along in two contradictory directions, one arm promoting a product that will cancel out the markets of the other.”

(Gene Campaign 2008)

“Although, some varietal sowing of conventional cotton seed would continue, we are moving towards 100 per cent Bt cotton regime.”

Monsanto Holdings (Business Standard 2009)

In 2008, India became the biggest organic cotton producer in the world (The Hindu Business Line 2008b). The organic cotton projects mostly use conventional seeds because organic cotton seeds are not (or in very minor quantity) available. Yet India also approved the transgenic Bt (Bacillus thuringiensis) cotton seeds in 2002 and with an incredibly fast rate genetically modified hybrid seeds took over the market from conventional, non-Bt hybrids. This has led to a situation, where non-Bt seeds are hardly, if at all, available. While organic cotton projects are increasing in their numbers and output, the conventional, non-Bt hybrids are disappearing from the market. As an obvious consequence, organic cotton projects are facing a seed supply crisis. India at the same time has become the top organic cotton producer and the biggest Bt cotton grower in the world. According to state data, 79% of all cotton is GM in 2009/10 (Dcd 2009), though it could easily be more, since Bt cotton is in many states grown illegally.

The provisions of the organic standards of both the Codex Alimentarius Commission and the International Federation of Organic Agricultural Movements require the use of organic seed in organic production and this requirement has been integrated in all national, regional and private certification standards. This being said, the unavailability of organic seeds on the market allows organic farmers to use conventional (i.e. non-organic, but non-GM) seeds.

This is exactly what has occurred in India: organic cotton is being produced from untreated, non-Bt seeds and after processing exported to the USA, EU, Japan, etc. What happens however if the available conventional seeds are genetically modified? GMOs are prohibited in all organic standards in the world, without any exception. The Indian NPOP (National Programme for Organic Production) is also very clear on that “[t]he use of genetically engineered seeds, pollen, transgene plants or plant material is not allowed” (NPOP 2005,3.2.1.3.). Thus, the question arises what to do in a situation when the rapid expansion of Bt makes non-Bt cotton seeds unavailable.
One would think that for India, as a leader in organic cotton production, the question of reliable and stable non-GM seed supply is of utmost importance. Importers, listening to news about Bt contamination scandals in organic cotton, certifying agencies sanctioned for not spotting the contamination in organic cotton, and continuing expansion of GM cotton, could easily switch to other organic cotton producing countries. Is there any space left in the midst of the vast expansion of GM cotton to organic cotton? Can organic projects go ahead fearing contamination and continuing their dependence on conventional hybrids?

The goal of this introductory chapter is to show the main disturbing problems in organic cotton production in India and thereby formulate the objectives of the research. For this, it is necessary to have a clear picture of the trends in both organic and genetically modified cotton, depicting the rapid increase in GM cotton production, both worldwide and in India.

1.2 Objectives

The thesis is an attempt to review the seed production and delivery system of organic cotton farmers in two states of South India with the ultimate objective of suggesting alternative seed systems that are supportive of livelihoods and ensure seed security for organic cotton production on the long run. This requires an examination of the cotton seed supply chain from seed production until the ginning processes where seeds are removed from the lint – further processes, like spinning and weaving/knitting operations are outside the scope of this research. The underlying hypothesis is that currently organic cotton projects in India are seed insecure and further relying on conventional hybrids by these projects is a dead-end strategy. If this hypothesis proves to be true, urgent solutions are required to ensure the further existence of these projects.

The following research questions have been formulated in order to find out the answer for the above-stated objective:

1. Are there still non-Bt cotton seeds available in Andhra Pradesh and Karnataka?
2. Which cotton varieties are used by organic cotton farmers in these two states and how do they ensure that seeds are not genetically modified?
3. What role – if at all – do NGOs, public institutions and the private sector play in ensuring that non-Bt seeds are available?
4. What options does the organic cotton sector in South India see in ensuring seed security?
5. Which strategies could/should organic projects follow in order to enhance and maintain seed security for organic cotton production?
The first four questions could be answered by investigating the mechanisms of formal/informal cotton seed sector of selected organic cotton projects. However, the last and maybe most important question for this thesis work can only be tackled when understanding the political and economic situation behind the cotton business in India. In practical terms, the recommendations could serve as a menu-card for organic cotton projects deciding which path to follow.

Being a vast country with around 1.2 billion people and extremely diverse agro-ecological backgrounds, the focus of the thesis is merely on South India’s two states that are the most important regarding cotton production: Andhra Pradesh and Karnataka. Regardless of this emphasis, other organic cotton projects have been consulted as well in order to find out about their seed supply situation and seed security strategies.

1.3 Status quo of organic and Bt cotton

The cotton growing areas of India fall within 8-32° N latitude and 70-80° E longitude at an elevation range of 0-950 m, with an annual rainfall distribution of 250-1500 mm (VENUGOPAL et al. 2003,142). India is unique in the sense that it grows all four species of Gossypium: *G. hirsutum, G. barbadense, G. arboreum* and *G. herbaceum*.

Cotton is a perennial crop although it is produced as an annual plant. The duration of cotton plants varies from 110 to 290 days and they require about 20-28°C temperature for optimum vegetative growth. Although humid and rainy weather conditions during early stages of growth are advantageous, too much rain and also warm, humid climate during the boll formation and maturity is undesirable.

There are generally 40 insect pests attacking cotton, one-fourth of which are sucking pests (MENON 2003). Among the important pests are jassids (Amarasca bigutulla), aphids (Aphis gossypii), white fly (Bemesia tabaci), spotted bollworm (Earias vitella), pink bollworm (Pectiniphora gossypiella) and American bollworm (Helicoverpa armigera). The Central Institute of Cotton Research (CICR) estimated that about half of the cotton output is lost to insect pests (VENUGOPAL 2003,200). Because of the severity of the pest problem, cotton is the largest market for pesticides: according to the last data found in literature, 45% of all pesticides in India are used on cotton (CHOUHARY and LAROA 2001), whereas it occupies only 5% of the cultivated area. Due to the massive use of pesticides, some cotton pests like the American bollworm and white fly have developed resistance to most of the insecticides used to control them (BIRTHAL, SHARMA and KUMAR 2000). Although the total pesticide consumption has decreased since 2002, which happened parallel to the adoption of Bt cotton (e.g. 45% reduction in Andhra Pradesh), a causal link between Bt and reduced pesticides has not been established (GRUERE, MEHTA-BHATT and SENGUPTA 2008). Nevertheless the increase of secondary pests and consequent pesticide use has been recently reported by the CICR in India (MOEF 2010).
1.3.1 Organic cotton

Organic cotton is grown without the use of toxic and persistent pesticides, synthetic fertilisers and genetically engineered seeds. Last years have experienced a tremendous rise in organic cotton production worldwide: between 2006 and 2007 there has been a 53% growth whereas between 2007 and 2008 an unprecedented 152% increase took place in the organic cotton supply market (OE 2008). This growth further increased, albeit to a more modest extent by 20% to reach 175 113 tonnes of organic cotton by 2008/09, representing 0.76% of the global production (OE 2010). According to Organic Exchange (OE 2010), organic cotton has been grown by about 220 000 farmers in 22 countries on 253 000 ha in 2008/09. The largest producers in the 2008/09 season were India (61%), Turkey (15.6%), Syria (12.6%), Tanzania (2.4%) and China (2.2%) which together accounted for 94% of world production, followed by USA, Uganda, Peru, Egypt and Burkina Faso (OE 2010).

Demand for organic cotton has been also increasing past years with 50 companies having significant organic cotton programmes and around 1500 brands and retailers taking a share in the international organic cotton market. In 2006, retail sales of organic cotton products reached $ 1.1 billion globally, whereas by 2008 this number increased to $ 3.2 billion (OE 2010). The organic cotton market continues to grow despite tough economic conditions. However, in 2008/09, the supply far exceeded the demand which has driven prices down; this coupled with the global recession ended in a spiraling down of global demand. As of last year, between 17-22% of total organic cotton production still remained to be unsold (OE 2010). Organic cotton projects are almost exclusively looking for exports for survival.

In India, organic cotton farming started in the beginning of the nineties and by last year reached 142 000 ha (WILLER AND K LICHER 2009). India’s harvested organic cotton volumes were around 10 834 tonnes during the 2005/06 season (THE HINDU BUSINESS LINE 2006). In 2007/08, an increase of 136% in production and 2089% in export took place when compared to the previous year. By 2008, the country harvested 73 702 tonnes of organic cotton thereby becoming the world leader in organic cotton production. As a result, organic cotton accounted for 1.38% of the total of 5356 million tonnes of Indian cotton production (WILLER AND K LICHER 2009). The biggest export markets are Asia (where value addition is taking place), the EU (predominantly Germany, Italy and France) and Mexico.

1.3.2 Bt cotton

Bt stands for Bacillus thuringiensis, a toxin-producing bacterium found naturally in soils. Scientists isolated certain genes responsible for the production of these toxins and using genetic engineering techniques inserted them among other crops into cotton. The
resulting cotton plants produce the Bt toxins and susceptible pests die when they feed on them. Thus, Bt produces an insecticide that makes it resistant to attack by certain insects, in particular the American bollworm.

The four major cotton-growing countries all adopted Bt cotton and by 2007, Bt cotton occupied 93% of American, 60% of Chinese, 66% of Indian and 95% of Argentinean cotton areas (James 2007). ISAAA (2008) reported that Bt cotton had been commercialised in 10 countries – the USA (1996), Mexico (1996), Australia (1996), China (1997), Argentina (1998), South Africa (1998), Colombia (2002), India (2002), Brazil (2005) and Burkina Faso (2008). In 2009, GM cotton occupied globally 49% of the total cotton area of 33 million ha, though this percentage reached 90% in the USA, Australia and South Africa (ISAAA 2010). Most Bt cotton farmers are located in China, with their number reaching 7.1 million in 2008 (ISAAA 2008). With 8 million ha under Bt-cotton in 2009/10, India occupies the first position in terms of area planted in the world – although ISAAA (2010) puts the percentage of Bt to 87% in the country, national official data shows it to be 79% (DCD 2010).

The Monsanto corporation of the United States dominates the global Bt cotton seed market. At least two thirds of the Bt cotton sold in the world is sold under license to Monsanto or sold directly by Monsanto and its subsidiaries (Etc 2005). Private sector efforts to introduce GM crops in India began in 1995, when the Indian seed company Mahyco got government approval to import GM cotton seeds from Monsanto to breed with selected Indian cotton varieties. Bt cotton was first approved in six states of the country in 2002, although it was actually already on the Indian market (illegally) already in 1998.

The first three commercially approved hybrids were developed by Mahyco in collaboration with Monsanto, which later sub-licensed its Bt cotton technology to other seed companies (so far more than to 60) in India for incorporation into their own cotton hybrids. A fourth Bt hybrid was commercialised in 2004 by the company Rasi Seeds. In 2006, three new Bt cotton events were given green light by the Genetic Engineering Approval Committee (GEAC). By 2007 there were 137 and by 2009, 619 officially approved Bt hybrids—up from three in 2002—involving four genetic events and several dozens of firms were on the market (Karihaloo and Kumar 2009).

In 2006, Indian state governments had set maximum retail prices for Bt seeds at Rs 750 per packet, which was less than half the price charged by seed companies before. This was the start of the unprecedently quick adoption of Bt cotton across India: both the area under Bt cotton and the number of farmers adopting the GM technology has showed a very steep increase.
**Figure 1:** Trend in total and Bt cotton production in 2002-10

![Cotton production in India](image)

Source: DCD (2009)

As Table 1 shows, in seven years the area under Bt cotton has increased by more than 275 times to record 8 million ha in 2009/10, while the number of Bt farmers reached 5.6 millions in 2009. Actually, the largest increase in the number of GM adopting farmers in 2008 worldwide was in India where an additional 1.2 million more farmers planted Bt cotton when compared to the year before (ISAAA 2008). It is important to note though that all viewed sources referred to different numbers regarding legal Bt cotton cultivation with quite a divergence on Bt coverage between data given by ISAAA and Indian state governments (with the previous depicting higher adoption rates).

**Table 1:** Data on Bt-cotton production in India (2002-10)

<table>
<thead>
<tr>
<th>Crop Year</th>
<th>Total area (mill ha)</th>
<th>Bt cotton area (mill ha)</th>
<th>Bt cotton area (mill acres)</th>
<th>% area of Bt cotton</th>
<th>No. of Bt farmers (1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002/03</td>
<td>8.73</td>
<td>0.029</td>
<td>0.072</td>
<td>0.3</td>
<td>20</td>
</tr>
<tr>
<td>2003/04</td>
<td>7.67</td>
<td>0.086</td>
<td>0.213</td>
<td>1.1</td>
<td>75</td>
</tr>
<tr>
<td>2004/05</td>
<td>7.63</td>
<td>0.553</td>
<td>1.366</td>
<td>7.3</td>
<td>350</td>
</tr>
<tr>
<td>2005/06</td>
<td>8.92</td>
<td>1.267</td>
<td>3.131</td>
<td>14.2</td>
<td>1 000</td>
</tr>
<tr>
<td>2006/07</td>
<td>9.16</td>
<td>3.8</td>
<td>9.4</td>
<td>41.5</td>
<td>2 300</td>
</tr>
<tr>
<td>2007/08</td>
<td>9.4</td>
<td>6.2</td>
<td>15.32</td>
<td>66</td>
<td>3 800</td>
</tr>
<tr>
<td>2008/09</td>
<td>9.4</td>
<td>7.6</td>
<td>18.84</td>
<td>80</td>
<td>5 000</td>
</tr>
<tr>
<td>2009/10</td>
<td>10.2</td>
<td>8.04</td>
<td>19.9</td>
<td>79</td>
<td>5 600</td>
</tr>
</tbody>
</table>


Since its introduction eight years ago, there has been no public effort in undertaking a comprehensive and systemathic assessment on the effects of Bt cotton in the field. The
controversy over Bt vs non-Bt cotton has been fueled by the lack of consistent public information on the performance of Bt cotton (SEM 2007) and the debate has been very intense between pro-GM interests and anti-GM activists. Although several studies have been proving the benefits of this new technology (MORSE, BENNETT and KAMBHAMPATI 2005, BENNETT et al. 2006, GANDHI and NAMBOODIRI 2006, ICAR 2006, QAIM 2006, SADASHIVAPPA and QAIM 2009, etc.) in terms of yield increase and reduction in chemical sprays, at least the same number of scientific evidence has been gathered in proving the harmful effects of GM cotton (QAYUM and SAKKHARI 2006, WANG, JUST and PINSTRUP-ANDERSEN 2006, 2008, JALEES 2008, etc.) in terms of less profitability due to higher inputs, higher debt-rate of farmers, loss of biodiversity, etc. The overall conclusion from the literature seems to be that the economic gains of Bt cotton cannot be generalised to all farmers, all states, and all years (GRUERE, MEHTA-BHATT and SENGUPTA 2008).

The controversy over the performance of Bt cotton in India involves on the one hand Monsanto-Mahyco (Mahyco, which stands for Maharashtra Hybrid Seed Company, is partially owned by Monsanto) and its licensees, portraying Bt cotton as a huge success, on the other hand several dozens of national and international NGOs, state governments’ reports, independent media investigations claiming that Monsanto’s GM cotton has been a failure and farmers have suffered economic losses.

During the research, there has been a surprising convergence in the opinions of the two sides: for the first time in history, in March 2010 Monsanto admitted that the pests (in specific pink bollworm, which is one of the most damaging cotton pest in India) have developed resistance to its Bt cotton crops in Gujarat and advised Indian farmers to switch to its two-gene product (Bollgard II) to delay resistance further (THE HINDU 2010b) even though Bollgard II has no additional toxin to combat pink bollworm.
2 Methodology

2.1 Defining seed security and seed systems

2.1.1 Meaning of seed security

There is no legal definition as to what seed security actually entails. VAN DER BURG (1997) defined seed security as “the state in which all farmers in a region or farming system have ready access to sufficient quantities of seeds of adequate genetic and physical quality, at the right moment, year after year”. He suggested to group farmers into low, medium and high-input based agricultural systems and to analyse seed security respectively. In low-input systems, farmers are seed secure when they can produce enough crops to reserve some as seeds for the next planting season. In medium-input systems, seed security is achieved if farmers can produce enough seeds for themselves, exchange with their neighbours and buy seeds from the formal system, whenever they wish. In high-external input systems, farmers buy new seeds of their variety of choice every year and rely on the regular supply of quality seeds by the formal system to claim seed security.

The Seed and Plant Genetic Resources Service of the Food and Agriculture Organisation of the United Nations (FAO 1997) defined seed security programmes as those activities ensuring “access by farming households to adequate quantities of good quality seeds and plant materials of adapted crop varieties at all times”. Whereas the two above definitions are very much overlapping, FAO has concentrated mostly on the implications of seed security in times of distress (e.g. natural and man-made catastrophes) and not so much on seed security in times of peace.

Nevertheless, to achieve seed security, both sources agree that strategies should be designed that aim at the protection of local crop diversity, and according to FAO (1997) at the improvement of the seed supply sector. Thus to be able to assess seed security for organic cotton production, the existing seed supply system must be studied – which forms the backbone of this thesis. Only upon understanding the different stakeholders and their relationships can one analyse seed security and offer recommendations as to how that can be achieved.

Seed security for organic cotton production

Seed security for organic cotton production is understood by the researcher as farmers/farmer groups having a stable physical, social and economic access to sufficient quantity and quality seeds, which meet their preferences of variety choice. This entails two dimensions: seed availability, which means the availability of sufficient quantities of seeds of appropriate quality at all times; and seed access, which implies that farmers have
the means (social, economic and political) to access appropriate seeds and also have the right to save their own seeds.

In India, both in case of organic and non-organic farmers, mixed-crop-livestock systems support the majority of rural livelihoods. Whereas most literature on seed security (e.g. Proceeding of the International Workshop on Seed Security for Food Security 1997) refers to seed security specifically as a crucial ingredient to ensure food security, the thesis attempts to divert away from this broader concept and direct its meaning exclusively onto a non-food crop, i.e. cotton and targeting one focus group, i.e. organic farmers.

Though seed security means very different things for different farmers, seed security for organic cotton farmers shall be understood according to the above-mentioned concept as farmers:

a) having a constant supply of sufficient quantity of non-Bt, untreated cotton seeds of their preferred variety/hybrid;

b) being able to afford and get hold of non-Bt, untreated cotton hybrids or varieties and can save their seeds if they choose to do so.

2.1.2 Cotton seed systems

As mentioned before, guaranteeing the access of farmers to sufficient quality seeds can only be assured if a viable seed supply system exists that multiply and distribute cotton seeds. VAN AMSTEL et al. (1994) defines seed system as “the total of the physical, organisational and institutional components, their actions and interactions that determine seed supply and use, in quantitative and qualitative terms”. Thus, two distinctive, but interacting types of seed delivery systems are recognised: formal and informal. The informal or also called traditional, local, farmer-managed seed system includes on-farm production, selection and saving of seeds, borrowing seeds from others, local exchange and trade of seeds, and distribution by NGOs, whereas the formal system refers to seeds managed by companies (private) and governmental bodies (public) (LARINDE 1997, REDDY et al. 2006).

REDDY et al. (2006) analysed the seed delivery system of major food and fodder crops in several districts of Andhra Pradesh in India. He concluded that for a well-functioning seed system that meets farmers’ demand for quality seeds one needs the appropriate combination of both the formal and informal system. According to them, seed systems can be further grouped into public, private and civil sectors. The civil sector, consisting of farmers’ own-saved seeds and exchange, still produces most seeds for staple food crops in developing countries (ALMEKINDERS, LOUWAARS and DE BRUIN 1994, REDDY et al. 2006). The public sector includes public seed companies and seed corporations,
research institutes and governmental departments, whereas the private sector refers obviously to private companies.

With analogy to the definition and identification of seeds systems for major food and fodder crops in one Indian state, this thesis attempts to shed light on the seed delivery systems for organic cotton production in two states of South India. The integrated seed system theory by REDDY et al. (2006) was used, since the basic concepts of seed security and seed system are similar in case of food, fodder and fibre crops in India. Mapping the cotton seed systems result in a visual representation of farmers with different seed choices and in an understanding of the degree of balance in seed security. The authors’ major statements about the necessity of a well balanced seed system as precondition for seed security are equally valid for any other crop, thus can be applied to the seed system of cotton and specifically organic cotton in South India.

The figures – based on their models – were changed in terms of the targeted crop, i.e. cotton and also in terms of the criteria for grouping farmers. Instead of small, medium, large farmers, the figures – presented in Chapter 6 – depict the seed sourcing behaviour of Bt, non-Bt conventional and organic farmers.

2.2 Design of the study

2.2.1 Primary data collection

A variety of literature on seed systems, seed security strategies and cotton cultivation was reviewed to determine the most appropriate methodology for the research and to assess the situation of organic cotton production in South India, with special focus on the major problems the sector is currently facing. The information and knowledge gained from this review has been crucial for formulating the right research questions. Furthermore it served as a guide to determine which actors are needed to be approached in order to fulfil the objective of this research and which questions are necessary to be asked in the interviews.

2.2.2 Secondary data collection

The empirical data is based on a four-month field survey that was conducted from August till November 2009 in two states of South India, Andhra Pradesh and Karnataka, which was followed up by subsequent e-mail correspondence and phone interviews up until March 2010. Qualitative methods were applied consisting of questionnaires, semi-structured individual interviews, group discussions and site observations.
There are three major zones for cotton production in India (north, central and south), and due to the time limitation of the research, the study only attempts to look into one of these. Within the south zone, three cotton producing states exist and the two biggest have been chosen as study areas. Regardless of this choice, some of the biggest organic projects from the other two zones have been also contacted and interviewed.

A total of nine organic cotton projects were identified and visited during this time, three in Andhra Pradesh and six in Karnataka. Since no official data has been published to date on the number of organic cotton projects in each state, the empirical research was started by first finding out which projects exist in the study area. The idea was to assess all cotton projects in the two states and thus do a complete survey, however it cannot be ruled out that apart from these, other, small cotton projects may exist. For the purpose of this study, only organic farmers were studied which belonged to a group that was certified by an organic certification body.

A questionnaire was prepared consisting of 23 questions (Annex I) which were filled out during individual interviews with organic cotton project managers and/or coordinators (except two, which were sent following meetings, by e-mail) between October 2009 and February 2010. Also, interviews with 44 farmers were conducted individually or in groups of 3 to 6 people, as well as semi-structured group discussions in several villages to determine which cotton seeds are being used, why and with which results by them.

Furthermore, seed company representatives (two public and two private), a seed dealer, NGO representatives and several scientists from two agricultural research stations were asked in single semi-structured interviews and/or phone interviews about their knowledge on the availability of Bt and non-Bt cotton seeds and about their views on the underlying causes that have led to the situation of today’s cotton seed supply. Furthermore, the Directorate for Cotton Development (DCD) in Mumbai, and the Department of Agriculture of Karnataka (KSDA) in Bangalore was visited to gather official data regarding the production of non-Bt cotton and opinions about the role of government in the cotton seed sector.

Further data was received from the Department of Agriculture in Andhra Pradesh by phone and e-mail regarding cotton production and cotton seed availability in that state. Also, several officials on district-level agricultural offices in both states were contacted by phone regarding data on Bt vs non-Bt coverage in their districts as of 2009/10. In addition, some data from the presentation (at Organic Trade Fair, Mumbai) of a senior official from India’s Agricultural and Processed Food Products Export Development Authority (APEDA) has been included regarding the government’s plans in tackling the seed problems of organic cotton farmers.
Another questionnaire (Annex II) was prepared specifically for certification bodies (CBs) certifying and inspecting organic cotton farmers in India: consisting of 8 questions, it aimed at determining the current concerns with regards to seed sourcing and certification.

Table 2 was drawn up to facilitate the finding of actors, which were necessary to interview in order to obtain data required for answering the five research questions highlighted in Chapter 1.

**Table 2**: Required players to be interviewed (signalled with Q if by means of questionnaires) in the organic cotton seed system

<table>
<thead>
<tr>
<th>Target groups for research questions</th>
<th>1. non-Bt seed availability</th>
<th>2. seeds used by farmers &amp; ways to ensure GM-free cotton</th>
<th>3. role of NGOs, public and private sector</th>
<th>4. options of ensuring seed security</th>
<th>5. strategies to enhance seed security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton project leaders</td>
<td>Q</td>
<td>Q</td>
<td>Q</td>
<td>Q</td>
<td>Q</td>
</tr>
<tr>
<td>NGOs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Universities</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed companies</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed dealers</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBs</td>
<td>Q</td>
<td></td>
<td>Q</td>
<td>Q</td>
<td>Q</td>
</tr>
<tr>
<td>Organic farmers</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gov. bodies</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

### 2.3 Data analysis

The approach used by the researcher was aimed at identifying and interviewing all relevant actors involved with the non-Bt cotton seed system in the research area. Based on the identification of key players, the cotton seed system was mapped according to the integrated seed system theory (Reddy et al. 2006); this helps to describe and visualise the present cotton seed system, group farmers according to their seed sourcing behaviour and determine whether the organic cotton sector can be characterised as seed secure or not.

The easiest to identify were the public sector players: in both states agricultural universities, departments of agriculture and state seed corporations were contacted for information regarding cotton seed production and availability of non-Bt in their respective states. Players were identified during the literature review as well as during the field research itself and were contacted between November 2009 and March 2010. Several districts agricultural offices were called to find out about exact coverage of Bt and non-Bt cotton: in Karnataka only those districts were phoned, where still a significant
percentage of non-Bt hybrid growing took place last year or at least 1000 ha of cotton varieties were grown during 2008/09 season. In Andhra Pradesh, the biggest cotton growing districts’ agricultural offices were contacted – these coincided with those districts where organic cotton production was happening.

A more challenging task was the identification of private companies selling non-Bt seeds – this was only possible after having talked to organic cotton projects and NGOs. Interestingly none of the public actors were able to help name the private sector players still involved with non-Bt seed distribution. The two companies which were named by NGOs as selling non-Bt seeds were contacted: one through a semi-structured interview, another one through phone interview.

The NGOs involved with anti-GM campaigns were contacted for further information regarding i.a. non-Bt cotton production. Their guidance was crucial in finding the right contacts and farmer leaders within the cotton seed system. Other civil sector players like seed savers and/or seed producer farmers were identified during the field research itself.

Table 3: Interviewed actors within the cotton seed system in South India

<table>
<thead>
<tr>
<th>SEED SYSTEM ACTORS</th>
<th>Karnataka</th>
<th>Instrument</th>
<th>Andhra Pradesh</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PUBLIC SECTOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture university</td>
<td>5</td>
<td>Semi-structured interviews</td>
<td>1</td>
<td>Phone interview (structured)</td>
</tr>
<tr>
<td>State seed corporation</td>
<td>1</td>
<td>Semi-structured interview</td>
<td>1</td>
<td>Phone interview (structured)</td>
</tr>
<tr>
<td>Department of Agriculture</td>
<td>4</td>
<td>Structured interviews</td>
<td>3</td>
<td>Phone interviews (structured)</td>
</tr>
<tr>
<td><strong>PRIVATE SECTOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private companies</td>
<td>0</td>
<td></td>
<td>2</td>
<td>Semi-structured interviews</td>
</tr>
<tr>
<td><strong>CIVIL SECTOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed saving farmers</td>
<td>3</td>
<td>Semi-structured interviews</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>NGOs providing seeds</td>
<td>1</td>
<td>Semi-structured interviews</td>
<td>2</td>
<td>Semi-structured interviews</td>
</tr>
</tbody>
</table>

Regarding the next step of the research, in which organic projects were interviewed, the coordinator NGOs were contacted first. Upon arranging individual meetings with them, they offered to accompany the researcher to meet different farmers on their fields and on
Methodology

few occasions also organised small farmer group meetings. Farmers were interviewed in
different villages regarding their seed sourcing and seed choice.

During the interviews the author was always present and in case of interviews with
farmers, accompanied by a translator, who translated the local language (Kannada in
Karnataka and Telugu in Andhra Pradesh) into English.

Besides the nine projects, the biggest organic projects of India have been contacted and
interviewed (except for Pratibha’s Vasudha project, which could not be reached). Some
of the details of their projects and seed procurement were asked either in person during
the Organic Trade Fair in Mumbai in November 2009, or by phone communication.

Certification bodies were approached with a questionnaire during December 2009,
however due to the low response rate, only a short summary of two replies have been
included. Both questionnaires were received by e-mail January 2010. Besides, structured
interviews with representatives of the two other certification bodies, which are certifying
cotton projects in the research area, were conducted during March 2010.

2.4 Critical reflection of the applied methods

Upon deciding the original methodology for the research, flexibility is a key factor
throughout the field research: changes in methodology and even in the very research
questions and research areas are often required in order to accommodate new information
that brings closer in achieving the final objective. This was exactly the case during the
process of this research, and this in-built flexibility allowed the researcher to adjust the
target groups, research areas and consider new perspectives.

The original idea was to map out all organic cotton projects in India and find out if and
which non-Bt hybrids and varieties are still available. This proved to be an over-
ambitious task for the limited amount of time (the Organic Exchange Farm & Fibre
Report 2009 lists 204 such projects (OE 2010), whereas the government maintains a list
of 144 (APEDA 2009)), and in order not to be superficial with only analysing data based
merely on questionnaires received by e-mail, the scope of the research was scaled down
to allow more in-depth investigation of the current situation and direct contact with all
projects involved. Consequently, the existing seed systems of organic cotton farmers
were studied in two states of South India using informal participatory techniques. Semi-
structured interviews were held with individual farmers as well as NGO leaders and
project managers overlooking the different organic cotton projects.

A drawback of this choice was to leave out the largest organic cotton projects in India
and thus to limit the findings to a specific area. To overcome this limitation, several of
the largest projects were also approached and questioned on the current and future plans
in ensuring seed security. This was possible since the researcher participated at the India
Organic Trade Fair in Mumbai (18-20 November, 2009) and at an organic cotton seed production training in Hyderabad (27-28 November, 2009), which enabled direct dialogue with some of these projects (bioRe Maikaal Ltd, Suminter Organics, AMIT Group, etc). The outcome of these talks and further phone interviews will be additionally provided as they may support some of the arguments and concerns that have come up during the analysis.

As a next step, the original plan was to meet ten farmers from each project and conduct individual interviews with the aim of finding out details about farmers’ seed sourcing behaviour, i.e. reasons for the selection of specific seed hybrids/varieties. It turned out shortly after the start of the field research that it was not the farmers but the organic projects themselves which procured and distributed seeds among their members. This meant that no additional information could have been received from farmers in terms of answering the research question regarding the hybrids and/or varieties used by them. Two options remained: either to skip entirely the farmer interviews, since the invested time would not justify the information that was additionally gained (and not directly related to the research questions) or to reduce the number of interviews and acquire new information that could be helpful for the analysis. This last approach was followed and with the course of the research, the number of farmers interviewed in each project was kept at a minimum of two or three. Apart from cross checking the information received from organic cotton project managers, directly asking farmers also enabled the researcher to get a real understanding of some of problems that farmers are facing, get to know details about their farming practises, level of satisfaction with the seeds they use, reasons for conversion, current problems and benefits from organic farming.

In view of the context of Indian organic cotton projects, where farmers are grouped and organised together and where seed supply is mostly centralised, the concept of seed security – previously phrased – gets a different meaning. Thus, seed security for organic cotton production shall be rather understood as NGOs and associations (not individual farmers):

a) are able on a constant basis to supply their farmer members with sufficient quantity of non-Bt, untreated cotton seeds of the preferred variety/hybrid;

b) are able to ensure the supply of affordable non-Bt, untreated cotton hybrids or varieties and allow farmers to save and re-use their varieties.

This concept thus replaced the one formulated at the beginning of the research – mentioned under chapter 2.1.1 – and the outcome of the research was measured against this definition.

Furthermore, although it was not planned, informal, open-ended style of discussions were adopted when several organic farmers were present and when both organic and Bt farmers participated in group discussions in several villages. This enabled them to
express their viewpoints, share their experiences and allowed the researcher to compare the perceptions of Bt and of organic farmers with regards to yield, plant and soil health, factors also influencing seed preference. In addition, the dynamics and arguments in these group meetings allowed for a better insight into the dilemma farmers are facing when deciding upon organic or Bt cotton farming.

Due to the unavailability of published data on organic cotton seed systems, to the year-by-year increasing number of organic cotton projects and to the vast expansion of Bt cotton farming, not much literature could be found on non-Bt seed availability. Under such circumstances, semi-structured interviews were the appropriate way to obtain information and questions had to be formulated openly to find out the scope of the problems.

However, the aspect that would be changed by the researcher - were the field research started again - is the sequence of interviews. Some of the interviews with organic cotton projects and thus the design of the questionnaire were done at the start of the research when little knowledge on the cotton seed system was yet acquired. Much clearer understanding of the issue has resulted in slight changes, even adding and deleting some of the questions, which required other meetings and contacts with those who had already gave feedback on the questionnaires.

On the other hand, the identification of key NGOs and subsequent meetings with them at the start allowed the researcher to acquire a quick understanding of the main players linked with organic cotton production. This facilitated the drawing up of a logical schedule for the field research itself. Furthermore, it proved appropriate to meet representatives of key government bodies and scientists at the end of the research when the relationships among the seed system elements were crystallised - this allowed the researcher for individual and structured interviews.
3 Cotton seed supply in South India

This chapter first looks shortly at the history of cotton production in India, after which the cotton seed sector with its players is presented in the two selected states of South India. This information is necessary in order to obtain results on seed availability of Bt vs non-Bt seeds (Chapter 4). Whereas subchapter 3.1 is solely based on literature research, subchapter 3.2 contains the results of expert interviews conducted with several actors within the cotton seed sector.

3.1 Three era in the history of cotton in India

3.1.1 From short to long staple varieties

Traditionally, cotton was cultivated in crop rotation, seeds were pre-treated with cow dung and urine, fertilisation was done using organic manures like farmyard manure and green manure, and Neem oil was used as a natural pesticide. *G. arboreum* and *G. herbaceum* diploid varieties (referred to as desi varieties in India and Pakistan) are indigenous to Asia and Africa and had been used for thousands of years providing hardiness, pest resistance and drought tolerance. *G. arboreum* most probably originates from the Indian subcontinent (MENON 2003). Diploid species are usually grown in marginal, drought-prone environments of India due to their inherent ability to withstand drought and resist sucking pests (e.g. hoppers, white flies, thrips and aphids) and leaf curl virus (DCD undated).

Two cotton species *G. hirsutum* (referred to as American cotton) and *G. barbadense* (referred to as Egyptian cotton) were introduced during the 17\textsuperscript{th}-18\textsuperscript{th} centuries to satisfy the textile mills’ demands for long staple\(^1\) varieties during British times (MENON 2003). The first spinning machine, invented by Arkwright - from which all modern spinning machinery is derived - required long staple cotton. This meant that “the quality in cotton fibre is dictated by the limits of the spinning machine” (UZRAMMA 1995). The objective in cotton production from 1790 onwards thus became to supply English and American mills with long staple cotton (MENON 2003).

Parallel, research on cotton was also shifted to meet industry’s demands for medium and long staple cotton. Diploid cotton varieties with their short staple length have become less and less demanded by markets. Still, all these varieties were grown year after year by farmers replicating the seeds without the need of any external inputs. Although yields were not high, the crops did not need much attention yet harvest was still assured.

\(^1\) Fibers, like cotton, are categorised by the length of the fiber itself, known as the staple. The longer the staple, the stronger, finer and higher quality the fiber is.
3.1.2 From varieties to hybrids

This era changed dramatically with the arrival of hybrids. Hybrid seeds need to be produced every year from a male and female parent, thus farmers cannot re-use the seeds. India has become in very short time the pioneer country for the commercialisation of hybrid cotton seeds. Hybrids have been developed between varieties of the same species (called intra-specific hybrids) and across species (called inter-specific hybrids). The name of C.T. Patel is known for releasing the first commercial intra-hirsutum hybrid in the world (a cross between two hirsutum parents) in 1970 (MURUGKAR, RAMASWAMI and SHELAR 2007). Hybrid-4 triggered the hybrid cotton revolution in India, with the subsequent release of several high-yielding intra-hirsutum and interspecific (G. hirsutum x G. barbadense) hybrids. This was the main engine for the drastic area increase under hybrid cotton cultivation. As the table below shows, by 2007/08, hybrids accounted for 66% of all cotton in the country (KHADI 2009).

Table 4: Area of cotton species cultivated in India (million ha)

<table>
<thead>
<tr>
<th>Varieties</th>
<th>1947-48</th>
<th>%</th>
<th>1955-56</th>
<th>%</th>
<th>2000-01</th>
<th>%</th>
<th>2007-08</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>G. hirsutum</td>
<td>0.14</td>
<td>3</td>
<td>3.21</td>
<td>41</td>
<td>2.61</td>
<td>32</td>
<td>1.8</td>
<td>19</td>
</tr>
<tr>
<td>G. arboeum</td>
<td>2.79</td>
<td>65</td>
<td>2.84</td>
<td>36</td>
<td>1.38</td>
<td>17</td>
<td>0.9</td>
<td>10</td>
</tr>
<tr>
<td>G. herbaceum</td>
<td>1.39</td>
<td>32</td>
<td>1.78</td>
<td>23</td>
<td>0.89</td>
<td>11</td>
<td>0.4</td>
<td>5</td>
</tr>
<tr>
<td>Hybrids</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.26</td>
<td>40</td>
<td>6.4</td>
<td>66</td>
</tr>
<tr>
<td>Total</td>
<td>4.32</td>
<td>7.83</td>
<td>8.15</td>
<td>81.5</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: KHADI (2009)

Although high-yielding hybrid varieties have yielded more, the need for external inputs has also increased. Hybridisation has brought along “expensive price tags” (MENON 2003,13) with heavy doses of synthetic fertilisers and pesticides, the need to irrigate and to buy seeds year after year. Due to the indiscriminate use of insecticides, pest resistance has developed (DCD undated), which resulted in the use of even more toxic chemicals to fight insects (MENON 2003).

3.1.3 From hybrids to GMOs

American bollworm was an unknown pest to India, since it did not affect the short staple cotton (MENON 2003). However, with the introduction of hybrids new pests arrived. This gave an excellent argument for biotech companies to introduce Bt genes into Indian
hybrids. Whereas the Bt cotton technology was commercialised in open-pollinated varieties (OPVs) in China and the US, in India it has been incorporated in hybrids\(^2\).

According to the director of CICR, in 2008/09, 67% of all Bt cotton area was covered under Bollgard-I hybrids (based on Monsanto’s \textit{cry1Ac} Bt gene technology) and 24% under Bollgard-II seeds (containing a combination of \textit{cry1Ac} and \textit{cry2Ab} genes); furthermore, hybrids based on JK Agri Genetic Ltd’s \textit{cry1Ac} and Nath Biogene’s \textit{cry1Ab-\textit{cry1Ac}} fusion gene technologies covered about 121 000 and 100 000 ha, respectively (\textsc{The Hindu Business Line 2009}). In addition, seven years after the commercial launch of Monsanto’s Bt cotton, Indian farmers planted the first publicly bred GM cotton varieties: Bikaneri Nerma-Bt, an in-bred variety and NHH 44-Bt hybrid.

\textbf{Figure 2}: State-wise Bt cotton area in India in 2009/10

\begin{figure}
\centering
\includegraphics[width=\textwidth]{bt_cotton_area_2009_10.png}
\caption{Bt cotton area in India 2009/10}
\end{figure}

Bt cotton is grown in all cotton growing states of India, except for Orissa and Uttar Pradesh. As it was shown in Chapter 1, the cultivation of Bt cotton is still on its steep rise. Only two states experienced a slight reduction in Bt coverage during last year when compared to the previous year: Punjab (which still has the highest percentage of Bt of the total planted cotton) and Tamil Nadu.

\(^2\) One explanation given for that by several NGOs is that companies were fearing in India that farmers would maintain the seeds in case they put the Bt gene into varieties (as they do elsewhere in the world) thus they opted for hybrids to ensure yearly sales of seeds.
Table 5: State-wise Bt cotton coverage in India 2009/10 (in lakh ha; 1 lakh = 100 000)

<table>
<thead>
<tr>
<th>States in India</th>
<th>Total area 2009/10</th>
<th>Bt area 2009/10</th>
<th>Non-Bt area 2009/10</th>
<th>% of Bt of 2009/10 total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maharashtra</td>
<td>35.03</td>
<td>30.48</td>
<td>4.55</td>
<td>87</td>
</tr>
<tr>
<td>Gujarat</td>
<td>26.24</td>
<td>15.39</td>
<td>10.85</td>
<td>96</td>
</tr>
<tr>
<td>Andhra Pradesh*</td>
<td>13.31</td>
<td>12.64</td>
<td>0.67</td>
<td>95</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>6.46</td>
<td>6.06</td>
<td>0.4</td>
<td>94</td>
</tr>
<tr>
<td>Punjab</td>
<td>5.36</td>
<td>5.14</td>
<td>0.22</td>
<td>96</td>
</tr>
<tr>
<td>Haryana</td>
<td>5.39</td>
<td>5</td>
<td>0.39</td>
<td>93</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>4.44</td>
<td>2.8</td>
<td>1.64</td>
<td>60</td>
</tr>
<tr>
<td>Karnataka**</td>
<td>4.16</td>
<td>2.62</td>
<td>1.54</td>
<td>63</td>
</tr>
<tr>
<td>Orissa</td>
<td>0.54</td>
<td>0.25</td>
<td>0.54</td>
<td>0</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>0.86</td>
<td>0.25</td>
<td>0.61</td>
<td>29</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>0.24</td>
<td>0</td>
<td>0.24</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>102.03</strong></td>
<td><strong>80.38</strong></td>
<td><strong>21.65</strong></td>
<td><strong>79%</strong></td>
</tr>
</tbody>
</table>

Source: DCD (2010); * adjusted by APSDA (2010) ** adjusted by KSDA (2010)

These figures only refer to official data from state governments (as of beginning of February 2010), and are based on company seed sales, thus do not take into account illegal Bt cotton cultivation, which according to PRAY AND RAHASWAMI (2009) was close to 20% in 2007. The original figure for Karnataka showed a total production of 3.95 lakh ha, of which 80% was given as Bt, however KSDA (2010) updated and corrected these numbers. Similarly, other states may as well modify their figures thus even these numbers shall rather be taken as estimates.
Illegal Seeds
Illegal seeds are those which are not approved by the GEAC or other regulatory bodies. The birth of illegal Bt cotton in India happened when Monsanto’s Bt gene escaped from the company’s field-trials and ended up in a cotton variety called N-151, which was sold in Gujarat by the Indian seed company Navbharat (MCGRAY 2002). Monsanto went public and sued Navbharat, which at the end was forced to stop producing its N-151 variety. Meanwhile, according to a joint Swedish-Indian study, „Monsanto’s three Bt varieties were hurried through a spectacularly incompetent regulatory process and approved for commercial cultivation” (SciDEV NET 2005). Since then, illegal Bt cotton varieties have proliferated and have been openly marketed cheaper than the legal hybrids in all the major cotton growing areas of the country.

According to data from PRAY AND RAHASWAMI (2009) almost the same amount of illegal Bt as legal Bt seeds were sold in 2005, and this decreased to 40% then to 20% over the next two years. According to statements by Monsanto India, Gujarat is the only state in India to manufacture illegal Bt cotton seeds (in 2007, 5 million packets) on a large scale (BUSINESS STANDARD 2008a). In 2007, the total area under illegal Bt cotton seed production stood at 1.2 million ha (down from 1.75 million ha in 2006), of which Gujarat constituted 637 000 ha (25% of its total cotton area), followed by Punjab with 169 000, Maharashtra with 117 000 and Haryana with 97 000 ha (BUSINESS STANDARD 2008a).

However, no current figures are available on the cultivation of illegal Bt seeds in India. Yet, not all illegal Bt seeds are truly Bt: there is also the problem of spurious Bt seeds, often in authentic looking packages but with poor quality seeds in terms of germination
percentage, viability and plant establishment (RAO 2007). Among samples collected and tested by CICR, only 26% of the Bt cotton was true first-generation hybrid, while 46% was contaminated with non-Bt cotton (SciDev Net 2006).

**Cotton farmers in crisis**
The arrival of the Bt era did not mean the elimination of pesticide sprays. Research on China’s Bt cotton reveals that farmers are still massively using pesticides on transgenic cotton (PEMS et al. 2007). An increase in secondary pests is already observed: “*though Bt farmers save a lot on primary pesticides, they have to spend more to suppress the outbreak of the secondary pests, leading to total pesticide expenditures between these two groups of farmers that are almost identical*” (WANG, JUST and PINSTRUP-ANDERSEN 2006). However, most often farmers do not have knowledge about the requirements of Bt cotton, and follow their own (or their neighbours’) spraying schedules. A survey by SHETTY (2004) showed that farmers in Guntur and Warangal districts of Andhra Pradesh sprayed cotton 20 to 30 times.

In India, K.R. Kranthi, acting director of CICR in Nagpur, said that the rapid adoption of GM cotton by farmers in India “*has coincided with the rise of hitherto unknown insect pests, increased pesticide applications by farmers, and declining cotton productivity over the past three years*” (THE TELEGRAPH 2010). India’s annual cotton output has jumped from 3 billion kg to 5.3 billion kg over the past decade, yet cotton productivity has declined: from 560 kg lint per ha in 2007 to 520 kg in 2008 and to 512 kg lint in 2009 (MOEF 2010,138). Most importantly, new insects, including mealybugs and mirid bugs, not known as cotton pests, have spread, causing significant economic losses and farmers have begun to spray extremely hazardous pesticides on the cotton to fight insects. But K.R. Kranthi expressed that many of the 619 Bt cotton hybrids appear susceptible to secondary pests and leaf reddening (MOEF 2010,137). Insecticide use in cotton appears to have increased from Rs 6.4 billion in 2006 to Rs 8 billion in 2008 (THE TELEGRAPH 2010).

SADASHIVAPPA AND QAIM (2009) came to opposite results using three rounds of a panel data set in four Indian states, showing that Bt cotton farmers benefited from pesticide reductions, higher yields, and significantly higher profits without Bt resistance development or spread of secondary pests. This inconsistency in results of Bt cotton and the proliferation of reports supporting both sides of the argument has contributed to the public confusion on the use of GM crops. The debate over Bt has been extremely intense last years and whatever side is presenting evidence to justify their truth, one thing

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3 Similar finding was reached by the first study that looked at the long-term economic impact of Bt cotton: conducted in five major cotton-producing provinces of China after seven years of Bt cultivation, it showed that populations of other insects have increased so much that farmers had to spray their crops up to 20 times in one growing season to control them (WANG, JUST and PINSTRUP-ANDERSEN 2008).
remains clear: cotton is mostly mono-cropped to maximise returns and that makes farmers highly vulnerable. Consequently in case of crop failures due to erratic rains, poor seed quality, increased pest attacks or indiscriminate use of pesticides, farmers who are most often taking loans to pay for their chemicals and seeds, lose everything.

Tens of thousands of farmers have got into the vicious cycle of debt and committed suicides the last decade. According to data from the National Crime Records Bureau, more than 16 000 farmer suicides happen every year due to failed crops and increased indebtedness (MENON 2003). The latest figures from this Bureau indicate that between 1997 and 2009, 200 000 farmers ended their lives (THE HINDU 2010a). A study on farmers’ suicides by VENKATESWARLU AND Srinivas (2000) indicated that indebtedness, resulting from high input costs, is the main reason for suicides of most of farmers.

3.2 Indian cotton seed market

As previously said, varieties can be reproduced for many generations with little deterioration in quality, enabling farmers to multiply their own seeds. This cannot be done with hybrids, since they suffer yield declines when used in subsequent generations, obliging farmers to purchase seeds every year from a public or private company.

Public hybrids are developed by state controlled agencies (i.e. agricultural universities, research centres) whereas private hybrids (also called proprietary hybrids) are developed by private seed companies through their own research. State seed corporations produce and market only public hybrids which are registered, notified and then certified by state seed certification agencies. Private seed companies produce and market both their own and also public bred hybrids. The government makes available the foundation seeds of public hybrids for anyone requesting them (so both for public and private seed companies). In contrast, private companies have patent rights over the production and marketing of private hybrids developed by them. Most often seed firms outsource the production of seeds to contract growers, to whom they supply the foundation seeds to produce commercial seeds.

In India, about 150 cotton varieties/hybrids have been released during the last 50 years. Out of these about 30-40 are under large scale cultivation although only about 20 varieties/hybrids account for more than 50% of production according to ALAM (2004). With about $ 250 million in sales, the Indian cotton seed sector is one of the largest cotton seed markets in the world (MURUGKAR, RAMASWAMI and SHELAR 2006,4). Since 1999, there has been a decline in the area under public hybrid seed production: between 1999 and 2004 the total area under public hybrids decreased from 5630 ha (13 960 acres) to 2708 ha (6175 acres). During the same period, the area under private cotton hybrid seed production increased from 4000 to 20 000 acres VENKATESWARLU (2004). Recent trends indicate that the decreased role of public sector in seed production and distribution
Cotton seed supply in South India is not only happening in India, but is the common picture elsewhere, be that in developing or developed countries (MORRIS 2002, MURUGKAR, RAMASWAMI and SHELAR 2007).

The main factors leading to such development in India in the cotton seed sector were explained i.a. by MURUGKAR, RAMASWAMI and SHELAR (2007). The authors argued that the most important external factors have been the 1991 economic reforms, which lifted barriers to investments by foreign and Indian firms; the introduction of plant breeders’ rights through the Plant Variety Protection Act; and the commercialisation of GM products. With the advent of a liberalised seed policy in the form of New Policy on Seed Development in 1988, the situation with regards to the seed sector players started changing: many national and multinational seed companies entered the business of seed production and marketing MURUGKAR, RAMASWAMI and SHELAR (2007). While farmers’ varieties started their erosion path earlier, the role of public sector began to lose importance after this policy.

The direction was thus clear, the ‘corporisation’ of the cotton seed sector was unstoppable: “[t]he Indian seed industry is rapidly moving into a phase of ‘corporate control over seeds’ with the introduction of transgenic crops” (SHIVA, EMANI and JAFRI, 1999). However the speed with which the shift from public to private sector domination took place was extraordinary. Without the following internal factors, the uniquely rapid take-over by the private sector could not take place:

i. most private companies entered the cotton seed business by marketing and producing public bred hybrids and relying on retired public sector breeders to lead their research;

ii. the private sector was quick to identify the unexploited market opportunities untouched by the public sector: e.g. short duration hybrids (which are exposed to weather risks for a shorter time);

iii. private companies gained much more by selling their own hybrids than by marketing public bred hybrids. This was coupled with the fact that “public sector seed corporations were unable or unwilling to invest in the marketing effort to compete with public bred hybrids” (MURUGKAR, RAMASWAMI and SHELAR 2007,4).

Equally important in the process of erosion of seed independence what STONE (2007) found out about the “deskilling” of farmers` skills in seed production and preservation based on a multi-year ethnographic study in Warangal district of Andhra Pradesh. According to him, farmers make their choice of seeds not based on own experience but on advertisements, thus their knowledge is contaminated.
3.2.1 Public seed sector in South India

“The deskilling of scientists took place even before deskilling of farmers, and government institutions lost before farmers lost, since none of their seeds are available on the market.” (CSA 2009)

The public sector consists of the National Seed Corporation, the State Farm Corporation of India and 13 state seed corporations which multiply and market varieties bred by the public sector institutions, i.e. the research institutes financed by the Indian Council for Agricultural Research (ICAR) and agricultural universities (MURUGKAR, RAMASWAMI and SHELAR 2006).

Out of the 13 state seed corporations in India, the four most important are in Maharashtra, Gujarat, Andhra Pradesh and Karnataka. They all depend on ICAR research since they do not have their own R&D. The late 1970s and early 1980s was an active period when the public sector released many location-specific hybrids (MURUGKAR, RAMASWAMI and SHELAR 2006). They had an important role up until 1988 when the New Seed Policy was created which allowed medium to big companies to enter the seed business. By the late 1990s, public bred hybrids were beginning to lose ground to private hybrids and since few years public bred hybrids have almost totally disappeared from the market.

The Seed Act of 1966 and the Seeds Control Order of 1983 laid down the rules on variety release, seed certification and seed testing, which is obligatory for all public bred varieties and hybrids (but only voluntary for private ones\(^4\)). Release is only possible after evaluation at multi-location trials for at least three years, after which they can be notified.

3.2.1.1 Public sector’s role in Karnataka’s cotton seed production

The University of Agricultural Sciences (UAS), Dharwad is the main public breeder of cotton varieties and hybrids in Karnataka, whereas the Karnataka State Seed Corporation (KSSC) is the main distributor of certified seeds, though KVKs\(^5\) also take up some seed production and mill owners also supply seeds to farmers after ginning of the cotton. Once

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\(^4\) In 2004, a new Seed Bill was proposed to replace the existing Seed Act of 1966 to make the registration of varieties obligatory. On 4th March, 2010 the bill was cleared at the cabinet meeting chaired by Prime Minister. According to provisions of the bill, “all varieties of seeds for sale have to be registered and the seeds are required to meet certain prescribed minimum standards”, though the bill is said not to restrict “the farmer's right to use or sell his farm seeds and planting material, provided he does not sell these under a brand name”. However, all seeds and planting material sold by farmers need to conform to the minimum standards applicable to registered seeds (INDIAVISION NEWS 2010).

\(^5\) Krishi Vignan Kendra (KVK) is a project of ICAR with the mandate of organising vocational training programmes in agriculture and other extension activities; testing on farmers’ fields in crop production, horticulture, livestock production, etc.; conducting front line demonstrations on major crops, etc. There are 562 KVKs in India, in every district.
breeder seeds are developed, KSSC and KSDA produce foundation seeds; while the department has its own farms, the seed corporation produces seeds on registered farmer fields. Once seeds are certified, they are distributed by KSSC.

University of Agricultural Sciences, Dharwad
Before the introduction of Bt, foundation seeds in Karnataka were produced among others by UAS, and were given to KSSC and to the National Seed Corporation. Yearly about 2500 tonnes of cotton seeds were produced on a contractual basis on farmers’ fields and 90% of these foundation seeds were supplied to KSSC. Varalaxmi, DCH-32 and DHH-11 were the most demanded hybrids. This situation changed about 5-6 years ago, when these hybrid seeds were supplied through government schemes directly to the farmers. However, as a senior from the Seed Production Unit of UAS explained, this stopped two years ago due to the lack of demand from the farmers – seeds are still left at the university’s storage place.

Varalaxmi, the first interspecific hybrid in the world was developed in 1971 at the Agricultural Research Station, Dharwad, followed by the release of DCH-32. “These two hybrids with extra long staple superiority in quality and unprecedented yield in quantity revolutionised the cotton cultivation in the entire country” (UASD undated). Other important cotton varieties/hybrids developed by the university are DHB-105, DHH-11, DHB-543, CPD-431, Abhadita, Sahana and DLSA-17.

The Organic Farming Institute has recently been established at the university to provide technical support for organic farmers. The institute has several non-Bt hybrids under research; two trials have been undergoing the past two years: one on the nutrient management of RAHB-87 and another one comparing DCH-32 under conventional, organic and integrative management. According to these trials, DCH-32 is an excellent hybrid and performs better under organic than under conventional conditions. Similarly, RAHB-87 can yield up to 6 quintal per acre (q/a). So far, however, no organic cotton seeds have been produced nor sold by them (because they were lacking a seed breeder, though this year the plan is to recruit one). Besides Dharwad, Punjab and Coimbature universities are involved with research on organic cotton, however the greatest cotton germplasm bank in India is at Dharwad.

At the moment the Seed Unit of Dharwad University is only producing varieties, about 50-60 quintals (500-600 kg) yearly, though the demand has increased last year (due to the

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6 Personal communication with Dr. N.K. Biradar Patil, Seed Production Unit. Dharwad, 02-12-09.
7 Ibid.
8 Quintal per acre is the usual way of expressing yields in India, thus throughout this paper this type of measurement is used with the abbreviation q/a.
9 Personal communication with Dr H.B. Babalad, Institute of Organic Farming. Dharwad. 02-12-09.
damaged crops in Kharif season\textsuperscript{10}) and thus the supply could not meet the demand. Anyone requesting non-Bt hybrids and varieties can place an indent but one season in advance is necessary to produce the seeds. The mandate of the Seed Unit is to produce quality seeds of nucleus, breeder, foundation and certified classes at university and farmers fields and to carry out research on seed production, certification, processing, testing and storage. The unit has been recently producing Jayadhar, Sahana and Renuka cotton varieties. Sahana is requested from the research station in Bagalkot district, whereas Jayadhar at Annikeri research station (Dharwad district), which then produce the certified seeds and sell them to the farmers at the rate of 40 Rs/kg\textsuperscript{11}.

**Karnataka State Seed Corporation (KSSC)**
The KSSC is the most important public sector institution selling cotton hybrids in Karnataka. At least up until few years ago they had produced non-Bt hybrids (DCH-32, DHH-11, NHH-44) however it turned out that this is not the case anymore due to the low demand for these hybrids. There are still 2000 quintals of non-Bt hybrids stored by KSSC, causing several crore (Rs 10 million) of damage to the corporation since they cannot be sold, according to a KSSC seed officer interviewed (KSSC 2009). For the 2009/10 growing season, KSSC sold hybrids from the 2006/07 harvest for free, yet noone wanted them; only organic projects asked but for such limited amounts (100-200 kg of seeds) that it does not worth it economically (KSSC 2009). This is the reason KSSC stopped producing non-Bt hybrids and is considering entering the Bt cotton business as of this year (KSSC 2009).

There were rumours told by several NGOs that last year KSSC started distributing Bt seeds with the brand name Beeja Raaja, sourced from the private company JK Seeds, and sold 936 packets. When contacting district officials at Mysore, they admitted that actually most of the 41 595 ha of cotton grown in the district is Bt purchased from KSSC. A technical officer at KSDA (2010) even admitted that these Bt seeds performed really poorly in the district and farmers have demanded compensation.

All organic projects using non-Bt hybrids in Karnataka have purchased the seeds from KSSC. However, the corporation also told organic projects that non-Bt hybrid seeds were not going to be kept for the next growing season.

**Karnataka State Department of Agriculture (KSDA)**
The KSDA’s role in the cotton seed sector is the distribution of certified seeds in Karnataka. Last year, 4237 kg of certified seeds were distributed (KSDA 2010). The Department usually places an indent with KSSC for the district-wise distribution of

\textsuperscript{10} There are two major cropping seasons in India: Kharif and Rabi. The Kharif season is during the south-west monsoon (July-October) whereas the Rabi season is during the winter months. So when cotton is sown during summer between May and July, it is referred to as *Kharif* cotton, when it is sown during the winter season from August till October, it is also called as *Rabi* cotton.

\textsuperscript{11} *Supra* note 6.
cotton seeds under the government subsidy scheme. According to technical officers at the Department, in 2009/10 indent was only placed for DCH-32, since the government subsidy scheme only covers extra-long staple non-Bt hybrids like DCH-32, Varalakshmi and DCH-105, however there is demand only for the first one from farmers (KSDA 2010).

3.2.1.2 Public sector’s role in Andhra Pradesh’ cotton seed production

Agriculture University in Andhra Pradesh

The Acharya N.G. Ranga Agriculture University (ANGRAU) has been working on the development of new cotton hybrids and varieties for several decades in four research stations (Guntur, Kurnool, Warangal and Adilabad districts). Dr M. Gopinath, who is the main cotton breeder of the university, explained that the research stations have several G. hirsutum varieties and non-Bt hybrids, many of them with higher yield potential than Bt hybrids. “Since no one wants varieties and the university is not involved in the promotion of seeds, not one single gram of seed has been solved the last 15 years” (ANGRAU 2010). Although, the media reported that the university is in the process of developing its own version of Bt cotton, which would be available for sale by 2009 (THE HINDU 2007), this seems to be “false and was rather a dream” (ANGRAU 2010). The university is not authorised to do research on Bt, since it does not have its Bt genes.

Andhra Pradesh State Seeds Development Corporation (APSSDC)

The APSSDC was established in 1976 to obtain breeder seeds from the Agricultural University and research stations, produce foundation seeds and supply them to identified farmers for seed multiplication and propagate certified seeds among farmers. The corporation has been engaged in seed production of foundation and certified cotton seeds of hybrids and varieties and it has supplied seeds through dealers, primary agricultural cooperative societies, integrated tribal development agencies and agricultural market committees and also has created a dealers network in the state.

The system deteriorated, however, when the state government directed the APSSDC to purchase private seeds. In a phone interview, an APSSDC officer confirmed that the corporation gave up selling cotton seeds several years ago. The last available data on public hybrid production in the state comes from 2004/05 and is shown in Table 6.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (Mio ha)</th>
<th>Private hybrids</th>
<th>Public hybrids</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-97</td>
<td>1.02</td>
<td>42</td>
<td>36</td>
<td>22</td>
</tr>
<tr>
<td>1998-99</td>
<td>1.28</td>
<td>48</td>
<td>41</td>
<td>12</td>
</tr>
<tr>
<td>2000-01</td>
<td>1.02</td>
<td>73</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>2002-03</td>
<td>0.69</td>
<td>93</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2004-05</td>
<td>1.17</td>
<td>81</td>
<td>11</td>
<td>8</td>
</tr>
</tbody>
</table>

Interestingly, both public hybrids and varieties were still available in 2004/05, though the trend of decrease is quite obvious. How all the 19 public hybrids and varieties suddenly disappeared is quiet a remarkable development and could possibly be explained by the price drops of private Bt hybrids in 2006. According to CSA (2008, 2009) since 2006, no public sector notified hybrid was registered for seed production with the state seeds certification agency.

On the other hand, the corporation was proposing in 2008 to get into the development of Bt cotton seeds, by first identifying companies that had the seed stock to partner with, then by buying the parent lines from these companies and by producing cotton seeds in farmers’ fields. The plan that was publically announced is to develop own hybrids by 2010 and sell half a million packet of Bt cotton seeds (BUSINESS STANDARD 2008b).

**Andhra Pradesh State Department of Agriculture (APSDA)**

The Andhra Pradesh government was the first state to have set a maximum retail price for Bt seeds at Rs 750 per packet (Rs 650 for Bollgard I, Rs 750 for Bollgard II), which was followed by several other states. This kicked off the rapid adoption of Bt cotton in the state and the consequent disappearance of public hybrids and varieties.

On its website the department proposed to implement a seed village scheme in 11 500 units covering an area of 115 000 ha during 2009/10 with a targeted certified seed production of 0.194 million tonnes. The objective is to supply foundation seeds to identified farmers and empower them to take up multiplication of seeds in order to meet the requirement of farmers. Although thirteen crops are targeted, cotton is not one among them. According to an agriculture official from the department, cotton seed production is 100% in the hands of private companies and the agricultural department has not produced any cotton seeds the past 3-5 years.

### 3.2.2 Private seed sector in South India

As opposed to public bred varieties/hybrids, certification is not mandatory for private bred ones (at least till the new Seed Bill is enacted, which makes certification obligatory). Sometimes it happens that private seed companies submit their hybrids for certification, but generally they do not want to go through the time consuming process of notification - this obviously supported the rapid increase of released Bt hybrids.

The first private sector cotton hybrid, MECH 11 was commercialised by Mahyco in 1979, whereas the company’s most successful cotton hybrid, MECH 1 was released in 1982 (MURUGKAR, RAMASWAMI and SHELAR 2006). Most companies started their intra-hirsutum hybrid releases only in the 1990s. Some others entered the cotton seed business

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12 http://agri.ap.nic.in/seed_village.htm, 11-03-10.
13 Phone communication with Kumara Swamy, APSDA, 11-03-10.
by marketing and producing public bred hybrids. From the late nineties onwards, a rapid development kicked off which reshaped the whole seed sector scenery in few years.

There are no firm estimates of the number of private seed firms; estimates vary from 200 to 500. Unlike the public sector, where research is separate from seed production and marketing, these functions are integrated in the private firms. The biggest private firms in terms of cotton seed packets sold in 2008 in India were Nuziveedu Seeds – which sold about 5 million packets of Bt seeds –, followed by Rasi (4 million), Mahyco (3 million) and Tulsi Seeds (2.5 million). Others, including Ankur Seeds, Emergent Genetics India and Vibha Agrotech, sold about 0.5-1 million packets each (THE HINDU BUSINESS LINE 2008a).

In Karnataka the top four seed companies sold altogether 1.01 million packets of Bt seeds in 2009 (KSDA 2010): Mahyco is leading (455 000 packets) among the companies, followed by Nuziveedu (304 000), Rasi (171 000) and Tulsi (77 000). In Andhra Pradesh, Nuziveedu is selling most cotton seeds (1.8 million), followed by Tulsi (1.15 million), Mahyco (700 000) and Rasi (400 000)14. Ankur Seeds, which sold about 150 000 packets of Bt seeds in 2009/10, did not sell any non-Bt seeds in Andhra Pradesh, although the year before they still had non-Bt seeds; according to the state regional manager of the company, due to the low demand it was not worth to produce non-Bt any more15.

Figure 4: Private sector sale of certified varieties in Karnataka

![Certified cotton varieties' sales (quintals)](image)

Source: adapted from KSDA (2010)

Although the 2008/09 season shows increased sales in varieties, the data from 2009/10 proves that it was rather an exception in a decreasing trend. It is clearly visible that during the last nine years, the sale of certified seeds by private companies has come down drastically, by 540% from 2065 to 385 quintals (1 quintal = 100 kg). These certified

14 Phone interview with Mr Balu, assistant director of agriculture, APSDA. 11-03-10.
15 Phone interview with regional sales manager of Ankur Seeds in Andhra Pradesh. 20-02-10.
seeds are produced by the public sector but sold through private channels – though none of the certified seeds are from fresh lots but from cold storage where seeds have been kept for few years.

Besides the sale of certified seeds, no information was received about how much of the non-certified, non-Bt hybrids and/or varieties the private sector produces or distributes. By contrast, it is known that in the 2009/10 growing season more than 1.03 million packets of Bt cotton (of 450 g) were sold by private companies, mostly by Mahyco, Nuziveedu and Tulsi in Karnataka (KSDA 2010). Although district-wise sales data is available, not all hybrid packets are used in the state where they were sold; for instance, most Bt packets were sold in Dharwad last year, the district is however only the sixth biggest Bt grower in the state (KSDA 2010).

Nuziveedu Seeds Pvt Ltd

When interviewed, the vice-president of Nuziveedu explained that the company produces 10 million packets (of 450 g) of Bt cotton, out of which 8 million was sold last year, as against 6.5 million in 2008 and 4.8 million packets in 2007 (NUZIVEEDU 2009). The company also produces non-Bt cotton seeds - but mainly to use as refuge\(^{16}\) around Bt fields -, which is mandatory to supply along with Bt seeds to prevent pest resistance, as ordered by GEAC guidelines. Thus overall, about 21% of total production (120 g with every 450 g packet) is non-Bt. The most popular seeds are Bt Mallika and Bt Bunny, which together sold 6.5 million packets last year (NUZIVEEDU 2009). The company has about 20 000 dealers across 14 states of India.

\(^{16}\) A refuge is a non-Bt crop planted around the Bt cotton. In India, a non-Bt cotton refuge is required as part of an insect resistance management programme for Bollgard cotton. “The size of the refuge belt should be such as to take at least five rows of non-Bt cotton or shall be 20% of total sown area whichever is more” (MOEF 2003). Each Bt packet sold has to contain a separate packet of non-Bt cotton seeds which is sufficient for planting in the refuge.
The non-Bt production was about 35,000 packets in India out of which 20,000 was sold in Andhra Pradesh. The sale of non-Bt seeds has been constantly decreasing last years: in 2007/08 270,000, in 2008/09 76,000 and in 2009/10 35,000 packets were sold besides the refuge seeds (NUZIVEEDU 2009). The company sells its proprietary non-Bt seeds: Bunny, Mallika, Super Bunny and Kisan Early, mostly in Maharashtra, Madhya Pradesh and Andhra Pradesh. The vice-president of the company estimated that the total non-Bt production in India is less than 50,000 packets (NUZIVEEDU 2009).

The vice-president explained about the illegal Bt coverage in South India that the sale of illegal Bt has drastically come down with the government lowering the prices of Bt cotton. In 2009, it was estimated at about 7% (about 1.8 million packets) and in South India it was negligible (NUZIVEEDU 2009).

### 3.2.3 Informal seed sector in South India

**NGOs**

Several NGOs are involved with seed production and/or distribution, mostly those that promote organic practises. The general finding throughout this research has been that wherever desi varieties are grown, farmers save their seeds, where improved varieties or non-Bt hybrids are cultivated, NGOs coordinate the seed procurement or production, cotton purchase and ginning, other inputs and the training of farmers.

Besides NGOs that are the basis of organic cotton projects in the South, KVKs can also play an important role. Though every district has its KVK, during the field research only one was found where cotton seed production has been carried out: at Hulkti, near Gadag in Karnataka, the Krishi Vigyan Kendra (KVK) has converted its 88-acre farm into organic farming. Set up in 1985, the KVK has been experimenting with several varieties of cotton. As Dr Hiregoudar, the head of KVK explained, the research last years has focused on a change of variety from Jayadhar: two varieties were tested (DLSA 17 and RAHS 14) with the main objective to improve the staple length because mills require longer staples (KVK 2009). Besides, another improved Jayadhar variety was developed few years ago called DDHC-11, which is higher yielding and has a better fibre quality than Jayadhar.

According to Dr. Hiregoudar (KVK 2009), yearly the KVK sells 30 quintals of Jayadhar seeds to about 200-300 farmers and 20 quintals of DDCH-11 seeds to approximately the same amount of farmers for a rate of 30 Rs/kg produced on their own commercial plots (where organic, relayed cropping is practised). Furthermore, the KVK selects one farmer in some villages to produce variety seeds, and after the ginning, the KVK sells the seeds – this way altogether 50 quintals of DDCH-11 seeds are sold to approximately 400 people every year (KVK 2009).
There are other NGOs in South India which are not directly linked to any organic cotton project but work generally on the promotion of organic practices among farmers, like the Green Foundation, Organic Exchange, Centre for Sustainable Agriculture, Deccan Development Society, Greenpeace, GRAIN to name just a few. Some of them play a very important role in seed production trainings, in testing and providing new non-Bt seeds to organic farmers (most importantly the Centre for Sustainable Agriculture).

**Farmers saving seeds**
In case of varieties, most often seeds are saved by the farmers, however when cotton is taken to the ginneries (where cotton lint is separated from the seeds), seeds are passed out of the hands of farmers. After ginning a fresh supply is given back to the growers (of which quality can be questioned, since mixing with other cotton is often unavoidable). Cotton seed viability can be maintained to the following planting season without significant deterioration, however if conditions are warm and humid, special precautions must be taken (e.g. packing in sealed polythene bags to prevent contact from moist air).
4 Cotton seed availability in South India

In the south zone, cotton is cultivated in hot semi-arid regions, mostly in medium-black, red and black soils. Both irrigated and rainfed cotton is grown: irrigated cotton occupies 26% of cotton areas in Karnataka and 36% in Andhra Pradesh (SUNDARAM et al. 1999). This chapter looks into the seed availability aspect: both the current production of varieties and non-Bt and Bt hybrids was studied in the two states on the basis of interviews with government officials, research centres, universities, seed dealers, NGOs and public sector seed suppliers.

4.1 Cotton production of varieties

Cotton varieties are predominantly grown under rainfed conditions and they have high potential in surviving droughts because their water requirements are limited. Since desi cotton growing areas have not been exposed to much pesticides use, high populations of natural enemies (predators and parasites) are still to be found in their vicinity (DCD undated). According to a report published online by the DCD (undated), *G. herbaceum* has several advantages over *G. hirsutum* varieties and hybrids: it is more suitable for rainfed areas, its cultivation costs are less, and its biotic and abiotic (salinity and drought) tolerance is higher. Although the boll size is smaller and its growth takes longer, it is the best species for harsh weather conditions.

Table 7: Status of *G. herbaceum* vis-à-vis *G. hirsutum* hybrids/varieties

<table>
<thead>
<tr>
<th>Particulars</th>
<th><em>G. herbaceum</em></th>
<th><em>G. hirsutum</em> hybrids/varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (% of total)</td>
<td>11</td>
<td>73</td>
</tr>
<tr>
<td>Resources allocation</td>
<td>negligible</td>
<td>predominant</td>
</tr>
<tr>
<td>Sucking pests</td>
<td>resistant</td>
<td>susceptible</td>
</tr>
<tr>
<td>Leaf curl</td>
<td>immune</td>
<td>susceptible</td>
</tr>
<tr>
<td>Boll worms</td>
<td>comparatively tolerant</td>
<td>susceptible</td>
</tr>
<tr>
<td>Fiber properties</td>
<td>coarse and short</td>
<td>smooth and long</td>
</tr>
<tr>
<td>Suitability to rainfed areas</td>
<td>more suitable and yields more</td>
<td>not suitable and yields less</td>
</tr>
<tr>
<td>Cost of production</td>
<td>less</td>
<td>high</td>
</tr>
<tr>
<td>Seed production programme</td>
<td>weak</td>
<td>strong</td>
</tr>
<tr>
<td>Social problems</td>
<td>not reported</td>
<td>reported</td>
</tr>
</tbody>
</table>

Source: DCD (undated)
The report claims that there are 460 global germplasm lines of *G. herbaceum* maintained at CICR, but research with *G. herbaceum* is only carried out at the research stations of two agriculture universities in Gujarat and Karnataka. Due to the emphasis on *G. hirsutum* during the last half century, it claims, genetic studies on diploid cotton almost totally ceased. The dominance of these varieties in certain pockets of India still persists today because of “…its immense ability to withstand biotic and abiotic stress (…) hence they deserve better attention for competitive cotton production both under rainfed and limited irrigation system…” (DCD undated).

These varieties have high potentials in terms of suitability to different agronomic conditions and to diverse spinning needs, however their shrinking areas suggest that those will not be exploited and utilised. The report claims that the low productivity of *G. herbaceum* is mainly because of its poor seed quality. The most important reasons for this are probably i) lack of interest of both the private and public sector in seed research, production and distribution; and ii) the necessity of farmers to get unprocessed, poor quality seeds from ginneries where due to mixtures of seed, the genetic purity of varieties becomes highly questionable.

Desi varieties are mostly grown in Karnataka and Gujarat. Many important cotton varieties were released in the South; the ones released after 1950 are shown in Table 8.

Table 8: Cotton varieties released in Karnataka

<table>
<thead>
<tr>
<th>Variety name</th>
<th>Cotton specie</th>
<th>Year of release</th>
<th>Days to maturity</th>
<th>Fiber length</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jayadhar</td>
<td>Herbaceum</td>
<td>1950</td>
<td>200</td>
<td>23</td>
<td>wilt tolerant; able to withstand dry spells; resistant to pests, diseases</td>
</tr>
<tr>
<td>Suyodhar</td>
<td>Herbaceum</td>
<td>1963</td>
<td>200</td>
<td>23</td>
<td>suited to low rainfall areas</td>
</tr>
<tr>
<td>Raichur-51</td>
<td>Herbaceum</td>
<td>1968</td>
<td>190</td>
<td>21</td>
<td>suited to low rainfall areas</td>
</tr>
<tr>
<td>Renuka</td>
<td>Herbaceum</td>
<td>1983</td>
<td>170</td>
<td>22</td>
<td>earliest in maturity</td>
</tr>
<tr>
<td>DDHC-11</td>
<td>Herbaceum</td>
<td>2003</td>
<td>180</td>
<td></td>
<td>higher yield potential; resistant to alternaria blight</td>
</tr>
<tr>
<td>RAHS-14</td>
<td>Herbaceum</td>
<td>2003</td>
<td>180</td>
<td></td>
<td>higher yield potential; tolerant to salinity</td>
</tr>
<tr>
<td>DLSA-17</td>
<td>Arboreum</td>
<td>2003</td>
<td>160</td>
<td>27-29</td>
<td>long staple with good boll opening</td>
</tr>
<tr>
<td>AK-235</td>
<td>Arboreum</td>
<td>1984</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sahana</td>
<td>Hirsutum</td>
<td>2001</td>
<td>160</td>
<td>26</td>
<td>multiple pest tolerant</td>
</tr>
<tr>
<td>Abadhita</td>
<td>Hirsutum</td>
<td>1983</td>
<td>160</td>
<td>26</td>
<td>tolerant to bollworm</td>
</tr>
<tr>
<td>LRA-5166</td>
<td>Hirsutum</td>
<td>1983</td>
<td>160</td>
<td>26</td>
<td>suitable for summer season too; tolerant to jassids</td>
</tr>
<tr>
<td>MCU-5</td>
<td>Hirsutum</td>
<td>1976</td>
<td>165</td>
<td>33</td>
<td>extra long staple</td>
</tr>
</tbody>
</table>
4 Cotton seed availability in South India

<table>
<thead>
<tr>
<th>Surabhi</th>
<th>Barbadense</th>
<th>1997</th>
<th>32 resistant to pests, diseases; extra long staple</th>
</tr>
</thead>
</table>

Source: based on DCD (undated) and CRC (2009)

Table 9: Time of sowing of cotton in South India

<table>
<thead>
<tr>
<th>Cotton species</th>
<th>Time of sowing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfed</td>
<td></td>
</tr>
<tr>
<td>(G. \ herbaceum)</td>
<td>July-Sept</td>
</tr>
<tr>
<td>(G. \ arboreum)</td>
<td>May-July</td>
</tr>
<tr>
<td>(G. \ hirsutum)</td>
<td>May- 15th July</td>
</tr>
<tr>
<td>Irrigated</td>
<td></td>
</tr>
<tr>
<td>Hybrids</td>
<td>May- 15th July</td>
</tr>
<tr>
<td>summer cotton</td>
<td>Febr-March</td>
</tr>
</tbody>
</table>

\(G. \ herbaceum\) varieties in Karnataka are sown with the start of the monsoon rains in August/September at a narrow spacing either as monocrop or intercropped with chillis and onion (mostly in Dharwad, Gadag, Belgaum, Haveri districts) and horsegram (in Bagalkot district). Studies have proven that intercropping increases income potential under rainfed conditions in Karnataka: for instance ANON (1989; cited in DCD undated) showed that Jayadhar grown with onion resulted in 206-210% higher income than if both crops were planted as a monocrop. Desi cotton is harvested in February-March. Other species are sown in the Kharif (summer) season in May-July and harvested in November-December, except for the summer cotton, like the LRA-5166, which is sown in the Rabi (winter) season and harvested during the summer (hence its name).

4.2 Shrinking areas of non-Bt cotton

4.2.1 Karnataka

One third of the total cotton production in Karnataka has been usually \(G. \ herbaceum\) (CRC 2009). No data was provided by governmental authorities on the variety-wise cultivation of cotton species in Karnataka or any other state. The latest figures were published from 2002/03, when Bt cotton was hardly cultivated in the state. Whereas in 2002/03, about 215 000 ha were cultivated with cotton varieties (italics signals cotton varieties in Table 10), by 2008/09 this number decreased to 138 000 ha and by 2009/10 to 124 000 ha (KSDA 2010).

In 2004/05, there were still 7 public hybrids and 58 varieties left in Karnataka (Table 11). Since then, there is clear decrease in areas sown with varieties and by 2009/10, only about 3-4 popular varieties have been sown in the state.
Table 11: Share (%) of cotton hybrids and varieties in Karnataka

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (Mio ha)</th>
<th>Private hybrids</th>
<th>Public hybrids</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-97</td>
<td>0.67</td>
<td>2</td>
<td>76</td>
<td>22</td>
</tr>
<tr>
<td>1998-99</td>
<td>0.64</td>
<td>7</td>
<td>55</td>
<td>38</td>
</tr>
<tr>
<td>2000-01</td>
<td>0.56</td>
<td>7</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td>2002-03</td>
<td>0.37</td>
<td>14</td>
<td>21</td>
<td>65</td>
</tr>
<tr>
<td>2004-05</td>
<td>0.23</td>
<td>32</td>
<td>7</td>
<td>58</td>
</tr>
</tbody>
</table>


Table 10: Cotton varieties/hybrids in Karnataka (2002-03)

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Cotton area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jayadhar</td>
<td>187 660</td>
</tr>
<tr>
<td>DCH-32</td>
<td>75 150</td>
</tr>
<tr>
<td>AK-235</td>
<td>9860</td>
</tr>
<tr>
<td>Suyodhar</td>
<td>3650</td>
</tr>
<tr>
<td>NHH-44</td>
<td>35 240</td>
</tr>
<tr>
<td>DHH-11</td>
<td>21 640</td>
</tr>
<tr>
<td>Varalaxmi</td>
<td>8630</td>
</tr>
<tr>
<td>DBH-105,</td>
<td></td>
</tr>
<tr>
<td>Sabita, Abadhita, Renuka, etc.</td>
<td>29 170</td>
</tr>
<tr>
<td>Total</td>
<td>371 000</td>
</tr>
</tbody>
</table>

Source: DCD (2005)

Figure 6: Trend in cotton seed use in Karnataka (2002-10)

Cotton seed use in Karnataka

Source: based on KSDA (2010)

Due to the lack of available data on different hybrids and varieties at state level, district level agriculture offices were contacted in order to find out what was the current situation with cotton varieties and hybrids. The received data proved that the decrease further continued and only few varieties could still be found out of those released in Karnataka.

In 2009/10, the total coverage by varieties in Karnataka has decreased to between 125-130 000 ha, most of which have been grown in Gadag, Dharwad, Koppal, some in
Bellary, Raichur, Davanagere and Bijapur districts. Jayadhar still dominates as a desi variety in North Karnataka, mostly in Dharwad (49,540 ha) and Gadag (45,400 ha) districts and in some parts of Koppal and Bellary. Jayadhar is followed in terms of areas sown by an improved Jayadhar variety called RAHS-14 (8065 ha) in Gadag and a *G. arboreum* called AK-235 (appr. 5000 ha) in Bellary district. On the basis of field interviews and phone conversations with district officials, the following table was constructed to summarise the situation of non-Bt cotton production in the state.

**Table 12: Karnataka non-Bt cotton cultivation in 2009/10**

<table>
<thead>
<tr>
<th>District</th>
<th>Hectares</th>
<th>Variety/hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VARIETIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dharwad</td>
<td>49,540</td>
<td>Jayadhar</td>
</tr>
<tr>
<td>Gadag</td>
<td>45,400</td>
<td>Jayadhar, RAHS-14 (8065 ha)**</td>
</tr>
<tr>
<td>Koppal</td>
<td>15,540</td>
<td>Jayadhar</td>
</tr>
<tr>
<td>Bellary</td>
<td>5088</td>
<td>Jayadhar, RAHS-14, AK-235</td>
</tr>
<tr>
<td>Chitradurga</td>
<td>21,32</td>
<td>Jayadhar, <em>G. arboreum</em> variety</td>
</tr>
<tr>
<td>Davanagere</td>
<td>993</td>
<td>Jayadhar</td>
</tr>
<tr>
<td>Gulbarga</td>
<td>600</td>
<td><em>G. hirsutum</em> variety</td>
</tr>
<tr>
<td>Bagalkot</td>
<td>340</td>
<td>Virnar</td>
</tr>
<tr>
<td>Belgaum</td>
<td>115</td>
<td>Desi varieties</td>
</tr>
<tr>
<td>Bijapur</td>
<td>107</td>
<td>LRA-5166</td>
</tr>
<tr>
<td><strong>HYBRIDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellary</td>
<td>9,080*</td>
<td>NHH-44, DCH-32</td>
</tr>
<tr>
<td>Mysore</td>
<td>4,230</td>
<td>DCH-32</td>
</tr>
<tr>
<td>Chitradurga</td>
<td>2,410</td>
<td>non-Bt hybrids</td>
</tr>
<tr>
<td>Bijapur</td>
<td>2,193*</td>
<td>non-Bt hybrids</td>
</tr>
<tr>
<td>Davanagere</td>
<td>2,080*</td>
<td>DCH-32, DHB-105, DHH-11</td>
</tr>
<tr>
<td>Raichur</td>
<td>2,000*</td>
<td>NHH-44</td>
</tr>
<tr>
<td>Gadag</td>
<td>672*</td>
<td>DDHC-11</td>
</tr>
<tr>
<td>Belgaum</td>
<td>551</td>
<td>non-Bt hybrids</td>
</tr>
<tr>
<td>Haveri</td>
<td>428</td>
<td>DCH-32, DHH-11</td>
</tr>
<tr>
<td>Dharwad</td>
<td>282*</td>
<td>DHH-11, DHB-105</td>
</tr>
<tr>
<td>Bagalkot</td>
<td>244</td>
<td>NHH-44, DCH-32</td>
</tr>
<tr>
<td><strong>ORGANIC</strong>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mysore</td>
<td>806*</td>
<td>DCH-32, Varalaxmi</td>
</tr>
<tr>
<td>Gadag</td>
<td>405*</td>
<td>Jayadhar, Surabhi, RAHS-14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>145,236</td>
<td></td>
</tr>
</tbody>
</table>

Source: based on district agricultural offices, Karnataka (2010).

* approximate number
** estimation from CRC (2009)
*** data from organic cotton projects (2009)
Thus in total about 145 236 ha non-Bt cotton was found to be grown in Karnataka. Several district officials only gave approximate figures for non-Bt hybrids, therefore the final figure shall rather be taken as a close estimate. For instance, about 35% of the Kharif season cotton in Bellary, 5-10% in Davanagere, 30% in Bijapur was said to be non-Bt hybrid cotton by district officials.

In other districts, like Dharwad, officials claimed that there was no non-Bt hybrid cultivation, whereas for instance the main seed dealer interviewed in the city of Dharwad gave the exact number of non-Bt hybrid seed (DHH-11, DHB-105) as well as variety (Abhaditha) packages that were sold by him for the 2009/10 season. It may indeed happen that these seeds were bought by farmers from other districts yet they should still be taken into account for the overall non-Bt cotton area for the whole state.

Similarly, the new improved Jayadhar variety called RAHS-14, has been spreading the last three years from village to village in Gadag district, yet the district official contacted did not know about this variety. Nevertheless several villages were visited during the field research where this variety was used and according to the estimates of CRC (2009), about 20 000 acres (8065 ha) are planted already with this variety (mostly in Gadag, but some in Bijapur and in Chitradurga). This was not accounted for in the official Rabi season cotton in Gadag in Table 12, neither in Bijapur, where farmers bought 35 quintals of RAHS-14 seeds, which translates to an additional 560 ha, (with seed rate of 2.5 kg/a). If the cultivation of this improved variety was taken into account, close to 153 500 ha would be grown with non-Bt cotton in Karnataka. This comes very close to the official figure received from KSDA (2010), according to which 154 000 ha was non-Bt in 2009/10, out of which 124 000 ha are varieties and 30 000 ha are non-Bt hybrids.

Furthermore, although the agricultural office in Mysore did not know the percentage of non-Bt in the district, according to the KSDA (2010) more than 17 000 packets (two packets equal 1 kg), whereas according to the KSSC Mysore office 10 497 kg of DCH-32 were sold in 2009/10 in this district. This later is sufficient for about 4230 (1 kg is used for 2 acres) ha – this figure was used in the table above.

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17 Personal communication with Prabhu Nadakatti, seed dealer, Dharwad. 03-12-09.
18 Phone interview with Joint Director of Agriculture, Mysore district. 15-01-10.
Overall, the total non-Bt production that this research found out district-wise, matched the figure given by KSDA. The official cotton production figure of Karnataka is 4.16 lakh for 2009/10, out of which 2.62 ha are covered with Bt cotton. This means that the Bt coverage in the state is 63%, which is the majority of cotton, yet it is lower than the overall Bt percentage of India (79%).

Everything in Kharif season may be accounted as Bt and everything else grown in Rabi as non-Bt – this simplification may be true in some districts, yet in most it does not take into account that still thousands of farmers are opting for non-Bt hybrids - such as DCH-32, NHH-11 and DHB-105 - in the Kharif season. The figure below shows the cultivation of cotton in 2009/10 in the top cotton producing districts of Karnataka. All cotton grown in the Rabi season covers non-Bt varieties. The percentages written in the columns indicate how much of the Kharif season’s cotton has been Bt in that district. It is straightforward from the figure that Bt cotton has taken over the Kharif season cotton production and dominates in all districts of Karnataka (except for Dharwad and Gadag, where Rabi cotton is still prevalent).
A senior breeder from CRC (2009) at Hebbali explained that the reason why the desi cotton acreage is shrinking is because the decision to grow desi varieties very much depends on the rainfall patterns: if rainfall is optimum, farmers prefer growing *G. hirsutum* hybrids, if rainfall is low, they go for desi varieties. In Gadag for instance, if rainfall is too little (less than 400 mm) the most remunerative option for farmers is to grow desi cotton, yielding about 2 q/a. If there has been a little higher rainfall, 3-5 q/a can be reached by varieties. In case one irrigation can be applied, the yield increases to 6-8 q/a (CRC 2009). However if farmers can afford one irrigation, they rather go for Bt hybrids and get even higher yields.

More specifically, the area of *G. arboreum* (e.g. DLSA-17, AK-235) has shrunk considerably because these varieties have to be sown early (May-June) and if at that time enough rain has fallen, farmers rather switch to Bt cotton, whereas *G. herbaceum* varieties are sown later in August, by which time the decision over whether to grow Bt must have been taken (Bt is sown till mid-July).

### 4.1.2 Andhra Pradesh

The research has found that the situation in Andhra Pradesh is quite different. The following varieties are listed by the CI CR (2007) as recommended for cultivation in the state: MCU 5, LRA 5166, Kanchana (LPS-141), L 389, L 603, L 604, NA 1325 (Narasimha) and two desi varieties Aravinda and Veena. More varieties released for commercial production are listed in Table 13.

#### Table 13: Varieties released in Andhra Pradesh

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Year of release</th>
<th>Yield (q/ha)</th>
<th>Duration (days)</th>
<th>Staple length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>G. hirsutum</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCU 5</td>
<td>1968</td>
<td>19</td>
<td>165</td>
<td>30</td>
</tr>
<tr>
<td>LRA 5166</td>
<td>1982</td>
<td>10 (R)</td>
<td>180</td>
<td>24</td>
</tr>
<tr>
<td>Kanchana</td>
<td>1987</td>
<td>20</td>
<td>180</td>
<td>25</td>
</tr>
<tr>
<td>LK 861</td>
<td>1993</td>
<td>25</td>
<td>180</td>
<td>27</td>
</tr>
<tr>
<td>L 603</td>
<td>1997</td>
<td>23</td>
<td>155</td>
<td>28</td>
</tr>
<tr>
<td>L 604</td>
<td>1997</td>
<td>26</td>
<td>160</td>
<td>26</td>
</tr>
<tr>
<td>Krishna</td>
<td>1968</td>
<td>10 (R)</td>
<td>145</td>
<td>25</td>
</tr>
<tr>
<td>Narasimha</td>
<td>1993</td>
<td>8 (R)</td>
<td>180</td>
<td>24</td>
</tr>
<tr>
<td><em>G. arboreum</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aravinda</td>
<td>1998</td>
<td>18</td>
<td>180</td>
<td>22</td>
</tr>
<tr>
<td>Veena</td>
<td>2002</td>
<td>11</td>
<td>160</td>
<td>25.3</td>
</tr>
<tr>
<td>Mahanandi</td>
<td>1978</td>
<td>11</td>
<td>180</td>
<td>30</td>
</tr>
</tbody>
</table>
The most popular varieties in the beginning of nighties were Narasimha – which was widely grown in Kurnool district up until the arrival of Bt – and LK 861, LPS-141, both of which are immune to whiteflies and were cultivated between 1991-94 in Guntur district (ANGRAU 2010). Last year, the university released a new hirsutum variety called Mahanandi, which has a yield potential of 10-12 q/a on black soil under rainfed conditions in Andhra Pradesh (ANGRAU 2010), yet no one has bought nor used it.

The cotton area for varieties has witnessed a sharp decline over the years, partly explained by the fact that the short staple length varieties have not been in demand. As a result of this and the fast expansion of Bt hybrids, by 2009, all cotton varieties basically disappeared from the fields in the state. Neither the public, nor the private sector has sold any variety seeds, and none of the NGOs, scientists, organic projects, certification bodies interviewed were aware of any varieties grown in Andhra Pradesh. Although the agricultural university has plenty of varieties and non-Bt hybrids, prices are not even given, since no one requests any seed (ANGRAU 2010). Only one NGO source mentioned of having heard about some tribal people growing Veena variety in the north. However, contacting a local NGO supporting the tribal community in Adilabad stated the opposite claiming that tribals only grow Bt cotton now. The varieties according to them can only be found at research stations.

**Figure 9:** Bt and non-Bt cotton cultivation in Andhra Pradesh

<table>
<thead>
<tr>
<th>Year</th>
<th>non-Bt areas</th>
<th>Bt areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003/04</td>
<td>1%</td>
<td>99%</td>
</tr>
<tr>
<td>2004/05</td>
<td>3%</td>
<td>97%</td>
</tr>
<tr>
<td>2005/06</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>2006/07</td>
<td>68%</td>
<td>32%</td>
</tr>
<tr>
<td>2007/08</td>
<td>91%</td>
<td>9%</td>
</tr>
<tr>
<td>2008/09</td>
<td>82%</td>
<td>18%</td>
</tr>
<tr>
<td>2009/10</td>
<td>95%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: based on APSDA (2010)
Andhra Pradesh is according to the latest statistics (APSDA 2010, DCD 2010) grows on 95% of its cotton areas Bt cotton, which means that on the remaining 5%, i.e. 66 000 ha (164 000 acres), non-Bt cotton is supposed to be planted in 2009/10. According to data from APSDA (2010), non-Bt areas in all districts have covered exactly 5% of the total cotton areas - which rather seem a result of mathematical calculation, than an actual fact, especially since agricultural officers from the two biggest cotton growing districts said that there was no non-Bt cultivation in their districts. If we rather thus calculate with their data, 44 900 ha remains to be planted with non-Bt in Andhra Pradesh. The three organic cotton projects, operating in the state cover cotton areas on 10 623 acres (4283 ha) this year and all of them use non-Bt hybrids. Beside them, in Edabavi village, close to Jangaon in Warangal district, there are about 10 farmers growing non-Bt cotton and the village is India-wise known for having declared itself as a non-GMO and chemical-free village (Oxfam 2009).

This still leaves an area of about 40 617 ha (100 730 acres) for non-Bt cotton, however according to the interviewed NGOs, farmer leaders and certification bodies, scientists and seed companies Andhra Pradesh, no one is requesting or buying non-Bt seeds besides organic farmers. According to a local NGO, there are about 1600 NPM farmers (farmers practicing non-pesticide management, of which main idea is self-reliance; it forbids the use of pesticides, however not of fertilisers nor of Bt seeds) in Warangal, 600-700 grow cotton, but all of them use Bt hybrids. According to a senior official from the Department of Agriculture, only small companies are involved with non-Bt cotton seed production and sales, although the department is not aware of which ones are those.

Therefore, several plausible explanations exist which may explain why officially 95% of cotton areas are Bt – in every district –, whereas the present research found only about 10 600 acres (0.03% of total cotton area) non-Bt in the state:

a. the statistics are wrong: very likely, since the uniform 95% Bt coverage in all districts give rise to some doubts as to the reliability of the data;

b. there are still other companies selling non-Bt cotton: unlikely, since the organic projects had made great efforts in finding any company which may sell non-Bt cotton hybrids in the state;

c. there are farmers growing varieties in some unknown patches of the state: unlikely, since none of the several sources interviewed knew of any such areas;

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19 Phone communication with agricultural officials in Adilabad. 17-02-10.
20 Altogether there are now 600 000 farmer practicing NPM on about 2 million acres in Andhra Pradesh, and discussions are on-going on the national level how to scale up this initiative. According to CSA (2009), about 70 000 of the farmers grow cotton, without pesticides, but due to unavailability of seeds, they use Bt hybrids.
21 Supra note 14.
d. the remaining areas of non-Bt cotton are covered by illegal or spurious Bt seeds: very likely, since the sales of such seeds do not show up in the seed sales’ statistics of companies, yet their harvest is still counted. Moreover several villages were visited in Karimnagar, where the majority of farmers were reportedly growing Bt from illegal seeds.

4.3 Monopoly of Bt cotton

As it was mentioned earlier, the first approval for Bt cotton was granted to three cotton hybrids, MECH-12 Bt, MECH-162 Bt and MECH-184 Bt developed by Mahyco (MENON 2003). MECH-162 was the most popular in the first year of its approval and almost all Bt cotton areas of Andhra Pradesh (5608 ha) and Karnataka (3908 ha) were covered by this hybrid among the three approved ones (CSA 2005). In 2003/04, Monsanto sub-licensed its Bollgard gene to other hybrid-cotton producing companies like Raasi, Ankur, Ajeet, Nuziveedu, Tulasi etc. By 2010, 2.62 lakh ha of Bt has been grown in Karnataka (KSDA 2010) and 12.64 lakh ha in Andhra Pradesh (APSDA 2010).

The cost of Bt cotton seeds in 2005 was about Rs 1650 for a 450-gram packet, compared with Rs 300 for the same amount of local hybrid variety DCH-32 (INDIA TOGETHER 2006). This resulted in a booming market for spurious seeds, which were sold at much lower prices, mostly by local traders. However, these seeds were mostly a mix of Bt, non-Bt and unapproved varieties. Since the germination rate of these seeds was inconsistent and often resulted in crop loss, many farmers were disappointed (GRUERE, MEHTA-BHATT and SENGUPTA 2008,15). However, in 2006 first the Andhra Pradesh government, then others, like Karnataka, set a maximum retail price on Bt cotton seed packages between Rs 650-750, which as a logical consequence resulted in a huge increase of Bt cotton cultivation, especially in Andhra Pradesh (as clearly visible on Figure 6).

In addition, approval was granted for the first Bt cotton variety. To compete with private seed companies, three prestigious agriculture institutes, the Indian Agriculture Research Institute, the CICR in Nagpur and the UAS in Dharwad have jointly developed ‘Bikaneri narma’, a new pest-resistant Bt cotton variety which cost was 20-25% cheaper than other Bt hybrids available in the market (NEWS ONE INDIA 2008). Last year, the GEAC approved this public-bred Bt variety and it was made available to the farmers through the National Seed Corporation and other public sector seed companies.
4.3.1 Karnataka

Karnataka is at the present the eighth biggest cotton grower state of India and 63% of its cotton growing areas are covered with Bt hybrids (KSDA 2010). Most Bt cotton is grown in Haveri district, where the past two years 99% of cotton areas have been cultivated with Bt cotton, as shown in Figure 7.

Besides Haveri, other districts have also reported 100% Bt growing in the 2009 Kharif season: Koppal, Gulbarga, Dharwad and Gadag. The percentages written above/on the
columns indicate how much of the Kharif season’s cotton has been planted with Bt cotton.

**Figure 12:** Bt and non-Bt cotton areas in Karnataka

![Cotton area coverage 2009/10 in Karnataka (ha)](image)

Source: based on districts’ agricultural offices (2010)

### 4.3.2 Andhra Pradesh

In Andhra Pradesh, genetically modified cotton hybrids were introduced in the state during the 2001/2002 season amidst resistance by environmentalists and social activists. Cotton coverage during 2006/07 was 10.96 lakh ha, out of which already 10.01 lakh ha (nearly 91% of cotton area) was covered with Bt cotton (APSSDC 2009, 112). 2.5 million packets of Bt seed packets (450 g) were sold in the state throughout that year, which doubled by 2009/10. According to statistics provided by the APSDA (2010), this year’s growing season is estimated to be 12.64 lakh ha Bt. The trend is obvious: one of the biggest cotton growing state in India is by and large covered with Bt cotton.

The most popular Bt hybrids in the state are Bunny Bt (released in 2005) and Mallika Bt (released in 2008), with these two hybrids, Nuziveedu has 35–40% share of the Indian hybrid cotton seed market.

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22 Interestingly the DCD (2009) has quite different information (though it receives data from state governments) with 6.57 lakh of Bt areas during 2006/07, translating to a 60% Bt coverage.

23 Supra note 14.
Cotton is only produced during the Kharif season in the state. Although district-wise data was received from APSDA (2010), some agricultural officials from the main cotton-growing districts were contacted (these are also the districts where organic cotton production takes place). Table 14 indicates that non-Bt cotton production is something of the past. All Bt seeds are produced in these districts by private companies, and if there are some non-Bt cotton farms, they are using the same companies’ non-Bt hybrids as well. When asked about organic cotton data, all officials responded that they were grown in a very small area (few hundred ha).

Interestingly, according to data from APSDA (2010), Bt areas in all districts have covered exactly 95% of the total cotton areas, whereas agricultural officers from Adilabad and Karimnagar, the two biggest cotton-growing districts of Andhra Pradesh, disclosed that in their districts, 99-100% of cotton was cultivated with transgenic seeds. Taking these data into account, the Bt coverage in the state becomes 97% and when taking the findings from the present research, 99.7% of Andhra Pradesh’ cotton is covered with Bt - the highest ever during the past eight years.

Table 14: Cotton production in selected districts of Andhra Pradesh in 2009/10

<table>
<thead>
<tr>
<th>District</th>
<th>Cotton area (ha)</th>
<th>% of Bt</th>
<th>Popular variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karimnagar</td>
<td>225 000</td>
<td>100</td>
<td>Bt Mallika</td>
</tr>
<tr>
<td>Adilabad</td>
<td>290 000</td>
<td>99</td>
<td>Bt Mallika</td>
</tr>
<tr>
<td>Warangal*</td>
<td>171 000</td>
<td>95</td>
<td>n.k.</td>
</tr>
</tbody>
</table>

Source: based on district agricultural offices (2010), * APSDA (2010)

24 Supra note 19.
5 Seed use of organic cotton farmers

The previous chapter demonstrated that due to the expansion of Bt cotton, hardly any non-Bt hybrid production is left in the two southern states, and only in Karnataka is the use of varieties still considerable. Under such circumstances, the task of seed procurement for organic projects must be troublesome – which are these organic cotton projects and how do they secure the seed supply for their farmers is the issue elaborated in this chapter.

5.1 Organic cotton projects in India

The number of organic cotton projects have been constantly growing in India in recent years as a result of increased demand for organic and fair trade textile abroad. By 2009/10, organic cotton has been growing in the following states: Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu, on 200 000 ha (out of which 130 000 ha are certified organic). There are 144 projects having produced 252 000 tonnes of raw cotton in 2008/09 (APEDA 2009) though according to OE (2010), there are 204 such projects that harvested 107 000 tonnes of raw cotton during that year.

The major organic cotton groups are under group certification (APEDA 2009), which means that farmers organise internal control systems (ICS) to ensure that organic rules are adhered to. ICS is an essential component of the organic certification process as organic certified farming is a method envisaged to hand over the responsibility completely to farmers operating in groups. This is to ensure the reduction in certification costs and the transfer of ownership to the farmers. An efficient ICS is seen as a guaranteed procedure for certification by all certifying bodies (PRADHAN 2007,15).

Before introducing the main objects of this thesis, some of the largest organic cotton projects of India are shown in Table 15. Many of these projects, including bioRe and Prathiba all have fully integrated supply chains allowing sourcing from fiber to finished garment. Spinning is done mostly with Super Spinning Mills in Coimbature and Rajlakshmi Cotton Mills in Calcutta, which process the organic cotton for its product, manufactures and export merchandise.
**Pratibha Syntex Ltd** is one of the world’s largest fully vertical suppliers of organic cotton products. The organic cotton cultivation project was started in 1999 with the name Vasudha. Since then, the project has become the largest organic farming scheme in India: from an initial group of 10 000 farmers working on 6000 acres, the project has expanded in 10 years to include 28 000 farmers covering 125 000 acres of farmland in Madhya Pradesh, Rajasthan and Orissa\(^\text{27}\). The plan by 2012 is to expand the number of farmers to 40 000, increase the acreage to 200 000 acres and establish own organic seed production facility.

**AMIT group**, presently the second largest organic cotton project in India, works with about 15 000 farmers in Gujarat, Maharashtra and Orissa, half of which are already certified. Farmers in Gujarat use a hybrid seed called Shankar-6, bought from the public sector for 300 Rs/packet (of 450 g), though seed production is envisaged with Shankar 11 and 12 hybrids in the future. In Maharashtra and Orissa, other hybrids and varieties are used, which are purchased yearly from the state seed corporations. All produced raw cotton is also manufactured by them into garments thus keeping the whole supply chain under control.

**AGROCEL** works with about 5000 cotton farmers in various states of India. Among them 1500 farmers are organic and fair trade located in Gujarat, and the rest are fair trade farmers in Tamil Nadu, Karnataka, Andhra Pradesh and Orissa. About 2000 farmers (all organic farmers) are using a locally-developed, medium-staple *G. hirsutum* variety called Deviraj, which is suitable for Gujarat. Deviraj was released in 1951 for Gujarat state, it needs 290 days till maturity and the fibre length is 27.4 mm (CICR 2007). The project started its own certified seed production programme already 10 years ago and today 50 farmers are certified for producing organic seeds. Ginning is done in the project’s own ginning mill and seeds are sold to farmer members and also to local projects.

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\(^{25}\) This data was given only as confidential.


\(^{27}\) *Ibid.*
Suminter India Organics, founded in 2004, works together with 10 500 farmers in Gujarat, Maharashtra and Orissa producing about 5000 tonnes of raw cotton on 45 000 acres of land. In Gujarat, farmers use a *G. hirsutum* variety called Daviraj, whereas in the two other states, non-Bt Bunny seeds are purchased. According to the representatives of the company, own seed production is not yet planned by the project.

EcoFarms was established by Mr. Omprakash Mor in Yavatmal, Maharashtra and since its start, the project has expanded to Madhya Pradesh and Orissa involving altogether 20 000 farmers. Most farmers employ 50% of their land to grow cotton and 50% to grow food crops. The farmers are using a desi cotton variety and seeds had been received from CICR, which suffice for all the cotton farms. By 2009, 23 600 acres were planted with cotton producing approximately 4000 tonnes of raw cotton, which is about 20-25% less than previous years due to drought conditions in 2009.

BioRe India Ltd was formed in 1992 in Madhya Pradesh to support local farmers in growing cotton following biodynamic farming principles. The cotton yarn is sold to a Swiss - Maharashtra trading company called Remei AG or to its approved customers. Along with cotton, food crops like wheat, maize, soybean, pigeon pea and groundnut are grown. In the year 2009/10, bioRe has been working with 6400 cotton farmers on 18 000 acres producing about 5500 tonnes of raw cotton. Earlier, 25 hybrids were used by farmers, but the project decided to centralise cotton procurement to focus only on 4-5 companies. Last year, the following hybrids have been purchased from regional offices of seed companies: Ankur Akka from Ankur Seeds Ltd, Ajeet 11 and 33 from Ajeet Seeds Ltd, H-8 from Krishidhan Seeds Ltd and JK Durga from JK Seeds. Although few years back, OPVs were tried out from Mahabeej, farmers have preferred using hybrids. Also, the state seed corporation in Maharashtra stopped providing non-Bt seeds since last year, so their choice has become limited. Whereas about 10% of farmers have defaulted previous years, in 2009, the percentage decreased to 5%: these farmers have been rejected from the project. The bioRe project’s biggest worry regarding seed sourcing is the unavailability of non-Bt seeds, followed by contamination of the seeds with Bt. The project is in the process of identifying the measures to be taken to ensure seed security.

Shree Samrudhi Agro Farming India Pvt Ltd was started in 2004, and by 2010 it works together with 2500 farmers on 5000 acres in Maharashtra. The hybrids used by farmers are Bunny from Nuziveedu, Ankur Akka from Ankur Seeds and Maruti from Krishidhan Seeds. Among the seed related problems, the unavailability of non-Bt seeds, the contamination from neighbouring Bt farmers and the defaulting farmers planting Bt seeds have been mentioned by the project, which is at the moment in search for locally-adapted varieties in order to rely on own seed production.

Arvind Organic is working in 72 villages in Akola, Vidarbha district (Maharashtra) with 1300 farmers on about 11 000 acres, out of which 6000 is for organic cotton. Farmers are using several hybrids, Maruti 9632 from Krishidhan, Ajinkya from Mahabeej, Bunny
from Nuziveedu and a desi variety named AK-7 from Mahabeej. Since the project aims at scaling-up within the next eight years to about 100 000 acres, own seed breeding programme is on the agenda. As of last year, there were 20-30 defaulting farmers who were removed from the project. The conventional price of cotton has increased to 3200 Rs/q, thus they can only afford a small premium of 5% for certified organic farmers.

5.2 Organic projects in the South

Figure 13: Map of the study area with visited organic cotton projects

5.2.1 Karnataka

Karnataka covers an area of 191,976 km² or about 6% of the total geographical area of India. It is the eighth largest Indian state by area, and the ninth largest by population. The state has 30 districts. Out of the total area, 65% (i.e. 12.31 million ha) are cultivated and
56% of the workforce in the state is engaged in agriculture (GOVERNMENT OF INDIA 2007). Since only 26% of the agricultural areas are irrigated, most of the agricultural output depends on the southwest monsoon.

Organic cotton farmers are mainly present in two states: Gadag in the North and Mysore in the South. There are several organic cotton projects in these two districts, some overstretch to neighbouring districts, such as Dharwad and Chamarajanagar.

Table 16: Organic cotton projects’ data in Karnataka in 2009/10

<table>
<thead>
<tr>
<th>Project name</th>
<th>District</th>
<th>Established</th>
<th>No. cotton farmers</th>
<th>Area (acres)</th>
<th>Production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renuka</td>
<td>Gadag</td>
<td>2008</td>
<td>332</td>
<td>550</td>
<td>110</td>
</tr>
<tr>
<td>Krashi group</td>
<td>Gadag</td>
<td>n.k.</td>
<td>30</td>
<td>600</td>
<td>n.k.</td>
</tr>
<tr>
<td>OFMPAGA</td>
<td>Gadag</td>
<td>2006</td>
<td>8</td>
<td>68</td>
<td>3</td>
</tr>
<tr>
<td>S.K.S.</td>
<td>Mysore</td>
<td>2006</td>
<td>120</td>
<td>550</td>
<td>20</td>
</tr>
<tr>
<td>Kabini</td>
<td>Mysore</td>
<td>2009</td>
<td>626</td>
<td>1380</td>
<td>520.5</td>
</tr>
<tr>
<td>ICRA-SAFF</td>
<td>Mysore</td>
<td>2004</td>
<td>89</td>
<td>90 certified</td>
<td>4.45</td>
</tr>
</tbody>
</table>

5.2.1.1 Gadag district’s organic groups

Gadag had a population of close to one million, of which 65% was rural as of the 2001 census. The district falls in the northern dry agro-climatic zone of Karnataka; the climate is semi-arid and agricultural drought occurs every year. The predominant soil is black cotton soil and the major crops grown in Kharif season are sorghum, maize, wheat, green gram, groundnut, sunflower, onion and chilli. Almost all agricultural land is rainfed, including all organic cotton projects.

Renuka Foundation

Srimati Renuka Foundation was founded in 2008, although Kuberaraddi Neelannavar started organic practices with four farmers already back in 2002. By 2009, 1000 acres has been cultivated in the project with mixed crops mainly cotton, chilli and groundnuts (RENUKA 2009). Few years ago, the project got financial help from the German Organic Services, which organised the marketing of their cotton. In 2009, organic cotton was planted on 550 acres by 332 farmers, out of which 74 are already certified by Control Union (RENUKA 2009). The farmers are situated in three villages 50 km southeast from Hubli. The certified cotton is sold exclusively to the company called Community Foods in the UK. In 2008/09, certified farmers received 3200 Rs/q for their certified organic cotton.

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cotton, plus a 20% premium (which is yet to be paid), whereas in-conversion cotton fetched a market price between 2500-2800 Rs/q in the same season (RENUKA 2009).

Dharitsi Krashi Parivari
The chairman of the 30-member group, P.S. Gouda works at the district level agricultural research station, Hulkoti, and is a trainer in organic agriculture. While some group members practise organic farming for more than 15 years, most farmers are under organic conversion. They produce cotton on approximately 600 acres with an average output of 120 tonnes (KRASHI 2009). The Krashi group has its own ginning and pressing unit and it hopes to have sufficient organic cotton to be able to gin and press separately (now, organic is still mixed with conventional). Up to this year, cotton was sold on the conventional market without premium; this year negotiations are still ongoing with two potential buyers (KRASHI 2009).

Mundargi Taluka Organic Farmers and Medicinal Plants Aromatic Growers Association (OFMPAGA 29)
The association is based in Kadampur, Mundargi taluka and its founder and former president is Naganoor R. Hanamappa, who is an organic farmer himself growing medicinal plants. This association has 230 farmers and is organised in a cluster-system, basically involving several organic groups: one in Kanvi (74 farmers), another in Kadampur (54 farmers), both of which are certified by Aditi, besides more than 100 other members have not yet been given certification (OFMPAGA 2009a). Two groups, consisting of 120 farmers, will start the conversion as of this year. The association is like an umbrella organisation for them, giving trainings, promoting organic practices among farmers, etc. All the organic farmers are under conversion, growing multiple crops where cotton plays a minor role. In the two groups, 4-4 farmers are growing organic cotton respectively, having produced 8.6 tonnes of raw cotton last year and 3 tonnes this year - the decrease is due to uneven rain and drought (OFMPAGA 2009a). This year, out of the two new groups that are joining, 12 farmers are growing cotton on 37 acres.

5.2.1.2 Mysore district’s organic groups
Similarly to Gadag, agriculture is the backbone of the economy in Mysore district too. Mysore’s population was 2 641 000 according to the last census, out of which 63% was rural and about 326 000 farmers were involved in cultivation30. Mysore is located in the southern part of Karnataka and is subdivided into seven talukas. H. D. Kote taluk covers a geographical area of 194 000 ha; although rich in forest and other natural resources, the taluk is also among the most backward in the state. It is estimated that 40 000 ha of land comes under cotton cultivation in H.D. Kote and a majority of the farmers use Bt seeds

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29 The abbreviation is made up by the author from the first letters of the group’s name.
Seed use of organic cotton farmers

(THE HINDU 2008). The soil structure is red sandy, black cotton and sandy soil. The taluk receives an average rainfall of 950 mm, in 60-65 rainy days, which occur through the southwest monsoon starting during the second week of June and finishing by the end of October (S.K.S. 2009a). The majority of agriculture is rainfed, including all organic cotton projects. Over the last 20-25 years the cropping pattern gradually changed from mixed and intercropping with millet cultivation to monocropping of cash crops such as cotton and tobacco, hence farmers are used to depend on the use of chemical fertilisers and pesticides.

S.K.S.
The organic farmers association called Savaiyava Krishikara Sangha (S.K.S.) has been promoted by an NGO called MYKAPS. The cotton project started in 2006 on 222 ha in nine villages and 132 farmers have taken membership in the association; in 2009/10, 120 farmers have been cultivating cotton, 28 of which are certified organic (S.K.S. 2009a). Besides cotton, the other main crops grown organically are vegetables, ragi and horse gram.

The president of the association has been given the Krishi Pandit Award from the government of Karnataka, which is awarded to the best performing organic farmers in the state. Vivek Cariappa is not only the president of the S.K.S. but is a member of the State Empowered Committee on Organic Farming of the government of Karnataka. The association is assisting farmers to market their produce to agencies such as Appachi Cotton Mill in Coimbatore (S.K.S. 2009a). The buyer, Apachi Cotton paid last year 23% premium after harvest and ginning and spinning is done by the company itself.

Kabini Organics
A new project was started in January 2009 with the financial and technical help from Rabobank, ETC and Apachi Cotton Mill company in H.D. Kote taluk. The same MYKAPS coordinates the production, certification, marketing and related activities of the project as with S.K.S. At present there are 626 farmers from 31 villages in the project and they have 556 ha under cotton production and the aim is to expand to 1613 ha (4000 acres) cotton involving 1500 farmers within three years.31.

ICRA - SOFF
The Institute of Cultural Research and Action (ICRA) has been working with 5000 farmers in five districts of Karnataka for the last 8 years. The NGO has established several organic villages and supported farmers to do organic practises. ICRA works together with one certified organic cotton project called Mysore and Chamarajanagar Districts Sustainable Organic Farmers’ Federation (SOFF)32 holding together 674 farmers (505 certified organic) on 1109 acres in three talukas (SOFF 2010). The cotton project

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31 E-mail correspondence with William d’Souza, executive director of MYKAPS. 11-02-10.
32 The abbreviation is made up by the author from the first letters of the group’s name.
started in 2004 and four years later, 148 farmers were planting cotton in mixed cropping mostly around Nanjangud taluka in Mysore district. In 2009, 278 farmers registered for growing cotton, but at the end only 89 did mostly due to the lack of rain (SOFF 2010). Out of the total 54 certified organic cotton farmers, only 35 sold the cotton as organic this year, the rest did not because the organic rate was lower than the conventional rate (SOFF 2010). The buyer, Appachi Cotton pays a 15% premium to organic cotton farmers.

5.2.2 Andhra Pradesh

Andhra Pradesh is the fourth largest state by area and fifth largest by population. Rice, sugarcane, cotton, chilli crops are the most common, besides vegetables oil production like sunflower and groundnut. The area covered by the state is 275 608 km² and its population was close to 76 million as of 2001.

There are three big organic cotton projects in Andhra Pradesh; they are much larger both in number of cotton farmers and in acreage than compared to the cotton projects in Karnataka. In the 2009/10 season, more than 10 600 acres (4283 ha) have been planted with organic cotton by 5630 farmers in total. Two of the projects also extend to other states (Maharashtra and Orissa), but due to the necessary limitation in scope, the research only has focused on Andhra Pradesh, thus figures from these groups mainly relate to data within this state. Like in Karnataka, farmers involved with these three groups do not exclusively grow cotton, so the numbers reflect only those organic and under conversion farmers that have planted cotton this last growing season. Though cotton is one of the most important cash crops of the state, organic cotton areas are to be found only in three districts in the North: Warangal, Karimnagar and Adilabad.

Andhra Pradesh has 23 districts, each of which is divided into several mandals and each mandal consists of several villages. Warangal district has an area of 12 846 km² and a population of 3.25 million of which 80% lives in rural areas. This district is famous for producing cotton, rice, chillis and tobacco. The main NGO promoting organic cotton in Warangal, Oxfam, has all its farmers in this district. Its northern neighbour is Karimnagar district, which is somewhat smaller (11 823 km²) and has somewhat higher population of 3.5 million, of which 80% is rural according to the 2001 census. There are very few organic cotton farmers here, belonging to Chetna. Adilabad district is situated on the northern boundary of the state forming a border with Maharashtra. The district has an area of 16 128 km² and a population of somewhat above 2 million, 74% of which is rural. The climate of the district is characterised by hot and dry summer except during

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34 Ibid.
the southwest monsoon season, in which 85% of annual rainfall is received. The predominant crops are sorghum, paddy and cotton – this later occupies about 27% of the district’s total area\(^{38}\). Both Chetna and Zameen projects have organic farmers in this district.

The 2009/10 growing season has been a very bad year for farmers, both for organic and also non-organic farmers. Due to a severe drought during summer months, boll formation of cotton has not been good; the reduced yield was a result of the lack of timely rain – at the time of interviews with Zameen farmers on the fields at the beginning of November, it had not been raining the previous one and half months. The lack of rain affected both Bt and organic cotton farmers as was told similarly by Oxfam farmers at the beginning of November. Water tanks and bore wells dried up, and most villages did not see any rain the previous 2 months. According to farmers in a village in Nellikudur mandal, Warangal district, 90% of cotton has been lost due to drought in 2009, but other crops were also suffering, even drought-resistant crops, like sorghum. This growing season was said to be the worst many farmers had ever seen and even the oldest farmers admitted that this was the driest year in the past 50 years they remembered. In the district, the average yield was 5 q/a in 2008/09, whereas this year it has dropped to 2 q/a.

Due to lower yields, the economic situation of farmers further deteriorated. As a direct result, many more suicides happened within cotton growers in northern Andhra Pradesh than the years before. During one weekend in late November, when organic farmers were interviewed in Adilabad, 5 cotton farmers ended their lives. The weeks that followed, another 17 committed suicides – all were Bt cotton farmers whose yield dropped to 3-4 q/a, which was not sufficient to pay back the high loans they had taken\(^{39}\).

**Chetna**

With the increasing demand for organic cotton in Europe, Solidaridad, a Dutch development NGO set up the Chetna Organic cotton project in India. Chetna Organic Farmers Association was formed, which now covers three states and accordingly has three clusters with offices in Utnoor (Andhra Pradesh), Yavatmal (Maharashtra) and Bhavani Patna (Orissa). The total number of farmers in the three states inspected by two certification bodies (Aditi in Andhra Pradesh and Control Union in the other two states) this growing season was 5483 with a coverage of 11 082 ha, out of which 5228 ha (12 965 acres) were planted with cotton (CHETNA 2009b\(^{40}\)). Last year (2008/09), there were 5785 farmers in the program and the acreage was somewhat higher.

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\(^{40}\) Figures adjusted by follow-up e-mail correspondence with Rama Krishna, 10-03-10.
1414 organic farmers are members of Chetna in Andhra Pradesh and cotton has been grown on 4152 acres in 2009/10 in two districts. In each village there are self-help groups consisting of 7-20 members. Chetna has developed self-help groups at the village levels, Mutually Aided Cooperative Societies (MACSs) at cluster levels and the Chetna Organic Farmers Association as the apex group of these people’s organisations to take control over the trade of their produce (PRADHAN, 2007,6). Moreover the Chetna Organic Agriculture Producer Company was registered in February 2009 to be responsible for trading of the organic and fair trade cotton from this year on.

The expected production in 2009/10 has come down to 3424 tonnes when compared to last year, due to the drop in the number of farmers, parallel production (organic and conventional management within the same field), Bt cultivation and drought (CHETNA 2009b).

**AOFG & Zameen**

AOFG is a network NGO working for small and marginal farmers, whereas Zameen Organic Pvt. Ltd. is a private limited company for cotton marketing, of which 51% of shareholders are farmers. AOFG trains, consults and evaluates farmer groups and farmers associations. There are two farmers associations, one in Andhra Pradesh, having 9 clusters in 90 villages, and the other in Maharashtra having 7 clusters in 80 villages (AOFG 2009).

**Table 17:** Chetna organic cotton farmers’ data 2009/10

<table>
<thead>
<tr>
<th>State*</th>
<th>Region</th>
<th>Total cotton farmers</th>
<th>Certified cotton farmers</th>
<th>Total land area acres</th>
<th>Raw cotton production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>Adilabad, Karimnagar</td>
<td>1414</td>
<td>799</td>
<td>4152</td>
<td>1064</td>
</tr>
<tr>
<td>M</td>
<td>Akola, Amravathi, Yavatmal</td>
<td>2475</td>
<td>1690</td>
<td>5721</td>
<td>1116</td>
</tr>
<tr>
<td>O</td>
<td>Bhawanipatna, Golamunda, Bolangir</td>
<td>1594</td>
<td>1097</td>
<td>3092</td>
<td>1244</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>5483</td>
<td>3586</td>
<td>12965</td>
<td>3424</td>
</tr>
</tbody>
</table>

*AP stands for Andhra Pradesh, M for Maharashtra, K for Karnataka.
Source: E-mail correspondence, Rama Krishna, Chetna. 10-03-10.

**Table 18:** AOFG & Zameen organic cotton data 2009/10

<table>
<thead>
<tr>
<th>State*</th>
<th>Region</th>
<th>Total Cluster</th>
<th>Total cotton farmers</th>
<th>Certified cotton farmers</th>
<th>Total land area acres</th>
<th>Raw cotton production (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>Kagaznagar</td>
<td>9</td>
<td>1689</td>
<td>1312</td>
<td>3307</td>
<td>1503</td>
</tr>
<tr>
<td>M</td>
<td>Amravathi</td>
<td>7</td>
<td>2109</td>
<td>2109</td>
<td>7562</td>
<td>2547</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>3798</td>
<td>3421</td>
<td>10869</td>
<td>4050</td>
</tr>
</tbody>
</table>

*AP stands for Andhra Pradesh, M for Maharashtra
Source: AOFG (2009)
In 2008/09, the total production of cotton in the district was about 2500 tonnes, however only for 1300 there was a buyer, thus only this amount was ginned (AOFG 2009). The cotton is bought by ALOK, which processes the lint and the major market for the Zameen organic cotton is in the UK. Direct linkages have been established between farmers associations and brands.

**Oxfam**

Oxfam officially started its organic cotton project in January 2008. They have 8000 farmers cultivating different crops in 88 villages of 4 mandals in Andhra Pradesh. Village-level farmer groups are integrated into mandal level societies, MACSs, in which farmers are shareholders. These MACSs are promoted by four NGOs: MARI, PSS, CROPS and SYU.

The four MACSs established a farming trading company called Oorvi to look after its business component and promote the internal control system. The ginning is done in one factory near Warangal and Oorvi at the end sells the in-conversion cotton to the Cotton Corporation of India for conventional price – at least till last year (OXFAM 2009). This growing season the aim has been to buy the cotton directly from farmers to reduce operational costs and store for 3-4 months the lint bales, before they could be sold for better prices in March (OXFAM 2009). The cotton price in Warangal has topped 3030 Rs/q this year – since this conventional price is high, it is very difficult to offer higher price for organic and fair trade farmers (OXFAM 2009). At the time of interviews (end November), negotiations were still ongoing with potential buyers, but most probably certified organic cotton lint was going to be sold to ALOK, Armstrong and Super Spinning Mills.

Oxfam and the four NGOs are following a saturated approach in which they try to involve 80-100% of farmers within a village to participate in their organic project – this has been the result of 6-7 years of their efforts. Cotton is just one of the crops besides turmeric, green gram, maize, paddy, chilli and sesame, for all of which Oorvi is trying to explore market opportunities.

**Table 19: Oxfam-partners organic cotton data 2009/10**

<table>
<thead>
<tr>
<th>Warangal mandals</th>
<th>NGO</th>
<th>Total cotton farmers</th>
<th>Certified cotton farmers</th>
<th>Total land area acres</th>
<th>Raw cotton production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parvathagiri</td>
<td>MARI</td>
<td>952</td>
<td>324</td>
<td>1272</td>
<td></td>
</tr>
<tr>
<td>Nellikudur</td>
<td>PSS</td>
<td>474</td>
<td>137</td>
<td>622</td>
<td></td>
</tr>
<tr>
<td>Lingala Ghanpur</td>
<td>CROPS</td>
<td>280</td>
<td>102</td>
<td>348</td>
<td></td>
</tr>
<tr>
<td>Atmakur</td>
<td>SYU</td>
<td>821</td>
<td>613</td>
<td>923</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>2527</strong></td>
<td><strong>1176</strong></td>
<td><strong>3165</strong></td>
<td><strong>1354</strong></td>
</tr>
</tbody>
</table>

Source: OXFAM (2009)
In 2009/10, the estimated production is 1354 tonnes (683 of which are fully organic); a reduction of 746 tonnes when compared to the year before, which is due to the reduced number of farmers planting cotton and the late sowing, since rains did not arrive in time (OXFAM 2009).

5.3 Seed use of organic cotton farmers

Since thousands of years, up until few decades ago, cotton cultivated in India was environmentally-friendly with little or no use of toxic chemicals in production. In an article written a decade ago by the CICR, senior scientists mentioned that Wagad cotton in Gujarat, Y-1 desi cotton of Maharashtra, Maljari in Madhya Pradesh, Jayadhar and Suyodhar in Karnataka, Nandicum in Andhra Pradesh and parts of cotton areas in north eastern hill region of India were still grown (RAJENDRAN, VENUGOPALAN and TARHALKAR 1999) in the traditional way, with the use of intercrops, natural pesticides and farmyard manures and without any synthetic chemicals.

Much has changed during the last decades. As of today, there are only some left-over pockets in India, mainly in Karnataka and Gujarat, where cotton is still produced without the use of agrochemicals (DCD undated). Although farmers in Andhra Pradesh do not produce cotton from local varieties any more, in Karnataka several thousands of hectares of varieties are still grown in the traditional way, without being certified as organic.

5.2.1 Seeds of Karnataka’s organic projects

During the interviews with project leaders of organic cotton groups in Karnataka, it was found that the biggest projects have been relying this and last years on seeds procured from KSSC. DCH-32 is an extra-long staple hybrid, which is under the government subsidy scheme, meaning that farmers can buy the seeds for a much cheaper price than other cotton hybrid seeds. Some seeds from another extra-long staple hybrid, called Varalakshmi, have also been used by one project this last growing season. All organic projects using the non-Bt, untreated hybrids operate in Mysore district.
and produce cotton in the Kharif season.

The other organic groups, all from northern Karnataka, use the seeds of a local variety called Jayadhar, grown extensively for the last decades in the Rabi season in this area. Initially garlic is planted, then chilli, then Jayadhar as an intercrop to chilli. Farmers only once buy the seeds, which after ginning are brought back from the ginning mills and saved for next year’s sowing. Also, there are few farmers in many villages keeping cotton variety seeds for selling them to other farmers (KVK 2009).

Besides Jayadhar, two other varieties have been also grown by hundreds of organic farmers: Surabhi, an improved G. barbadense, long-staple variety developed by the Agriculture University in Tamil Nadu, and RAHS-14, an improved Jayadhar variety, developed by UAS, Dharwad.

**Table 20: Seed use of Karnataka’s organic cotton groups**

<table>
<thead>
<tr>
<th>Project name</th>
<th>Name of seeds used</th>
<th>H or V</th>
<th>Seed producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renuka Foundation</td>
<td>Surabhi, Jayadhar</td>
<td>V</td>
<td>Own</td>
</tr>
<tr>
<td>S.K.S.</td>
<td>DCH-32, Varalakshmi</td>
<td>H</td>
<td>KSSC</td>
</tr>
<tr>
<td>KABINI Organics</td>
<td>DCH-32</td>
<td>H</td>
<td>KSSC</td>
</tr>
<tr>
<td>ICRA – SOFF</td>
<td>DCH-32</td>
<td>H</td>
<td>KSSC</td>
</tr>
<tr>
<td>Dharitri Krashi Parivar</td>
<td>Jayadhar</td>
<td>V</td>
<td>Own</td>
</tr>
<tr>
<td>OFMPAGA</td>
<td>Jayadhar, RAHS-14</td>
<td>V</td>
<td>Own</td>
</tr>
</tbody>
</table>

| H: hybrid, V: variety

5.2.1.1 Gadag district’s organic groups

**Renuka Foundation**

The Renuka Foundation is unique among all organic cotton groups in the south, since it has its own organic variety, which has been tested, improved and multiplied during last years. One of the founders behind this farmer group, Ramesh Harve explained that with the help of the Agriculture University in Tamil Nadu, they developed their own organic seeds from the landrace called Surabhi and after two years of on-site multiplication, they planted them out. At the moment, 300 acres is grown with Surabhi and seeds are sold for 40 Rs/kg (RENUKA 2009b).

“Jayadhar is better in terms of fodder quality whereas Surabhi wins in yield and staple length (28mm)” - explained by the technical advisor of the foundation, while standing on one of the breeding plots of the NGO (RENUKA 2009a). One organic farmer added that Surabhi had the advantage of easy harvest and big pots, whereas Jayadhar was known from its tougher and more labour-intensive harvest. All farmers that were visited in the project expressed their satisfaction with Surabhi, since the variety has higher yield, is less expensive, due to easier and quicker harvesting, and is long staple.
On the breeding plots near the town Annigeri, farmers are selecting the best plants, in terms of early germination, good vigor, maximum flours and pods, resistance to diseases and pests. From the selected plants, the breeder seeds are given to few farmers for a further two-year testing to confirm the quality and resistance of cotton plants to diseases. Farmers outstanding in good organic practices in their IC-2 (second year in conversion) status have been given for the first time the Surabhi seeds for further improvement (RENUKA 2009a).

IC-1 and IC-2 farmers are growing Jayadhar variety, using their own seeds and selling the harvest on the conventional market without premium. Surabhi variety is only grown by certified organic farmers and only sold to a UK buyer called Community Foods (RENUKA 2009a).

Two breeder farmer fields were visited, one of which received Surabhi seeds for the first time and sown them in August, which he intercropped with sorghum; till last year, he has been growing Jayadhar, intercropped with chilli, and had a 5 q/a yield. The other breeder farmer, also in IC-2 status, started with Surabhi this growing season, which he planted on 6.5 acres. There was an observable difference between the two breeding sites, with this last having taller plants. This was explained by the farmer as the positive effect of garlic planted the year before on the same field. Now he is growing cotton in relay cropping with chilli and garlic, intercropped with horsegram, which is a great crop for mulching and also fixes nitrogen. When asked about cotton farmers in his village, Kondikoppa in Dharwad district, the farmer explained that there were about 1000 farmers, 22 of them are organic, 7-8 cultivating Bt cotton, the rest growing Jayadhar mostly as organic by default.

Another farmer visited in Basapur village in Navalagunda taluka has been growing both Jayadhar and Surabhi for several years organically. Last year he got 4 q/a yield in Jayadhar and 5-6 in Surabhi although it was a bad season (with not enough rains). This year he expects up to 8 q/a yield for Surabhi though if this variety would be sown earlier (like Bt in June-July) and not in relay cropping with chilli and onion, the yield would be even higher up to 10 q/a. This year he has sown chilli and garlic the second week of June and cotton in the middle of August.

Dharitsi Krashi Parivari
All farmers practise mixed farming and save their own cotton seeds or exchange with neighbours. The chairman of the group, P.S. Gouda explained that he has been doing relayed cropping, which meant that he planted onions and chilli in June and intercropped with his own variety of cotton sown in September when the monsoon rain arrived (KRASHI 2009). The local short staple variety, Jayadhar is used by him and the group for many years. The average yield is 2.5 q/a and since he has 13 acres, he expected 3 tonnes of cotton this growing season (KRASHI 2009). He saves his seeds, by bringing back packages of seeds from the ginning mill for the next year’s sowing and he also gives the leftovers to his neighbouring farmers.
Another well-known farmer was visited within this group in Jantthi-shirur village, Mundargi taluka. Chenappa R. Budihal, who is one of the directors of Organic Cell in Karnataka, is an organic farmer since 16 years. He is one of the seed savers in Gadag district and he keeps a seed bank in his own house. The tradition of saving seeds in his family goes back to 300 years, his father and grandfather has done the same and taught him about it. He has several dozens of different varieties of millets, legumes and two varieties of cotton, all produced in an organic way. He keeps Lakshmi and Jayadhar seeds for selling to other farmers; yearly he produces about 30 bags (one bag is about 50-60 kg) cotton seeds, most of which is sold to farmers and the remaining he uses for animal feed and for the next season’s planting. This season, he is producing Jayadhar seeds on 17 acres; the harvest is in February. Generally, he attains a yield of 5 q/a and seeds are selected depending on two factors: big flower size and disease-free leaves.

C.R. Budihal gives some seeds to farmers and also sells them at a rate of 20 Rs/q. In the 2009/10 season he sold 400 kg of Jayadhar to about 20-30 farmers from the village and within 30 km radius. Farmers do not like Lakshmi that much due to some problems (late flowering) so none purchased this variety last year. One traditional way of storing the seeds is mixing them with ash and fumed curry leaves in order to preserve them from diseases and pests. In case of cotton, this is not necessary – they are simply put in textile bags and kept in the corner of his house for a maximum of about two years. Both varieties are kept for several generations, however the same seeds are not kept for more than 1-2 years.

Mundargi Taluka Organic Farmers and Medicinal Plants Aromatic Growers Association (OFMPAGA)

All farmers in this association are under conversion and use mostly Jayadhar and some RAHS-14 seeds, growing cotton intercropped with chilli and onion (OFMPAGA 2009a). Out of the eight cotton farmers, three were visited. A young farmer admitted that two years ago he grew Bt cotton, because representatives of the company Rasi came to the village and they were advertising 20 q/a yield for their seeds. Along with dozens of farmers, he got attracted by the promise, and although the yields he attained were quite high, he is knowledgeable about the soil and realised that the earthworms left his field and his soil fertility got damaged. That was when he decided to shift to organic production: he heard B.C. Purad talking about his seeds and he bought 6 kg of RAHS-14 from him for 40 Rs/kg.

B.C. Purad is a very well-known farmer scientist in the region, a pioneer and an advocate of organic cotton seed production. He has been growing organically since 15 years, though only this year he will become a certified organic farmer. Purad worked with soil

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41 The government of Karnataka has made a separate cell called as ‘organic cell’ in the Department of Agriculture to promote organic farming.
42 Personal communication with Vijey. Hirewadatti, Gadag district. 04-12-09.
conservation at the Agriculture Department at Kundagol, and started testing cotton varieties while employed, till he retired in 2006 (OFMPAGA 2009b). The purpose of his research has been to find out which varieties are the most suitable for local conditions and have the highest yields. He considers himself a social worker whose role is to spread information and promote his best varieties. He has a Memorandum of Understanding with Dr. S.S. Patil, a senior plant breeder at CRC, Hebbali – Purad has been sowing whichever varieties Dr. Patil has developed. The project is based on farmers’ participation in which farmers evaluate which genotypes they would like to have and they receive those seeds for free. “I have gained a lot from this plant breeding cooperation since I have built up very good links to other farmers” (OFMPAGA 2009b). He is a kind of intermediary between the research station and farmers who tell him about their needs and the scientist recommends which varieties shall be sown (other food crops too) in their specific climatic and soil conditions.

From 1996 till 2000 Purad had been growing the following *G. herbaceum* varieties: RAHS-14, 127, 130, 131, 132, 192. The most promising were the first two, which were continued to be sown up until now. RAHS-127 is the longest staple variety he has had with 27.5 mm staple length, however farmers have not preferred it, since the price they fetch for it is the same as for RAHS-14, yet the yield is 1 q/a less. From 2000 till 2003 he tried another set of varieties H-7, A-142, AH-7, RH-221, RH-100 and RH-101 but none were suitable for his soil conditions (OFMPAGA 2009b).

**Figure 15:** Examining *G. arboreum* varieties of an organic seed producer

RAHS-14 has been his best variety so far: both the yield (5 q/a) and the germination is very good and it is suitable for even alkaline soils (OFMPAGA 2009b). After initial testing, he gave the selected seeds (selection was done according to the yield) to 3-4 farmers for further testing between 1998 and 2003. He has been selling the seeds since 2003, and most of the farmers in his village have been growing RAHS-14. In 2007, it was officially released as an improved variety of Jayadhar. By now, almost all cotton farmers in the area of about 50 km of radius use this variety (OFMPAGA 2009b). He has been selling about 620-700 kg of RAHS-14 seeds yearly at a rate of 40 Rs/kg. Last year he sold RAHS-14 seeds to about 2000 farmers (seed rate of RAHS-14 is 2.5 kg/a) and gave free seeds of RAHS-127 to 20 farmers (OFMPAGA 2009b). Alone to farmers in Bijapur district, he sold 350 kg last year. These
seeds are by now grown in Raichur, Koppal, Gadag, Haveri, Bijapur on approximately 20,000 acres according to his, and the CRC’s estimates – all from his seeds. At the moment there is a shortage of RAHS-14. In Mundargi taluka, RAHS-14 is grown organically by some farmers (OFMPAGA 2009b).

In the 2009/10 season he has planted 34 *G. arboreum* varieties for testing. He has sown late, so when his field was visited in the first days of December, plants were still at the stage of boll formation (see Figure 11: Purad on the right). His plan is to select the high-yielding varieties and seed them again on one acre each. In 2010, he gives the potential seeds to some selected farmers for further testing.

### 5.3.1.2 Mysore district’s organic groups

**S.K.S.**

The project purchases untreated, non-Bt hybrid seeds, Lakshmi and DCH-32 from KSSC; the seeds bought last year were from a two-year-old production. This growing season, the main problem has been the seed issue: in 2009 they got untreated seeds, but it is unknown whether the KSSC will still produce seeds for them (S.K.S. 2009a).

The farmers visited in Nandinathapura village have been growing cotton for many years. The first farmer besides having been planting cotton for 20 years also manages a kitchen garden. His main crop is ragi, grown for home food security and stored inside the house. Except for cotton, all seeds are his own. He had 6 q/a cotton yield last year, whereas in 2009 due to the drought he only expected about 2-3 q/a. He has been planting both hybrid seeds this year, intercropped with ladyfingers, cowpea and pigeon pea which serve as trap crops for sucking pests and stem borers. When asked about the seed supply, he responded that he was not aware of seed availability problems since the seeds were always provided by the KSSC through the S.K.S. In 2008, he – as other organic certified farmers in the group – received 3600 Rs/q for his cotton.

Another long-time cotton farmer was visited in the same village who was growing cotton on 6 acres, intercropped with cowpea, marigold, pigeon pea, green gram and black gram. Last year, the yield was 4 q/a, whereas in 2009 only 2 was expected. He explained that for the past 30 years he had been planting the same two hybrids with an average yield of 3-6 q/a. Many years back, he got 8-9 q/a yield, which eventually came down to 2 q/a before he decided to become an organic farmer.

On his 24-acre farm, the president of S.K.S. normally has produced cotton on six acres. By contrast to other organic farmers within his association, he does not want to use hybrids. This year he has only planted cotton on one acre using two varieties, MCU-5 and Surabhi – both varieties were received from farmers in Maharashtra. The sale does not go to the market, rather the objective is to keep alive the varieties in the midst of hybrid, mostly Bt domination. “Seeds are being patented, and seed companies are extending
Seed use of organic cotton farmers

tentacles to what was till recently assets of the village community. But with the seeds sector being taken over by the companies, availability and hence control over food production will no longer vest with the farming community” - said Vivek Cariappa (S.K.S. 2009b). He would like other organic farmers to use varieties as well, however they prefer hybrids.

Kabini Organics
Parallel cultivation is still allowed among farmers in the first year of conversion in this project. The project sources seeds via the same route as S.K.S., and the harvest is expected to be sold for 2900-3000 Rs/q to Appachi Cotton. Facing the same seed sourcing problems as S.K.S, the executive director of the MYKAPS project complained “we would need 30 quintals of seeds in 2010, but it is questionable whether KSSC would supply the seeds any longer”43.

ICRA - SOFF
The untreated, hybrid seeds, called DCH-32, have been purchased also from KSSC. There was no fresh lot available, so the seeds produced in 2007 got re-certified by KSSC in 2009 and sold to the farmers. Seeds were bought at a subsidised price of 50 Rs/bag (1/2 kg) last year, however seeds are not liked by the farmers, because of low yields and pest problems (SOFF 2010). Moreover, yield is generally low also due to the red soil, which is not suitable for cotton production and due to the lack of rain at the first stage of plant growth. The federation placed an indent with KSSC for 300 kg of DCH-32 seeds for 2010, however it depends on farmers’ decision whether they want to continue with this hybrid (SOFF 2010).

During a farmers’ meeting in Nanjagud, six cotton farmers were asked on their experiences with the seeds. One of the leader farmers, called Siddarajappa from Kaghalur village, explained that for 15 years he had been growing cotton, but since last year his neighbour planted Bt cotton, thus he stopped growing it. Another three farmers explained that they stopped growing cotton because of the lack of rain: one had 2.5 q/a cotton last year which he cultivated together with castor, red gram and horsegram, the other had 3 q/a, and the third had only 1 q/a; despite of the low yield, they were satisfied since they did not have expenses and received other crops from the same land too. Another cotton farmer, who has received 1.75 q/a yield this year, said that till about 5 years ago, the same hybrid had yielded much more, between 6-8 q/a. Farmers think that since they are receiving seeds from old stock, the vigour of the seed has been lost resulting in lower yields. Thus they are prepared to switch to another hybrid or variety, once it is shown that the performance is acceptable.

43 Personal communication with William D’Souza, director of MYKAPS, H.D. Kote. 27-09-09.
5.2.2 Seeds of Andhra Pradesh organic projects

During the interviews with project leaders of organic cotton groups in Andhra Pradesh, it became apparent that all projects relied almost exclusively the past few years on seeds procured from one company, Nuziveedu Seeds. The reason provided for that was that there were no other companies selling non-Bt seeds. Besides, the most popular hybrid among farmers called Bunny has a good germination percentage and good plant growth.

Most organic projects started seriously thinking about their seed strategy after a workshop on the seed issue in August last year organised by Flocert where several companies (Nuziveedu, Krishidan), organic cotton projects (AGROCEL, Pratibha, Chetna, Zameen) and NGOs (CSA) participated. The representative of Nuziveedu acknowledged at the meeting that there was no non-Bt seed production any more – all the seeds they had given recent years to organic projects were from old stock, and in few years they would have no more seeds (CSA 2009, Chetna 2009b). Till then, they are ready to produce non-Bt seeds for sale, but the orders have to be made well in advance and the price would be double (something the company could easily allow itself to do due to its total monopoly in the non-Bt seed business in Andhra Pradesh).

Table 21: Seed use of Andhra Pradesh’ organic cotton groups

<table>
<thead>
<tr>
<th>Project name</th>
<th>Name of seeds used</th>
<th>Seed producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chetna</td>
<td>Bunny, Super Bunny</td>
<td>Nuziveedu</td>
</tr>
<tr>
<td>Zameen</td>
<td>Bunny, Mallika; Ajinkya, Vijetha</td>
<td>Nuziveedu, Mahabeej</td>
</tr>
<tr>
<td>Oxfam</td>
<td>Bunny, Mallika</td>
<td>Nuziveedu</td>
</tr>
</tbody>
</table>

Chetna

Chetna Organic Farmers Association facilitates linkages with the seed dealer and does not directly involve in supplying the inputs to the farmers. Seed procurement is organised through the farmer MACSs; GMO-free declaration is obtained either from the company that supplies seeds or the dealer where the order is placed (CHETNA 2009b). Self-help groups tell the field staff how much land they want to plant the following season and then a matrix is created to show how much and which hybrids are demanded. Once this is known, formal discussions are held with dealers, who usually ask in March, April which seeds are requested (CHETNA 2009b). In 2008/09, Bunny, Superbunny and Ankur Akka seeds were on demand, similarly to 2009/10, however only very small amount of Ankur Akka seeds were available (none in Andhra Pradesh). “The main problem is the non-availability of untreated and non-Bt seeds” – expressed the project manager of one of the

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44 Nuziveedu claimed at the meeting that they wanted Rs 1000 for a 450 g packet of non-Bt seeds - because its production is more difficult due to the maintenance of isolation, the company wanted a share from the premium that the projects receive, with a one-year advance payment (CHETNA 2009b, CSA 2009).
clusters (CHETNA 2009a). Two dealers were supplying the untreated, non-Bt seeds in Andhra Pradesh last year: M/S. Prakash Traders in Karimnagar and Waman Ramulu in Adilabad (CHETNA 2009a). Besides them, Superbunny seeds were procured via a dealer in Orissa. The following table shows how many packets of non-Bt seeds were requested and to what extent this request could be met.

Table 22: Cotton seed requirements of Chetna for three states in 2009

<table>
<thead>
<tr>
<th>Seeds</th>
<th>Packets requested</th>
<th>Packets received</th>
<th>Price per packet 2009/10</th>
<th>Price per packet 2008/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunny NCS-145</td>
<td>1300 + 300</td>
<td>1600</td>
<td>Rs 455</td>
<td>Rs 388</td>
</tr>
<tr>
<td>Superbunny</td>
<td>2400</td>
<td>2400</td>
<td>Rs 480</td>
<td>Rs 448</td>
</tr>
<tr>
<td>Ankur Akka</td>
<td>2500</td>
<td>160</td>
<td>Rs 410</td>
<td>n.k.</td>
</tr>
</tbody>
</table>

Source: CHETNA (2009b)

Several villages were visited in Karimnagar district, namely Kishtapur, Repaka and Gundaram, all located in Ellanthakunta mandal. All farmers were still under conversion and were growing cotton on 1-2 acres. Bunny seeds were used by all farmers in these villages and seeds were organised for them via the MACSs, thus most of them did not know about problems related to seed supply. The previous year, their yield was between 2-4 q/a, reaching to 6-8 in those three visited farms, which used irrigation. Half of the farmers, whose fields were visited, grew paddy along with cotton, which they intercropped with red grams. One of them, G. Raji Reddy who is the president of the MACS in Karimnagar, owns more land than average, 19 acres, 11 of which has been planted with cotton. His 2008 yield was 3.5 q/a, for which he received 3450 Rs/q.

Although Chetna has received seeds from Nuziveedu’s old stock recent years, the company told to the coordinators of Chetna that there was no more interest in producing and/or supplying non-Bt any longer – the next season they still supply but afterwards it would be problematic (CHETNA 2009b). The CICR replied to Chetna’s request for seeds that if order was placed a year in advance, they would be able to produce the non-Bt seeds. The seed production in the state starts in September and Chetna would need to place an indent with Nuziveedu or with the research institute that early, however “farmers decide only in the following April what crops to plant making it dependent on climatic conditions - mainly rainfall. Chetna as an NGO cannot bear the risk of arranging seed procurement when it is unknown how much of it could be used and we also do not have a storage facility to keep the seeds for the next year” (CHETNA 2009b). Nevertheless, Ramakrishna, the senior program manager for Chetna Organic Farmers Association made clear in February 2010 that for the coming season, 3000 packets of seeds from Nuziveedu and 3700 packets Ankur 561 and Ankur Akka hybrids from Ankur Seeds have been ordered and their supply was promised by the respective companies.
AOFG & Zameen

Farmers associations collect data from farmers what yield expectations they have, whether they are satisfied with their seeds and what seeds they would desire for the following year. This information is pulled together on mandal level, and on the basis of this seed companies are approached. In Adilabad all mandals get seeds directly from the regional office in Kagaznagar, except for Kasipet mandal, which approached directly the subdealer in the town of Asifabad to purchase non-Bt, untreated Bunny seeds (AOFG 2009).

In 2009, 3000 Bunny packets were ordered from Nuziveedu but only 1000 were supplied. This is the reason why the Maharashtra State Seeds Corporation Ltd (Mahabeej) was asked to supply Ajinkya and Vijatha seeds (900 packets). The corporation is still producing non-Bt but announced that they would start with Bt production in 2010 using Bt genes from Monsanto (AOFG 2009). Besides, Zameen ordered 200 packets of organic certified seeds from Jayveen Seeds (a company based in Indore, Madhya Pradesh) for farmers in Maharashtra, however they were not satisfied with the yields (AOFG 2009).

Before the introduction of Bt, Zameen cotton farmers were using 10-15 different hybrids and farmers were allowed to procure seeds themselves – however since the rapid expansion of Bt and the following unavailability of non-Bt seeds, farmers have been restricted to use maximum four hybrids and seed procurement has become centralised. “In Maharashtra, 30-50% of organic farmers have been growing local short staple varieties that withstand drought and dryspell, however due to market demand for longer staples, we had to ask these farmers to switch to hybrids last year” – explained by G. Venkat Raman (AOFG 2009). According to him, “if you do not involve in seed production, there will be no non-Bt seeds left in 2-3 years.” Depending on market demand, the project is willing to start new activities, like farmer-level seed production, but for the next season AOFG still depends on Nuziveedu for seeds (AOFG 2009).

One of the most striking consequences of unavailable seeds is that the cotton acreage of the project went down by about 2000 acres (30% of total) in Maharashtra and Andhra Pradesh this growing season. As a result, for 2010 they would order only 3000 packets of seeds. There were three options generally available at this point for the farmers (AOFG 2009): (i) instead of cotton farmers grew soybean, red gram or green gram (and Zameen is in the process of looking for buyers to get premium for these organic crops), (ii) farmers were downgraded into IC-0 status due to contamination issues or (iii) farmers switched to planting Bt and thus stepped out of the project (happened to 10% of all cotton farmers).

In one of the villages that were visited (called Kanargam in Wankadi mandal), there were 45 organic farmers in 2008/09, however due to unavailability of non-Bt seeds, 16 farmers dropped out and planted Bt this season (AOFG 2009). One organic farmer in the village explained about the seed buying process that farmers generally approach the seed dealer
and ask which seeds were available - based on his recommendations, they buy seeds. He admitted that spurious seeds were available from the seed dealer in Asifabad for 1000 Rs/kg, and at least 23 acres in the village were planted with such seeds.

In Kannappalli (Koutala mandal) village an organic farmer, who is also the cluster association president, explained that he had tried several hybrids in the past years. He started organic farming in 2006; that year he planted two acres of non-Bt Bunny with 9 q/a yield, the following year he tried non-Bt Mallika with 6 q/a yield, whereas the last two years he cultivated Ajinkya seeds from Mahabeej45. He used different hybrids on a trial-and-error basis and liked Bunny the most. Each time he received the seeds from the regional office, which prior requested farmer associations to write together farmers’ demand for seeds. Although only few farmers requested Ajinkya from his village, due to unavailability of non-Bt Bunny, all organic farmers ended up planting Ajinkya.

A tribal farmer from a remote hilly area has been practicing traditional agriculture without any inputs and he has been an organic farmer since three years. He cultivates cotton on 4 acres, for the first two years he used Bunny with an average of 2.5 q/a yield, in 2009 he used Ajinkya and expected 2.5-3 q/a yield. “Last year two farmers planted Ajinkya and they had higher yields than Bunny farmers, which inspired other farmers, so this growing season everyone has been growing Ajinkya”46. He said he was satisfied with Ajinkya since he made zero investment and for 2010 he did not mind whichever hybrid to use from these two.

In an ad-hoc group meeting, where four organic and two Bt cotton farmers participated in Vanjiri village (Kagaznagar mandal), all organic farmers agreed that Bunny was better than Ajinkya because of higher germination rate, bigger boll and plant size. They were not happy with Ajinkya and would prefer getting Bunny or Mallika seeds in 2010. They even expressed that they would rethink the continuation of organic farming if those seeds were not available this year. Yet Bt farmers were doing worse than organic farmers in 2009 due to the lack of rainfall and overall all six farmers present agreed that organic farmers were profiting more.

After the open-ended group discussion, farmers were shown the cotton bolls from the demoplot that the NGO initiated in 2009 – one hybrid and one variety (received from another NGO called CSA to start own seed production), without anyone knowing what they were seeing. All farmers preferred the hybrid and thought it was a Bt hybrid. Upon learning that it was non-Bt, they were all very much interested and would have liked to purchase it for the following season. This situation again showed clearly how little effort it takes to convince farmers. They all agreed that the open-pollinating variety was able to

45 Personal communication with Gangaram. Kannappalli, Kagaznagar district. 06-11-09.
46 Personal communication with Madavi Jaithu. Regulagudem, Kagaznagar district. 06-11-09.
withstand climatic changes but until agronomic aspects were proven to be acceptable, they would not want to go for varieties.

**Oxfam**

Every year, the four partner NGOs procure the requested amount of seeds from the dealer in Warangal and then distribute them among interested organic farmers. In 2008, two dealers offered non-Bt seeds and Gayathri Seeds was chosen since they offered a better rate. “*When I was looking for non-Bt seeds, most seed dealers were laughing at me*” – explained Kaviraj Sadineni the project coordinator of one of the partner NGOs, PSS (OXFAM 2009). This year, most probably the same dealer is asked again to provide the non-Bt seeds.

Last year, PSS ordered 600 packets of non-Bt Nuziveedu seeds, but instead they received 279 packets of Mallika and 195 of Bunny (OXFAM 2009). The order came after farmers were asked which seeds they would prefer – the result was a variety of hybrids: Bindu, Pradam, Chetrapati, Mallika and Bunny, but the first three could not be sourced as non-Bt (OXFAM 2009). Due mainly to this reason, some farmers dropped out – they preferred planting the requested hybrid with Bt gene rather than staying organic but planting another hybrid. Due to parallel cultivation of Bt and organic cotton last growing season, 19 farmers were put on the sanction list among the NGO’s 474 cotton farmers, which meant that they had to start the three-year conversion again and they got excluded from the farmers’ list (OXFAM 2009). The other reason for the 5% drop was that rains came quite late, thus many farmers decided to switch to food crops.

CROPS, the other NGO which monitors 400 cotton farmers in 14 villages, ordered 140 packets of Mallika and 248 packets of Bunny last year. All the seed request of farmers could be met. Since three years, only these two hybrids have been used and varieties have not been available.

Whereas in 2008/09, average yield was about 6 q/a, in 2009/10 it has been 4 q/a - still higher than in other organic projects because of better soil condition and availability of irrigation in many cases: 25% of the Oxfam farmers use irrigation (OXFAM 2009).

In a village called Rajulakothapalli (Nellikudur mandal), a group meeting was called upon where 10 organic and 5 Bt cotton farmers participated. There are about 200 acres of cotton cultivation in the village, out of which 42 acres are organic and 158 are Bt cotton. Non-Bt Mallika and Bunny seeds are used exclusively by the organic farmers who explained that all of them got seeds from an authorised dealer of Nuziveedu (called Gayathri Seeds) in Warangal through the local NGO, PSS. The same dealer also sells about 10-15 different Bt hybrids from various companies (mostly Tulsi, Mahyco and Nuziveedu).
6 Assessing the cotton seed sector

The previous three chapters described the cotton seed sector (Chapter 3), the availability of non-Bt cotton seeds (Chapter 4) and the use of cotton seeds by organic projects (Chapter 5) in two states of South India. Up to this point, the first three research questions have been answered, however these answers will only be complete with the overall assessment of cotton seed security in organic projects - which will be done in this chapter - and with the description of what organic cotton projects do to avoid contamination from GMOs (which is part of research question 2 and will be dealt with in subchapter 7.4).

This chapter focuses on summarising the research findings in the light of the theory that was described in Chapter 2 in order to build up the models on seed delivery systems and to answer the question whether seed security exists. Only upon understanding the different stakeholders and their relationships is it possible to analyse seed security and offer recommendations as to how that can be achieved. Furthermore the second part of this chapter goes more deeply into the present role of the public sector, which is a crucial element to balance out the dominance of private companies.

6.1 The recipe for seed insecurity

As was expressed in Chapter 2, seed security is understood as farmer groups/organic projects having a stable physical, social and economic access to sufficient quantity of quality seeds which meet their preferences of seed choice. Thus seed insecurity arises if there are problems with any of the following: a., the timely availability of sufficient quantities of quality seeds; b., farmers not having access to appropriate seeds; c., farmers do not have the right to save own seeds.

Guaranteeing the access of farmers to sufficient quantity of quality seeds can only be assured if a viable seed supply system exists that multiply and distribute cotton seeds. Thus taking into account the analysis done in Chapter 4-5, the task of drawing the models – based on REDDY et al. (2006) to describe the seed systems in Andhra Pradesh – becomes straightforward. The authors in that study claimed that for a well-functioning seed system that meets farmers’ demand for quality seeds one needs the appropriate combination of both the formal and informal system. Thus if the models describe an imbalanced situation, where there are serious flaws to a healthy seed delivery system, seed insecurity arises. The instability of seed supply jeopardises the availability dimension of seed security. In case the present situation reflects a balanced seed system, the access angle must still be scrutinised in order to determine whether seed security exists. Since in India, farmers have the right to save their seeds – India is among the first countries in the world to have passed legislation granting farmers’ rights in the form of
the Protection of Plant Varieties and Farmers’ Rights Act, 2001 – , this element will not threaten seed security. The following models illustrate the situation of cotton seed delivery systems of Karnataka and Andhra Pradesh.

**Figure 16:** Cotton seed delivery systems in Karnataka (left) and Andhra Pradesh (right)

![Cotton seed delivery systems diagram](image)

Source: based on REDDY et al. (2006)

**Figure 17:** Generalised representation of organic cotton seed supply in Karnataka (left) and in Andhra Pradesh (right)

![Organic cotton seed supply diagram](image)

Source: based on REDDY et al. (2006)
In Karnataka, all seed supply dimensions are in place, although in a distorted form, with a clear dominance of private companies. If we only look at organic farmers (Figure 13), which are the subject of this analysis, the picture is more balanced with a supply both from the formal (public institutions, namely KSSC and UAS) and from the informal (farmers’ saved seeds, NGOs and local seed trading and exchange) sector. Thus the appropriate combination of both systems was present as of 2009, which according to REDDY et al. (2006) is the foundation of a healthy seed supply system. This balance is crucial as it enables a choice for the organic farmers or projects supplying their members with seeds. Taking away KSSC as a non-Bt seed supplier from the picture, as is evident from organic sources it would most likely happen this year (e.g. S.K.S. 2009), makes the whole system imbalanced and leaves farmers without choice the of non-Bt hybrid seeds (UAS, Dharwad was only selling varieties last year). Consequently the current balance is a very fragile one that cannot be called a stable system, which is one condition for seed security.

The situation is much worse in Andhra Pradesh, where the cotton seed supply is almost exclusively dealt with by private companies. The informal sector is totally absent, so as the public sector. Only a slight exception has been found in the case of organic farmers: 900 packets of non-Bt seeds were supplied for one organic project by a public institution from Maharashtra (Mahabeej). If this is not taken into account, then 100% of seed supply is dominated by private companies in the state, making the whole cotton seed system totally imbalanced. Looking only at organic projects, except for these 900 packets by one project, every organic farmer gets seeds produced from one private company: Nuziveedu. This situation is not only fragile but undermines one of the very basic values of organic production which is the independence of farmers. Not only do they lack the choice, but even this choice is a very vulnerable one. Having this in mind, no doubts can be raised as to the seed insecurity situation of cotton farmers in general and organic cotton projects in particular in Andhra Pradesh.

Overall, the disturbingly missing public sector and overwhelming presence of private sector is without doubt a recipe for seed insecurity, be of conventional or organic cotton farmers (as the case of Andhra Pradesh demonstrates). Similarly, an active civil sector without the presence of public or private sector also leads to seed insecurity (as the case of Karnataka shows). Although the seed insecure situation has been by 2009/10 manifested itself in the two states to different degrees (less severe in Karnataka), the possibility still exists to reverse this to a stable, seed secure status and thereby continue the organic cultivation of cotton. However, this is unlikely to happen with the existing seed systems (since no changes are foreseen for the close future) and not more than one, maximum two years is left to save the organic cotton sector, since afterwards no non-Bt cotton seeds would be available. The following subchapter goes deeper into why the public sector cannot be counted on and thus why different strategies need to be looked for in search of seed secure organic cotton projects.
6.2 Public sector ignorance?

“Why are they funded, when in crisis situation such as this, they cannot come up with solutions and help the multiplication and supply of non-Bt seeds?” CSA (2009)

Among the two states, only in Karnataka do public institutions play a role in the cotton seed supply. As was highlighted earlier, neither the Acharya N.G. Ranga Agricultural University, nor the APSSDC, nor any other public institution in Andhra Pradesh has any meaningful role in promoting and/or providing non-Bt seeds. This subchapter attempts to demonstrate why and to what extent the public sector is involved or absent in the cotton seed supply in Karnataka.

The KSDA claims to be neutral in terms of its position on Bt cotton – it neither promotes, nor discourages the cultivation of Bt hybrids (KSDA 2010). State officials at KSDA highlighted that it was important to give the choice to farmers and not push them to or away from the planting of Bt. They pointed at the central government saying that there was no official stand on Bt cotton (KSDA 2010) – though obviously it was the government who gave the approvals for the cultivation of GM cotton.

One may wonder whether with the one-sighted PR and widespread marketing efforts of private companies - which were by all interviewed public sources acknowledged - on the successful performance of Bt, farmers get an objective picture on which basis they can make a proper decision. The freedom of choice can only be guaranteed when people have the access to all necessary information for a decision. As to the question what the government does in balancing out the one-sighted information and/or promoting the use of varieties or non-Bt hybrids, no answers were provided.

Statements from both KSSC “KSSC needs Bt for survival, since there is no demand for non-Bt and the company has to be maintained; if demand arises again for non-Bt we will get new seeds,” (KSSC 2009) and the UAS, Dharwad “the role of university is to provide non-Bt seeds if there is requirement or indent placed” (KHADI 2009) makes clear that none of the institutions have interest in promoting non-Bt seeds and sees their roles passively in merely providing what is asked for.

Also, whether the position of the state government is really neutral can be questioned. The government’s state seed corporation in Karnataka made a mutual agreement with one of the biggest Bt cotton seed companies in India, the JK Seeds for selling their private Bt cotton seeds starting last year (KSDA 2010). Whereas for decades, the private sector was selling the hybrids of the public sector, the picture reversed and now the public sector lacking the interest (or the demand as they call) in non-Bt hybrid sales and not yet having own Bt hybrids (which may probably change this year as well), took up the role of a marketing agent for a private company and used its wide distribution networks, founded on tax-payers money, for the sale of a private company’s product. This tie-up has not
been publicised very much, yet the KSDA admitted that if the business turned out well, other companies’ Bt hybrids may also be sold by KSSC soon (KSDA 2010).

The DCD in Mumbai and state governments are “not promoting Bt, but also not putting obstacles in front of it” as several state officials repeated in different interviews (DCD 2009, KSDA 2010). Bt is not recommended for rainfed situation or light soils; whereas higher fertilisation and split doses of fertiliser application are all requirements for its success – highlighted the joint director of the DCD (2009). What state governments have been trying recently is to reach out to farmers via extension services and tell them that if the right conditions are not met, they should not grow Bt (DCD 2009). State officials at KSDA commented that they explicitly did not recommend Bt for rainfed areas (KSDA 2010). The only problem is that even though farmers do not want Bt, they do not have a choice any more. Kolhatkar complained that “the problem is that companies are cheating, since they do not tell the requirements for Bt cultivation to the farmers. 38% of cotton is irrigated in India, all the rest is rainfed, thus most Bt cotton is cultivated on areas where it should not be” (DCD 2009).

The situation was very well summarised by one interviewed scientist at CRC, Hebbali who said that the public seed distribution channel is in bad shape; even though the university has high-yielding non-Bt hybrids, which have higher potential than Bt hybrids, “no one bothers distributing them (...). It should be the role of state seed corporations, but they are not keen on promoting varieties, nor non-Bt hybrids” (CRC 2009). The private sector has good distribution channel systems, which are very much liked by farmers thus even though the public sector has better hybrids, they will not reach the farmers (CRC 2009). The fact that the public sector is mostly into Bt cotton is clearly shown by the recently released public-bred Bt varieties and the media-hype that surrounded it. As mentioned before, the CICR came out last year with a Bt variety named Bikaneri Nerma, and a Bt hybrid NHH-44. This was the first time the public sector entered the Bt sphere in India. About 5-10 state governments were given Bt seed packages (5-10 kg) for try-out and further multiplication as certified seeds (DCD 2009). The Maharashtra State Seeds Corporation few months ago got permission for large-scale seed production of the Bt Nerma variety for 2010 (DCD 2009). All this makes the direction for agricultural departments and state seed corporations very clear. Yet, as was told by the joint director of DCD (2009), “the entry of public sector into the Bt seed market comes way too late, since by now private companies totally dominate the market.” This view was also shared by the vice president of NUIZIVEEDU (2009).

Last year these public Bt seeds were sold to many farmers, however farmers in Maharashtra reported that they had bad experience with them: two farmers were interviewed who complained that their cotton plants failed and they along with other
farmers were about to receive compensation. According to some scientists, the failure could have happened if the purity was not maintained properly. Whichever may be the reason, the reputation of public sector Bt could be damaged – at least among farmers – and it would take long until trust is regained. The Bt release in the public sector was long awaited and its approval widely publicised in media, however its adoption is probably set back, although no media news have been found to report on it.

As of 2009, 40 Bt cotton hybrids and/or varieties were under research by research stations across the country. Knowing that around 620 Bt hybrids are released for commercial cultivation, “farmers are left in the hands of companies, via their massive advertisements, so state governments can only help them by recommending which ones are suitable for which region” - opined the joint director of DCD (2009), which is the technical body on the cultivation of cotton in the country. According to him, “the public sector lost the battle on the cotton field”, thus the only thing they can do is some control measures, like price control (as was done by the Andhra Pradesh government) or instructions on disclosing full-truth on seed packages (used by the Madhya Pradesh government). However more proactive solutions have been also offered, for instance, by the government of Orissa, which has forbidden the cultivation of Bt cotton. As for the future, Kolhatkar thought that “cotton will be in the hands of business and non-Bt seed production will only be left for maintenance reasons of the seeds, otherwise not” (DCD 2009). He admitted that if there should be a shift for any reason to non-Bt, large-scale cotton production would not be possible any more.

Both the public sector and market players seem to have casted their vote on Bt cotton, however not all hope is lost for the non-Bt cotton case. Although these seeds have been left aside, some scientists and NGOs still try to revive and improve non-Bt seeds. Out of own interest, without any budget or project from the university, a senior breeder, Dr S.S. Patil from the CRC, Hebbali - the same research centre developed and released the public-bred Bt variety and hybrid - gives non-Bt varieties to farmers and involves them at different stages of seed production.

He works with a group of farmers, receives their feedback on the seeds; every year, he involves few farmers, who can then give away or sell the seeds freely but who have to return some seeds to the scientist. As it was described in Chapter 5, a farmer called B.C. Purad, with whom he has been working for 7 years, has been experimenting with G.

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47 The Plant Variety Protection (PVP) law of India has a provision for farmers to claim, via a PVP Authority, compensation from the breeder of a variety if it does not perform as expected (Section 39 (2) of the PVP Act, 2001) though such a body has not yet been set up.

48 When the breeder of the public Bt hybrid, Dr B.M. Khadi, dean of postgraduate studies of UAS, Dharwad was asked about the failure, he said that some Bt variety farmers failed last year, but this was not because of Bt, since other non-Bt varieties also failed. “In drought situations with long dry spells, like in Maharashtra in 2009, irrespective of Bt, cotton fails generally” (Khadi 2009).

herbaceum species, though last year he was given G. arboreum seeds for testing. The scientist complained though that the research center has given many G. hirsutum varieties (50-60 kg) to NGOs recent years, none has taken up systematic seed production. The centre is willing to give parental seeds to farmers and NGOs for them to try and evaluate what is best for their conditions. Last year only a small NGO requested non-Bt seeds but the CRC was only able to provide 10-15 kg seeds – NGOs, farmers need to request a year in advance so that the centre could produce sufficient quantity (CRC 2009).

The research center has an ongoing research on drought-resistant G. hirsutum genotypes with the objective to recommend the genotypes suitable for the different zones under drought conditions. In 2006-07, four proved to be very good (in terms of low drought-resistant susceptibility index and high yield): Sahana, ARB-815, ARB-757 varieties and a hybrid named SSB-5. All these have been officially released since then. Last years, other four varieties were added to this list: ACCLD-18-Cy, CPD-817, DHH-0761, and WGHH-411, none of which are released yet (CRC 2009). Similar research is on-going at Guntur (in Andhra Pradesh), Surat (Gujarat), Kandna (Madhya Pradesh) and Hisar (Haryana) with G. hirsutum drought resistant varieties. However, even if research is on-going with some varieties and non-Bt hybrids, they seem not to reach farmers. There are about 200 genotypes under field trials at the centre, about 25 non-Bt hybrids have higher potential than the best Bt hybrids, yet no one wants them, according to S.S. Patil (CRC 2009)\textsuperscript{50}. Therefore whenever the best non-Bt hybrids are tried out and proved, Bt genes are inserted to them and thereby the public sector could come out with higher-potential Bt cotton hybrids (CRC 2009).

\textsuperscript{50} When the main cotton breeder in Guntur (Andhra Pradesh) was asked, exactly the same answers were given: non-Bt hybrids and varieties with potentially high yield and good qualities are available, yet no one requests them (ANGRAU 2010).
7 How to avoid GM contamination of seeds?

Whereas in Karnataka, seeds for organic cotton projects come both from the public and civil sector, in Andhra Pradesh, all seeds are bought from private companies. Depending on whether hybrids or varieties are at stake, and whether seeds are bought, saved or exchanged, different risks arise with regards to the contamination of seeds with Bt genes. This chapter shortly introduces these risks and explains which measures are used by organic cotton projects and which are further recommended to prevent contamination of seeds.

Most certification bodies in India tolerate the presence of GMOs in organic cotton up to 0.1%, which is the limit of reliable detection, following practises in the European Union (ADITI 2010). With respect to the costs of segregation and possible contamination with Bt material in non-Bt crops, the question in the West has focused on the liability aspect: who should pay the additional cost. Logically it should be the source of the ‘contamination’, following the polluter pays principle, which is an accepted practise in the European Union, however in developing countries, such as India this is not the case. As became evident throughout all farm visits, the cost of segregation from Bt cotton is borne by the organic farmer alone, and only the premium may provide an incentive for the farmer to preserve the integrity of his/her organic produce. If Bt genes are detected in the organic cotton, the farmer (or even whole farmer groups) bears all the costs: loses his/her premium as well as the organic status – several of such cases happened alone this growing season in all organic cotton projects.

Contamination from Bt cotton can happen at biological level through transgene flow or at physical level through mixing-up during the handling of production and post-production processes. The risk of contamination can arise during a variety of steps: maintenance of foundation seeds, seed and/or cotton production by farmers (cross pollination, volunteers, use of equipment), cotton storage at farmers’ house, transportation to (and from) the ginning factories and ginning factory processes. Since the present study focuses on cotton seeds, the whole chain up to the processing at ginning mills is involved.

7.1 Non-Bt cotton seed production

Hybrids
95% of hybrid cotton seed production in India is concentrated in Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra (VENKATESWARLU 2007). In Karnataka, during the 2006/07 crop season, the total estimated area under cotton seed production was 5000 acres; in Andhra Pradesh, it was 16 000 acres (VENKATESWARLU 2007), though in the later, all seeds were exclusively produced through orders from private companies.
In case of public hybrids, the seed production is done by producers registered with the state seed corporations. All seeds must be certified through a seed certification agency. Agriculture research stations also produce foundation seeds which are provided to private companies and individual farmers. However, almost all private companies circumvent this certification process, since for them the certification requirement is voluntary (KSSC 2009).

In 2002/03, KSSC still covered nearly 20% of the area under cotton seed production in the state, whereas in Andhra Pradesh, the APSSDC accounted for less than 5% of the production area (VENKATESWARLU 2004). Since many years, there has been no certified seed production either by KSSC or APSSDC, thus even though KSSC still sold some hybrids they were from old stock (KSSC 2009). Similarly, the private company of which non-Bt seeds are used in Andhra Pradesh also admitted having sold seeds that had been produced years back (NUZIVEEDU 2009). Nevertheless, this chapter also describes which factors are important in preventing Bt contamination at this level, were there some non-Bt seed production by either private, public or the civil sector.

In case of hybrids, companies first make an assessment of how much seeds are needed for the coming season based e.g. on farmers’ preferences and current market sales and then plan their seed production areas. In India, last year 12 000 tonnes of Bt cotton seeds were produced and 3000 tonnes non-Bt as refuge (NUZIVEEDU 2009). The mandatory requirement of maintaining the 20% refuge for the Bt cotton is not at all implemented due to the fact that nobody really taught the farmers how to do refuge management, nor explained why it was important in order to maintain pest resistance (SAHAI undated). “Non-Bt is mainly produced for refuge, though all farmers throw away the 120-gram bags within the Bt packages” (NUZIVEEDU 2009). The company produced cotton seeds on 20 000 acres in India in 2009 and it has involved farmers for seed production through contract farming. Usually, some villages specialise in seed production, even if they grow cotton for the commercial market too.

**Figure 18:** Manual cross-pollination of cotton

The major part of hybrid cotton seed production is cross-pollination which is done manually. Emasculation (the removal of anthers of a flower to leave only the female reproductive organ there) and pollination (placing pollen grains on the stigma of the flower, see Figure 14) makes hybrid seed production a costly, labour-intensive and difficult task. The physical transfer and dusting of pollen grains on the stigma of each emasculated flower cannot be
7 How to avoid GM contamination of seeds?

circumvented by pollination using honeybees or other techniques (VENUGOPAL et al. 2003). In commercial hybrid seed production plots, hand emasculation of female parent in late afternoon is followed by pollination the next morning and this work accounts for nearly 90% of the total labour requirement and 45% of cultivation costs (VENKATESWARLU 2004,1).

One disturbing aspect of cotton seed production in India, not covered in this thesis, is the number of child labourers employed on cotton seed farms: according to a study done by VENKATESWARLU (2007), in the 2006/07 season, about 416 460 children under the age of 18 were employed in cotton seed farms in Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka, which accounted for 92% of the total production area in the country; alone in Karnataka 47 500 and in Andhra Pradesh 127 800 children had to work on cross-pollinating cotton.

Varieties
In case of varieties, seeds can be saved from the crop by farmers themselves by carefully selecting good bolls, though most often farmers get back seeds from their produce or from others’ produce from the ginning factories – thus the risk of contamination arises in the mills themselves (described in subchapter 7.3). Reusing seeds can be one of the sources of contamination, according to CSA (2009), which itself started organic cotton seed production. If one flower in the entire field (there are about 50 flowers on each of the 4000 plants in an acre) is cross pollinated, it results in at least 8 seeds having traces of Bt. When these are planted in the next season, each of the 8 plants, when producing 50 flowers, can contaminate at least 25 more during that season (CSA 2009). On the other hand, according to the head of Gadag district’s KVK, the contamination is not an issue with varieties since the flowering time of Bt and varieties are different, moreover Bt cotton is ginned till January, whereas Jayadhar in March (Kvk 2009).

7.2 Biological contamination

Cotton is mainly self-pollinating although partial cross-pollination occurs (HUTMACHER, VARGAS and WRIGHT 2006). There are about 10 000 pollen grains in the flower, which start to germinate when reaching the stigma. Pollen grains are viable up to 24 hours after which they lose potency (VENUGOPAL et al. 2003,140). They are heavy and sticky thus reducing the chance for wind pollination. Among insects, most often honeybees are the natural agents for pollen transfer. Cross-pollination is generally 3-20% (VENUGOPAL et al. 2003,141) and it mostly depends on the presence of insects. Although cross-pollination may happen only in close vicinity of the plants, insects could carry pollens up to few hundred meters.

Since biological contamination from GM seeds to non-GM seeds is a serious risk, several pollen flow studies were carried out. The current understanding about cross-pollination is
that at least 5-25% of natural crossing occurs under most environmental conditions and up to 50% under specific conditions, e.g. high insect population (CSA 2008).

A Mahyco field trial, done in Maharashtra during the 2002/03 season using a 20 m x 20 m plot planted with transgenic cotton, reported that cross pollination of the cry1Ac and cry2Ab genes were detected up to 15 m (MAHYCO 2003). Similarly, the GEAC – under the Ministry of Environment and Forests – concluded from multi-location experiments in 1996, 1997 and 2000 that “out-crossing occurred up to 2 m, and only 2% of the pollen reached a distance of 15 m” (MOEF 2003). These studies, however, did not take into account that the extent of contamination that may flow from large source populations of Bt cotton to small sink populations of non-Bt cotton – knowing that 80% of cotton areas are Bt as of today in India, these results are rather outdated and lack reality.

A literature review (which is not a complete list) on out-crossing studies of cotton revealed that natural out-crossing reduces to below 1% at an average of 15-20 m, although several studies acknowledged that increased out-crossing percentages occur with higher pollinator insect populations (HUTMACHER, VARGAS and WRIGHT 2006). When evaluations in commercial cotton fields were carried out, measurements made at 1625 meters (1 mile) from GM plants showed that pollen-mediated gene flow was detected at less than 0.04% (VAN DEYNZE, SUNDSTROM and BRADFORD 2005).

Table 23: Studies on out-crossing distances in cotton

<table>
<thead>
<tr>
<th>Source</th>
<th>Out-crossing below 1% (m)</th>
<th>Year of publishing</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALI et al.</td>
<td>25</td>
<td>2006</td>
<td>Sudan</td>
</tr>
<tr>
<td>LIEWELLYN and FITT</td>
<td>20</td>
<td>1996</td>
<td>Australia</td>
</tr>
<tr>
<td>CHRISTIDIS</td>
<td>20</td>
<td>1965</td>
<td>Greece</td>
</tr>
<tr>
<td>XANTHOPoulos and KECHAGIA</td>
<td>10</td>
<td>2000</td>
<td>Greece</td>
</tr>
<tr>
<td>VAN DEYNZE, SUNDSTROM and BRADFORD</td>
<td>9</td>
<td>2005</td>
<td>USA</td>
</tr>
<tr>
<td>SEN et al.</td>
<td>9</td>
<td>2004</td>
<td>Turkey</td>
</tr>
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</table>

Different countries require different isolation distances for cotton seed production – usually the same recommended planting distances are followed between Bt and non-Bt that are in place to maintain purity in conventional plant varieties. In India, the Minimum Seed Certification Standards only require 50 m of isolation distance to be maintained for foundations cotton seeds and 30 m for certified seed production; however,

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51 For instance, the Seed Certification Standards of California prescribes isolation distances between the same species of cotton for foundation or registered cotton seed production 660 feet (200 m) plus 20 feet (6 m) of buffer rows and between different species of cotton 1320 (400 m) plus 20 feet of buffer rows (C-CIA 2009).
this distance must be maintained for public sector certified seeds and not for private hybrids (CSA 2008).

A well-known NGO working in the field of sustainable agriculture made a study in Andhra Pradesh and Gujarat during 2007 evaluating the contamination possibilities of non-Bt cotton with Bt genes, which included several visits to seed production sites and ginning mills (CSA 2008). Not a single seed production site was found which adhered to the prescribed isolation distances. What the NGO found, however, was that the average distance between different seed production plots (even between non-Bt and Bt) was about 1-3 m.

A similar conclusion was reached after visiting two Bt seed producer farmers in Mahabubnagar district in Andhra Pradesh during November 2009. One of them had a seed production plot and with only few meters of distance, without any buffer zone, was also growing a Bt hybrid of Nuziveedu for commercial purposes. The other had his Bt seed production plot with only 5 m of distance from someone else’s Bt seed production field. These findings prove that private companies may not maintain any isolation distance or buffer zone. The same was commented by a senior representative of Nuziveedu: both Bt and non-Bt seeds are produced within the same village and could even be neighbouring farms, since “we cannot tell farmers if they want to grow Bt, not to grow it” (NUZIVEEDU 2009). Consequently, cross-pollination cannot be ruled out between different Bt hybrids, but also between Bt and non-Bt hybrids on the seed production level.

The Bt gene has been introduced into hybrids developed from the new world cotton species (G. hirsutum and G. barbadense) which are tetraploid, therefore these cannot pollinate with the desi cotton (G. arboreum and G. herbaceum) which are diploid. Hybridisation between G. barbadense and G. hirsutum, which are both tetraploids, is possible through insect pollination (THOMAS 2003). Consequently there is a risk that gene exchange might occur between tetraploid cotton hybrids and/or varieties, especially with high insect activity and when planted in close proximity.

Genetic contamination thus becomes an issue when an organic cotton farm is using non-Bt hybrids or tetraploid varieties and is adjacent to a Bt field. In case the organic farmer uses hybrids and contamination happens from a neighbouring Bt field, the Bt gene is detectable only at the seed level (since there is no protein in the fibre) but the seeds are not re-used (since they are hybrids). Nevertheless, since inspection agencies test the seeds and not the fibre, even though hybrid seeds would not be used again, the organic cotton is rejected from such plots. If remains unnoticed, the integrity of organic clothing is still not harmed, since the fibre does not contain the unwanted genes. However another concern is that seeds are processed further to cotton seed oil, which is a cheap cooking oil; this is the process how Bt has widely entered the food chain in India without anyone testing its health implications. If, on the other hand, a non-Bt hybrid is contaminated at the seed
production level, and these seeds are brought by an organic farmer, the likelihood of producing Bt cotton is very high.

Since diploid cotton cannot cross-pollinate with tetraploid cotton, desi varieties cannot be contaminated by Bt hybrids. In case of cross-pollination between Bt hybrids and tetraploid varieties (e.g. *G. barbadense*), the consequences of unnoticed contamination is much more, since the seeds containing the Bt genes will be re-used by farmers the following generation. There are some patches of *G. hirsutum* and *G. barbadense* varieties in some districts of Karnataka, thus the risk of contamination is significant when these are grown adjacent to Bt cotton fields. *G. hirsutum* varieties are mainly grown in the dry Bijapur district as summer cotton which means they are sown in January/February and mature by July/August, and *G. barbadense* is grown by few hundreds of organic farmers in Gadag district.

Most organic cotton farmers in India rely on hybrid seeds produced by companies which mostly – if not exclusively – deal with Bt cotton. All organic projects in Andhra Pradesh are therefore subjected to the risk of cross-pollination at the seed production level and at the cotton production level if neighbours are Bt farmers. Most organic farmers in Karnataka rely on public sector certified seeds, where the risk at the seed production level is lower due to the obligatory certification system, but may be similar if cotton lands are adjacent to Bt fields. Other projects in Karnataka use mostly desi cotton which do not cross-pollinate with Bt hybrids. Only one project is known to use non-desi variety called Surabhi, but none of the farmers have supposedly Bt neighbours.

### 7.3 Physical contamination

Human errors and negligence give rise to several opportunities where physical contamination of non-Bt cotton may happen from farmers’ fields up to the ginning mills. After harvest, most seed producing farmers store their cotton, often several hybrids, in their houses, sometimes leaving them open till they are carried to the ginning mills. During transportation, there is no guarantee that the non-Bt and Bt cotton is separated. Once at the mills, workers are supposed to clean up the machinery, however, as the CSA (2008) study revealed, several parts of the machinery cannot be cleaned completely, thus again providing for another contamination hotspot.

“There are 35 ginning factories we have in Maharashtra and Andhra Pradesh alone. Ginning of Bt and non-Bt cotton is done in the same place, but non-Bt is ginned after cleaning the machinery” – told by the vice president of NUVIEEDU (2009). Seed producing farmers are present during the ginning and cleaning process, until some sample of their seed lots are sent for the ‘Grow Out Tests’ to ascertain germination percentage and genetic purity. However the presence of GM is not tested (CSA 2008). After the tests, seeds are treated by the companies (seeds for organic farmers must remain untreated),
packaged, transported to distributors and then sold. If the cleaning and segregation of Bt and non-Bt seeds are not done properly at the storage, transportation and processing level, the physical contamination of non-Bt cotton seeds – which most organic cotton farmers use – cannot be avoided.

For instance the ginning of cotton of the Krashi group takes place at Kabadi Ginning factory in Harlapur (Gadag district) where so far contamination was not an issue, since no Bt cotton was ginned there. “This has changed last year, so extra precautions have to be taken at the ginning level to avoid contamination. Since the harvest of Bt cotton is much earlier, enough time is left to clean the machinery” – explained by one of the farmer members.

In case of varieties, the cotton also ends up in ginning factories, however „there is the pathetic situation when farmers get seeds back from the ginning mills, though nobody knows which varieties those may be. If he wants Jayadhar the person in the mill selling the farmer the seeds will tell him that it is Jayadhar, though no one knows and no one checks” – explained by a senior breeder at the CRC (2009). A big part of variety seeds are supplied this way and the quality is thus eroded since purity cannot be assured any more. There is no authentic source of seeds any more since nobody confirms the quality of these varieties, unless they are bought as certified seeds (CRC 2009). Last year, the main seed dealer in Dharwad as well as the UAS sold several quintals of certified varieties to farmers. Once a farmer obtains the variety seeds, he/she usually keeps the seeds for subsequent seasons – which means every year taking back the seeds from the ginning factories and exposing the cotton to the risk of physical contamination.

Yet another seed source of varieties is local sales: in case of cotton from variety seeds travelling to the gin, waiting till seeds can be re-bought means a lot of hassle for the farmers, who very often prefer selling the cotton to whoever comes to the village and buying the seeds from the truckloads that arrive, again facing the risk of contamination at the ginning and transportation level.

7.4 Existing measures to avoid contamination

Through risk limitation strategies, both the risk of biological and physical contamination can be reduced and many of these are already practised by organic farmers. The following summarises these strategies and highlights the weak points of present organic practises (sometimes without reference to project names). As the name implies, these risk limitation strategies minimise the risks, though they cannot completely rule them out, unless both the production of seeds and cotton and also the processing activities take place in a GM-free area.

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52 Personal communication with C.R.Budihal, Jantthi-shirur village. 26-10-09.
1. **Cultural practices** are for instance planting non-Bt cotton species so they do not flower at the same time as Bt cotton. The best way to achieve this is the cultivation of varieties, most of which are grown in the Rabi season, thus the flowering and harvest is several months after that of Bt cotton. This is what all organic projects in Gadag district practise and due to the later harvest and consequent ginning processes, both the biological and physical contamination risk is drastically reduced. All other projects, using hybrids, are at greater risk of biological contamination, and should they continue to rely on private sector hybrids, other measures need to be employed to reduce the risk.

Another cultural practice is crop rotation in order to minimise contamination from e.g. volunteers that may come up on organic fields from neighbouring Bt seeds. Realistically, most organic farmers are small farmers with limited resources, thus very often they want to use all their fields for the most important cash crop, i.e. cotton that gives them premium. Organic projects prescribe for their farmers to follow crop rotation, however several farmers’ fields were visited in Andhra Pradesh where monoculture was practised. This not only leads to soil nutrient deficiencies, but increases problems with pest and disease management as well as the risk of biological contamination from neighbouring Bt fields.

Yet another very important measure is the use of buffer zone, which is an integral element of organic agriculture. Maintaining border crops of at least 3-5 rows with higher plants, like sorghum, to prevent pollen drifting have been advised by NGOs (e.g. CSA 2009, OXFAM 2009). Sufficiently high crops (3 m) can also prevent the entering of sucking pests onto the cotton field. Red gram is the most often used border crop and intercrop, of which height is ideal for the purpose of preventing cross-pollination. However, most farms that were visited had only one or two rows planted with border crop and several did not have any. In one project, the buffer zone has consisted of 3 rows of non-cotton crops like maize, red gram, castor, etc. In another, the coordinating NGO encourages farmers to keep a considerable buffer zone, which is reportedly in 90% of the cases applied. The other 10% have had problems with certification and some farmers have been forced previous years to go back to IC-0 status from certified organic. Yet in another project, buffer zones are hardly kept according to the coordinating NGO.

2. **Isolation distances** are often cited as the most crucial preventive measure to avoid Bt contamination – they are meant to minimise the gene flow effects, however they cannot totally exclude the possibility of contamination. During the field research it became obvious that the reliance on isolation distances and/or artificial barriers are measures which have not been implemented in South India effectively, not even in the organic sector. The NPOP standard does not state explicitly the required distance that is to be maintained between organic and GM crops leaving it to individual projects
and certification bodies to decide. Different inspection agencies require different isolation distances. In case of one organic project, initially, the standards on organic certification specified an isolation distance of 400 m, which was later reduced to 100 m, however even this has become difficult to maintain as Bt cotton is now found in every village (PRADHAN 2007). Many farmers, whose fields were visited, had only 1-2 m of distance from neighbouring Bt fields. Some NGOs opinion that if fields are neighbouring Bt fields, contamination is almost inevitable (e.g. CSA 2009).

**Figure 19:** Buffer zone between Bt (left) and organic (right) cotton fields

A whole other approach is promoted by the dean of UAS, who is also the breeder of the public Bt variety and an outspoken supporter of Bt technology. According to him, 5 m isolation distance is enough, unless there are honeybee activities (KHADI 2009). Also, there is no need for refuge cropping since there are no continuous Bt cotton areas, by contrast to the US; according to US studies, refuge is needed if more than 1.6 km is planted with Bt cotton, otherwise it is not necessary (KHADI 2009). KHADI (2009) opined that in India, there are no big monoculture plantations with cotton and other crops are grown in between Bt fields, thus due to smaller unit area, there is no need for refuge.

Among the 20 farmers who were asked in one specific project (most had 1-2 acres of cotton), three had no Bt neighbours, 11 had one, 5 had two and one farmer was found whose cotton field was surrounded from three directions by Bt neighbours. Buffer zone was grown by half of them, though only one row of red gram. Fifteen in-conversion farmers were asked in three different villages on their knowledge about the required distance from Bt fields and while some did not know the answer, most guessed between 2 and 200 m. This shows that educating farmers on the necessity of isolation distance and buffer zone is still lacking in some places.

In other projects, the ICS manuals describe a minimum distance of 50 or 100 m between Bt and organic cotton fields, however similarly to the previous project, very often this is not realistic. One of the strategies one project has used is to build up continuous plot systems, which are thus not scattered so that organic farmers are surrounded by other organic farmers. Despite of this, approximately 30% of organic fields are said to be neighbouring Bt cotton farms, according to the NGO coordinator. Their main strategy to avoid cross-contamination is through maintaining
buffer zone. In one project in Karnataka, minimum distance is not required, however bunds and hedges are obligatory at borders. One of the most effective approach was adapted by one group: there was no minimum isolation distance requirement from Bt fields, but if any cotton farmer had a Bt neighbour, automatically his/her cotton could not be sold as organic, only as conventional on the local market (further supporting the statement that organic farmers pay the price of actual or potential Bt contamination).

3. **Separate ginning**: the storage, packaging and transportation processes all follow stricts requirements in organic practises to maintain the segregation of organic from conventional produce (not at seed production level, since there are hardly no organic seeds available). Though human errors always occur, due to the no-parallel cultivation rule (which means at organic farms, no simultaneous conventional cotton farming is allowed – a practise nevertheless allowed by the Indian NPOP standards with conditions) in all organic cotton projects, and the separate packaging and transportation to the ginning mills, the likelihood of physical contamination seems minor. Some projects may be more precautious than others: for instance at Renuka Foundation, the harvesting is done by a separate labour group and cotton is stored at the NGO’s warehouse before ginning so to avoid the possibility of any physical contamination (RENUKA 2009a).

There are, however, no separate ginning factories where only organic cotton is processed; at least not until last year. Chetna for the first time ginned all its organic cotton at the second ginning unit of Sagar Fibers Pvt. Ltd in Yavatmal, Maharashtra, which is exclusively dedicated for organic and fair trade cotton. Most other organic and in-conversion cotton is sent to mills, where the segregation is done either in space or in time. In both cases, a thorough cleaning of machinery takes place; in case of Zameen and Oxfam cotton, for instance, the ginning mill is paid for a contract period, in which only organic cotton can be ginned – only afterwards is Bt cotton allowed to enter the factory (AOFG 2009, OXFAM 2009). At Renuka Foundation, ginning can only be done if the ginning mill has been cleaned three times (RENUKA 2009a).
Besides these measures, the following recommendations could further minimise the chance of contamination: establish good relations with neighbours, especially those whose fields directly adjoin Bt-cotton fields; thoroughly clean equipment prior to use on the fields and learn how to clean all pieces of equipment; carefully inspect and clean trucks, carriages, trailers prior to loading with non-Bt cotton; and keep records of all fields where Bt cotton is planted.

### 7.4 Role of inspection bodies

*The worth of organic cotton lies in its certification which is guided and informed by the Internal Control System.*  
(Pradhan 2007, 16).

Two certification bodies responded in written to enquiries about their certification and inspection procedures and concerns. Aditi Organic Certifications Pvt. Ltd. is an Indian certification body established in 2006 and Lacon Quality Certification (India) Pvt. Ltd. is a subsidiary of LACON GmbH, Germany. As all certification bodies, they are accredited by APEDA, Ministry of Commerce under the NPOP. Among the studied cotton projects, Aditi certifies the Chetna project in Andhra Pradesh and the OFMPAGA in Karnataka, whereas Lacon certifies Zameen in Andhra Pradesh (and also in Maharashtra).

According to these CBs, the contamination of GMOs do happen and the ICS is asked to take all possible measures to avoid non-compliance: e.g. farmers are asked to keep cotton seed bags and purchase receipts for the inspection; field officers regularly monitor before and after sowing and random sampling of seeds and of raw cotton is carried out with lab analysis both by the ICS team and external inspectors.

Aditi claims that at least 100 m of isolation distance shall be maintained by a certified organic cotton farmer from a Bt cotton field, however in reality, it is rather between 2-10 m (Aditi 2010). Lacon admitted that one sample out of every 500 farmer is positive for Bt – the cotton from these fields is consequently not procured from the project and farmers come under one year suspension. In case of contamination, accidental or advantageous, Chetna, as well as Oxfam and Zameen put farmers back to IC-0 status and do not sell their cotton as organic (AOFG 2009, Chetna 2009b, Oxfam 2009).

The director of Aditi further explained that testing has been done at three levels with the Chetna project: (i) random testing of plant material with Bt kits by internal inspectors, (ii) random testing of raw cotton by external inspectors, and (iii) every lot (17 000 kg) is subjected to qualitative PCR testing (since the CB does not allow for any threshold of GM contamination, qualitative testing suffices – thus quantitative is not needed) (Aditi 2010). This year, at the first level, few farmers were downgraded to IC-0 status due to contamination, at the second, one farmer’s cotton procurement was rejected, and at the third, up to the interview no contamination has been found.
Representatives from two other CBs were asked personally about the problems and solutions regarding possible contamination from Bt cotton. IMO India started its activities in 1995 and certifies all three cotton projects in Mysore district and the Oxfam farmers in Andhra Pradesh. Whereas in 2008, they tested cotton after harvest and two samples were found positive – these farms were not certified as a consequence –, in 2009 they also took samples from the seeds at sowing times – all of which proved to be non-GM. This year they continue on testing the harvest too and on the basis of results decide whether the 50-100 m isolation distance shall be strictly implemented. Control Union Certifications India that certifies the Renuka Foundation has in general not yet found contamination at field level, but at transportation and processing level and this is why they draw samples at ginning, spinning and garment stage.

53 Personal communication with Umesh Chandrasekhar, director. Kodaikanal. 20-03-10.
54 Personal communication with Pankaj Kumar Sinha. Kodaikanal. 20-03-10.
8 The organic way forward

“We should not fail to meet the needs of all our members and the future lies in the vigour and variety of our seeds and other planting material.” Vivek Cariappa (S.K.S. 2009b)

Two of the most important questions remain to be answered in this last chapter: what plans do organic cotton projects have in South India to ensure seed security and which of these or other strategies should be followed in order to enhance seed security for organic cotton production.

8.1 Perceptions of the organic sector

The table below presents the results of the questionnaires, in which project leaders were asked to evaluate and rank which of the listed five problems they are facing most with regards to seed sourcing and which of the offered solutions they find the most relevant for their projects: the lower the points, the most relevant the given problem and/or solution is (see also Figure 17 and 18).

**Table 24**: Problems and solutions of organic projects’ seed supply in 2009/10

<table>
<thead>
<tr>
<th>Main problems with seed sourcing</th>
<th>Oxfam</th>
<th>Chetna</th>
<th>Zameen</th>
<th>Renuka</th>
<th>S.K.S.</th>
<th>Kabini</th>
<th>ICRA-SOFF</th>
<th>OFMPAGA</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bt contamination of seeds</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>Bt contamination by neighbouring fields</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Bt contamination via processing</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>defaulting farmers sowing Bt seeds</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>unavailability of non-Bt seeds</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td><strong>Gravity of concern</strong>: 1 least, 5 highest, 0 no concern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Solutions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>changing policies to ensure the integrity of non-Bt cotton production</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>public sector taking leading role in research and sale of non-Bt seeds</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>creating companies selling only non-Bt</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>ban on GMOs on state/national level</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>own seed production</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>38</td>
</tr>
<tr>
<td><strong>Degree of relevance</strong>: 1 least, 5 most</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Krashi group’s questionnaire was not provided in time.
According to the perception of project leaders/coordinators, the most relevant problem currently is the unavailability of non-Bt seeds. This did not come as a surprise given that the topic of thesis was also chosen due to the ‘crisis’ situation most organic cotton projects are facing as a result of the lack of non-Bt seeds. The contamination issue follows as the next most serious problem, principally, due to cross-pollination from neighbouring Bt farms, then due to biological contamination of seeds and as least problematic, due to contamination via processing. The order of these concerns somehow contradict a report done by CSA (2008) referring to a CICR study that claimed that most contamination happened at the physical level (5-30%), followed by genetic contamination (5-15%). It is true though that if there was one contaminated seed, it would be enough to spoil the end-product, thus cross-pollination through gene flow and the seed contamination seems a much more threatening risk than physical contamination. Interesting that one of the least severe problem cotton projects face is that farmers may buy and use Bt seeds as to get higher yields, without announcing it. Every year several cases of defaulting farmers happen in most projects – the importance of both internal and external inspection and the testing in case of suspicion becomes an important tool to expose such attempts. Most often though, farmers choosing Bt over non-

Bt seeds for a variety of reasons (hybrid of their preference is not available as non-Bt, attractive higher Bt yields, pressure from community leaders, etc) do inform the project and thus get expelled.

As possible solutions to the seed crisis, almost all projects considered own seed production as the best way forward. As a second choice, project leaders found that politics is crucial: either a complete ban on GMOs and/or stricter regulations would help

![Figure 21: Result of questionnaire on main problems of seed sourcing (see Table 24)](image1)

![Figure 22: Result of questionnaire on main solutions to seed crisis (see Table 24)](image2)
they getting out of the ‘Bt-seed-monopolised’ reality. As last, the research and distribution of non-Bt seeds by the public sector, and the exclusive sale of non-Bt seeds by some private companies were chosen as possible solutions.

The first question on concerns regarding seed sourcing was asked from certification bodies too – their responses were slightly different. Their most urgent concern is the seed contamination, which is understandable from their perspective, since when seeds – of which purity only the GMO-free declarations testify – are contaminated, the whole organic production is spoiled, beyond their control. As next problem comes the unavailability of seeds, which is again an area that CBs cannot solve themselves. The order of the last three problems were similar on average than of cotton projects.

8.2 The way out of seed insecurity for organic projects

This subchapter is aimed at offering solutions for organic cotton projects at all three levels where contamination from Bt genes is possible: at seed production, cotton production and at processing level. These suggestions that have been collected from different NGOs, farmer leaders, CBs, the literature and also based on own observations and ideas, can serve as a menu-card for organic cotton projects as a way out of seed insecurity.

8.2.1 At seed production level

The following lists the best ways for cotton seed production, in terms of maintaining the integrity of organic production:

1. Take control of seed production;
2. Produce organic seeds where Bt cotton is not grown;
3. Prefer decentralised seed production at farmers’ field level;
4. Train farmers to become seed producers and seed savers in each project area;
5. Offer several choices of seeds to farmers, among them varieties;
6. Establish direct relation with scientists to encourage participatory plant breeding.

At present there is no organic cotton seed production in India except for few cases, where it is sourced from certified organic farms, as the example of Renuka Foundation (and in Gujarat, the AGROCEL group) shows. No wonder that under the present crisis situation, most cotton projects finally have understood the importance of taking control of seed production.

The issue of whether organic farmers should use hybrids or varieties has been debated for a long time within the organic community. Whereas the use and maintenance of varieties by organic farmers may receive more pro arguments, as Dr. Ramanjaneyulu from CSA
said “we feel using hybrids is not a problem as long as the farmers have control over the (parental) seeds” (CSA 2009). Having seed production under control shall be considered one of the most crucial fundaments of any organic project. A more important question than hybrids vs varieties is which ones do respond well under local, organic conditions.

Recently, Bt seed producers have received about Rs 220-300 for 750 g seeds, which are sold later as a 450 g packet for Rs 750 (CSA 2009). If some of these farmers are paid more to produce organic – and only organic, without the possibility of having any Bt seed producer neighbour – it would not only provide a more attractive livelihood option for seed producer farmers, but would quickly make available enough seeds for whole organic projects. This idea stemming from a training organised by CSA in November 2009 on organic cotton seed production, is great for a start, however, on the long-term, seeds should be produced and saved by the organic community itself, not to give any further chance of losing seed independency.

CSA has been motivating recent years NGOs to get parental lines and start seed production first with the establishment of demonstration plots, afterwards with the try-out of selected lines in different places of project areas to see which ones are suitable for local climatic and soil conditions. According to CSA (2009), one acre of hybrid cotton seed production site can produce seeds for 500 acres. For one acre, 10 plants suffice: 8 females and 2 males and this can be done at home-scale level with proper isolation from any other cotton (so best in kitchen gardens, or in any field where cotton is not grown in the vicinity).

Three years of selection by CSA using principles of participatory plant breeding resulted in two hybrids which have responded well to organic conditions: YnBH-1, which in 2007/08 yielded 9.3 q/a under rainfed conditions, with staple length of 26-28 mm, and RCBH-1, which yielded 6.5 q/a in the same year and had the same staple length (CSA 2009). Further selection is necessary with these hybrids since the production has to be sustained for few years more to minimise variations and remove off-types (a process called roughing), which need close monitoring. The NGO is planning to take up multi-location trials from 2010 onwards.

So what is the way forward for organic cotton projects?

Several options were still open, when representatives of Chetna were asked at the beginning of November 2009. One of the strategies was to move all cotton production to Orissa – where Bt cotton is forbidden – and focus on other crops in Maharashtra and Andhra Pradesh. Another possibility was to move towards NPM, since Chetna is a member of a consortium of eight NGOs promoting zero-usage of pesticides. Yet another idea was to have a joint cooperation among cotton projects with the aim of non-Bt seed production. A month after the interview, thanks to a training organised by CSA on organic cotton seed production, it was clear that Chetna was opting for starting own seed
production. As mentioned before, CSA developed few hybrids and varieties the last three years under organic management with the aim of tackling the seed supply crisis of organic cotton projects. In 2010, Chetna has initiated a long-term seed programme with 2 acres of seed production plot and the seeds from this area would be sufficient to grow cotton on 1000 acres in the 2011 season (CHETNA 2009b).

The AOFG cotton project considers that there are two complimentary ways to ensure seed security (AOFG 2009):

1. Co-operation with seed companies like Nuziveedu and others to produce non-Bt, child labour-free seeds (short-term solution);
2.a Community-based seed production, joining an NGO initiative with existing technology (long-term – if this is successful, no need for own R&D);
2.b Initiating farmer co-operative societies for community seed production (hybrids) – 10 acres for R&D purposes (long-term solution).

The cotton project last year signed an agreement with Nuziveedu to start organic seed production in 2009 on three acres producing about 1500 packets of seeds in Tamil Nadu used for this year’s planting (in 2010, they would produce seeds on 15 acres getting about 7000 packets, enough to supply all member farmers) (AOFG 2009). The cotton project is interested in supplying other cotton farmers’ associations too once they have enough seeds. Moreover, CSA gave organic seeds to the AOFG cotton project, which started a demo plot 4 km from Kagaznagar in Adilabad. The project has been working for one and a half years on hybrid cotton seed production. Some farmers (15) were selected to produce seeds of the hybrid RCBH-1 and a variety called LRK-516. The lab results from November 2009 of 10 plants under dry, rainfed conditions showed that RCBH-1 yielded 5.5 q/a and had 31 mm staple length, whereas the variety had 2.9 q/a yield and 29.5 mm staple length (AOFG 2009).

Oxfam’s main strategy for countering the seed supply problem is also own seed production. It has been already started in Warangal last year – the pilot initiative is being implemented by one of its partner NGOs called PSS (OXFAM 2009). After observing performance of the cotton from the 2009/10 season on a two-acre plot, the NGO will decide how seed production should go ahead and selected farmers will receive 100 g of seeds for testing as of this year. Oxfam is financially helping to try irrigated large-scale seed production in four areas. If farmers are satisfied with the outcome (mainly yield) of these testings, in two years time seeds could be distributed to them (OXFAM 2009). In 2010, they still rely on outsourcing.

As for the future, own seed production is envisaged by the directors of the SOFF in Mysore: last year they received parental seeds of three varieties: LR-125, BN-1 and Narasimha from a Hyderabad-based NGO called Deccan Development Society (SOFF 2010). In 2009, they tried them on a small plot with very encouraging results: both yield
and quality of these long staple cotton varieties was good, thus this year the aim is to give the seeds to 10 selected farmers and try them in different soils. Also, they are in touch with the Agriculture University in Tamil Nadu and they are planning to buy this year seeds of two varieties: Surabhi and MCU-5. Thus those farmers who do not want to continue with DCH-32 can opt for these varieties and from 2011 on, the federation is planning to supply own organic cotton seeds to farmers (SOFF 2010).

The two other projects using hybrids in Karnataka are at the process of deciding what measures to take to ensure timely seed supply. The S.K.S. project paid a visit in early 2010 to the CRC at Hebbali, and scientists agreed to take up field trials with non-Bt hybrids in H.D. Kote in Mysore district (S.K.S. 2009a). Depending on its outcome, large-scale seed production could commence the following year.

The cotton projects in Gadag district, all of which use varieties, do not sense this crisis situation around seeds since they have a constant supply from their own cotton via ginning mills. However, due to contamination possibilities, stricter procedures are required at the ginning phase in order to avoid mixing of organic and non-organic seeds.

Regardless whether hybrids or varieties, seed production sites should avoid the presence of any Bt neighbours and trained farmers who are to be connected with breeders at universities, should be entrusted with seed production, selection and seed saving at every project. The Renuka Foundation, with its own organic variety cotton production and breeder farmers, could serve as a model for other projects.

8.2.2 At cotton production level

At the cotton production level, the following lists the most important measures that should be taken into account in order to maintain the integrity of organic production:

1. Develop continuous organic areas;
2. Encourage the use of organic cotton seeds by free distribution to project members and neighbouring cotton farmers;
3. Produce cotton where Bt cotton is not grown – if Bt neighbours are inevitable, maintain isolation distance and buffer zone or grow other crops;
4. Diversify crop production and use crop rotation;
5. Maintain isolation distance of at least 50-100 m from Bt fields;
6. Establish buffer zone with 3-5 rows of high crop plants next to Bt cotton.

Although in the majority of projects, cotton is the most important cash crop, the only one that up to this moment is sold with premium, other crops grown as intercrop, rotation crop or grown in relay cropping should receive a much higher emphasise. Farmers have to be trained to grow other crops in organic management, and project leaders should be encouraged to look for marketing options for other organic crops. This is already done at
S.K.S. in Mysore, at farmer groups in Gadag and at Oxfam and AOFG in Andhra Pradesh – where NGOs are teaching farmers to focus on growing pulses, chillis, vegetables and other crops which could be sold for good prices in the local markets. This diversification of organic cultivation and a shift-away from the monoculture of cotton growing is a necessity if projects want to promote organic principles, enhance soil fertility and ensure the livelihood stability of organic farming families who in this way can rely on the sale of several crops.

This growing season has been exemplary in terms of the effects of reduced market possibilities for organic cotton – due to the worldwide economic recession, most projects had difficulties in selling even the certified organic cotton. As a result, much of the organic and in-conversion cotton produced this year in South India ended up at conventional markets, sold without premium. If farmers are to be maintained within the organic groups, project leaders need to look beyond the export markets for cotton and create market possibilities domestically.

GMO-free regions would be the ideal solutions for organic cotton production, however so far only the government of Kerala – where no cotton is grown – and Orissa declared that GMOs cannot be cultivated in their states. Not having sufficient political will at state level, the best thing organic projects could do is to organise adjacent farmers and create continuous organic areas so to avoid Bt cotton neighbours and thus minimise the risk from Bt contamination. At Renuka Foundation, organic farmers supposedly do not have Bt neighbours (RENUKA 2009a); indeed, during the field visit, none of the three farmers’ lands were adjacent to Bt fields – also since they are requested to talk to their neighbours discouraging them from growing Bt cotton, highlighting again that good relationship with neighbours can be a crucial factor in preventing genetic contamination from adjacent fields.

Alternatively, in a country, where 80% of cotton on more than 8 million ha is Bt, organic projects should select certain villages and shift all cotton farmers to organic production thereby creating islands of GMO-free areas. With own seed production, and free seed supply to farmers in the community, there can be a chance that more cotton farmers would be interested to grow non-Bt cotton.

“If you have Bt cotton neighbours, don’t grow organic cotton – just preserve the seeds for better times and grow other crops” – suggested Vivek Cariappa on his biodynamic farm in H.D. Kote taluk of Mysore district, where due to the expansion of Bt, his family decided to grow cotton on a minor scale just to preserve the two varieties they have (S.K.S. 2009b). If the circumstances are not adequate for organic cotton cultivation – for instance because of the lack of untreated seeds, or the lack isolation possibility from Bt neighbours – it should not be forced. Since the legal requirement for foundation seed production is 50 m and for certified seed production 30 m of isolation distance in India, organic projects should at least maintain the 50 m of isolation distance and a buffer zone
of 3-5 rows of high crops from any Bt cotton field. Were this isolation distance not possible, and farmers could not be grouped together as to avoid Bt neighbours, organic cotton should not be grown on such fields that year. Since Bt farmers also often practice crop rotation, good relationships can ensure that their cultivation schedules could be coordinated in a way that would not diminish the organic farmer’s possibility for cotton production.

8.2.3 At processing level

Once, the cotton is harvested, the following conditions should be fulfilled in order to avoid contamination:

1. Sealed and cleaned transport vehicles;
2. Separate ginning mill for organic cotton – if not possible, timely separate cotton, by reserving the whole mill for organic processes;
3. Train group of organic team to supervise storage, transport to, and cleaning processes at ginning mill;
4. Ensure thorough cleaning of all machines prior to ginning, with supervision;
5. Have exclusive storage for organic cotton, where it can be stored prior and after ginning.

There are already established standards which ensure that at the level of processing, the risk of physical contamination is minimised. Ginning operations must be certified according to the Organic Exchange Standard or a recognised international (EEC 2092/91, USDA NOP) or national organic standard (NPOP). Lacking mandatory organic textile standards, the Organic Exchange 100 Standard was developed to support claims of 100% organic cotton content (prior to that, standards only existed for cotton production, but not for processing). It is a voluntary private standard and it lays down requirements for the whole supply chain from field to the packaging of the final product.

At the time the OE standards were developed, there was no existing textile certification standard that covered the handling and tracking of the organic cotton throughout the supply chain. In 2008, the Global Organic Textile Standard (GOTS) was created, which has become the leading organic textile processing standard. The GOTS is a comprehensive standard which aims at “defining requirements to 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” (GOTS 2008). With the publication of the revised Version 2.0 and the introduction of the logo and labelling system the GOTS has entered the largest retailers and brand dealers. The OE standards have become a stepping stone while companies organise themselves to comply with the strict social, health and environmental criteria of GOTS. The GOTS, similarly to the OE standards, require that everything has to be made
at all stages of the processing chain “to ensure that organic and conventional fibres are not commingled and that organic fibres are not contaminated by contact with prohibited substances” (GOTS 2008,2.4.1).

According to the OE standards, organic cotton must be transported only in appropriate packaging, containers or vehicles that are closed so to prevent any mixing with conventional cotton (OE 2009,B1.6). Furthermore, the ginning operation must have a segregated receiving area where organic cotton can be delivered and this area has to be labeled with signs indicating that it is for storing organically grown cotton (OE 2009,B2.2). Also, the ginning operation must clean out the processing lines used for the organic cotton by running one bale of organic cotton through the process; at the end of the clean-out process, the bale is considered contaminated and has to be sold as conventional cotton. The machines in the gin can also be manually cleaned to remove all traces of conventional fiber prior to processing the organic cotton (OE 2009,B2.2). If organic projects are interested in own organic seed production and sale of those seeds as “organic”, after ginning, seeds extracted from the organically grown cotton must be sent to a segregated storage area or one that has been cleaned prior to the ginning of the organic cotton (OE 2009,B2.2).

8.3 The role of government in enhancing seed security

“There is a credibility crisis perceived from the outside and to address this crisis, all stakeholders must engage and act collectively.”

Prabha Nagarajan

The central Indian government, more specifically APEDA within the Ministry of Commerce, has initiated some minor efforts as to counter the risks from GMOs in the organic cotton sector. The ministry is planning to come out during this year with the Organic Textile Standards as part of NPOP, and with this India will be the first country to introduce obligatory standards for the organic textile industry. Moreover, a web-based traceability system on all organic products has been introduced in February 2010 to maintain the integrity of production and certification system. After inspection, the entire inspection report and non-conformity closure has to be registered and inspection certificates can only be issued where no major non-conformities have been detected. This process is supposed to give integrity to the organic production, since it will not be possible, as practiced sometimes before, that certification is issued despite of major non-conformities, such as lack of GMO-free declaration from the seed supplier.

Also, two governmental committees started to work on the issue of seed availability for organic projects. Both the Fibre Policy Committee (which in its meetings in October and

November 2009 discussed the seed problem for organic cotton production and the Organic Cotton Advisory Board (under the Cotton Advisory Board) is looking into this issue. This Board on its meeting last year acknowledged that states did not play a role in the organic cotton sector and there were several gaps within the sector, leaving everything to private arrangements between contractors and farmers. No concrete action plan emerged, however it was agreed that states should play a more active role especially with regards to the availability of non-Bt seeds and research institutes should focus more on research into improved varieties and hybrids of non-Bt cotton seeds. More consolidated efforts are needed to follow-up these meetings, however most probably a recommendation will foster the creation of an Organic Cotton Technology Mission, building on the successes of the conventional sector’s similar mission, as told by one of the members of these committees. The main aims of such mission would be to make varieties more popular again, direct more funds into research on the improvement for staple length for organic cotton seeds, make public sector offer quality untreated, non-Bt seeds and reassert seed sovereignty.

Were the government interested in ensuring that the current status of being the top organic cotton producer in the world is not undermined by further scandals, it has to step in and ensure that (i) enough funds are available for organic seed research and breeding programmes; that consequently (ii) the public sector takes up the role of supplying sufficient quantity and quality seeds of affordable price to organic cotton projects; and that (iii) it fosters the creation of GMO-free zones on taluka/district/state level where Bt cotton production is forbidden; and (iv) a tighter safety regime (close monitoring, obligatory buffer zone, independent studies on resistance and environmental and health implications, etc) is implemented for Bt cotton and any other transgene crops in India. Unless these steps are taken, grassroots’ efforts such as participatory plant breeding, NGO-promoted seed production are the only ways forward.

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56 Ibid.
57 Phone communication with Prabha Nagarajan. 26-02-10.
58 Ibid.


9 Conclusion

Whether organic cotton farmers are seed secure in South India, or whether the possibility still exists to maintain organic cultivation of cotton with the existing seed systems was at the core of this thesis. The underlying hypothesis i.e. that currently organic cotton projects are seed insecure and further relying on conventional hybrids by these projects is a dead-end strategy, has been proven to be correct. Seed security can still be achieved, but not with the existing seed systems (i.e. overall dominance of private companies, ignorance of public sector and unorganised civil sector) and not much time is left to save the organic cotton sector.

The biggest risk facing the organic cotton sector in India today is the adoption of the conventional model, by relying on private companies’ seeds suitable for synthetic inputs, not maintaining crop rotation, lack of isolation distances and proper buffer zones to prevent contamination from Bt cotton. All these weaknesses are even more risky under the present circumstances, where Bt cotton is coming to an almost complete coverage of cotton areas. Previous studies and interviews with seed producer farmers revealed that prescribed isolation distances are not maintained for cotton seed production, making the use of non-Bt cotton hybrids a potential risk for the integrity of organic cotton. Presently, there are high chances of contamination at both biological and physical level, though there are concrete measures how these possibilities can be minimised. These risk limitation strategies do minimise the risks, though they cannot completely rule them out, unless both the production of seeds and cotton and also the processing activities take place in a GM-free area.

The most difficult external challenges in the organic cotton seed sector in South India are the unavailability of non-Bt seeds and the lack of research into organic hybrids and varieties, both of which are a direct result of disinterest from the public sector. Besides, the late ‘wake-up’ of most organic projects in starting own seed production and thus the reliance on private companies for the supply of non-Bt seeds, the lack of adequate information for farmers on measures how to prevent contamination further accelerated the path into the present crisis situation.

The crisis has signalled to everyone in the organic sector that the time in which the hope vested in the commercially driven seed research and supply is over; non-Bt seeds that are well responding to synthetic treatments and irrigation will not only do worse under organic conditions, but will also not be available. Both public and private entities have left the organic cotton sector alone and there is no time left to rely, negotiate, hope for further seed supply from them. Without taking control of the seed production, the days of organic cotton production are numbered, and further scandals may easily bring down the whole sector.
The public sector should take up its responsibility of non-Bt hybrid seed breeding, variety improvement, and production and promotion - this was mentioned by most NGOs and farmers, specifically by organic and those Bt farmers who use Bt because of the lack of choice - throughout this research as a necessary next step. It should be the role of state seed corporations to promote and market high-potential public sector seeds, and therefore re-establish seed sovereignty.

Since up to this date, no action plan from the government side exists to save the organic cotton sector in India from further damage due to Bt cotton, organic projects have to finally step up and (i) take control of own seed production, (ii) implement stringent preventive measures to avoid contamination from Bt, (iii) continuously inform and educate farmers on the integrity aspects of organic cotton production and avoidance of contamination from Bt, and (iv) make allies among themselves to commonly address the issue of seed sovereignty and the right to GMO-free agriculture.

The research has come across yet not discussed several aspects of organic cotton production, most importantly economic and environmental factors. Although yield data was gathered from farmers as a measure to evaluate seed preferences, the overall income of farmers was not at the focus of this study. The objective of the thesis was not to investigate the pros and cons of GM and organic cotton cultivation, nor to explore the impacts of these two production systems on cotton farmers and the cotton industry in India. Yet, it was impossible to ignore the constant economic comparisons farmers have made between Bt and organic cotton production and the lack of information, the absence of public extension work and the overwhelming propaganda by private companies that surround non-organic farmers.

There is a high need to look back the past eight years since Bt cotton was first planted and explore the impacts (environmental, economic and social) of this production system on cotton farmers and evaluate through an independent investigation across states in what aspects Bt farmers may be better off – if at all – than their organic farmer colleagues. If it proves not to be the case, alternative techniques, like organic agriculture should be promoted or other crops should be grown in areas not suitable for high-input agriculture.
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ANNEX I

Questionnaire for Organic Cotton Projects

I. BASIC DATA

1. What is the name of the organic cotton project and when was it created?
2. How many certified organic cotton farmers participate in the project and how many are under conversion?
3. What is the total area (acres) under certified organic cotton in 2009/10 and what is the area under conversion? Has it changed since the year before?
4. Which agency certifies your project?
5. What was the total cotton production last year (in tonnes) and what is the expected production this year?
6. What is the average land size (in acres) of organic cotton farms?
7. To which companies do you sell the organic cotton?
8. What percentage of organic cotton farmers is rainfed and what % is irrigated?

II. SEED SOURCING

9. How do organic farmers get cotton seeds? (Put an X to the option(s) applicable in your project)
   O farmers get the seeds themselves;
   O the project takes care of seed procurement;
   O farmers buy the seeds from places assigned by the project;
   O other:..............................................................................................................................
10. Which cotton hybrids and/or (non-hybrid) varieties are used by farmers? What % of farmers use which one(s) this year?
11. Why do you use hybrids and/or open-pollinating varieties?
12. How much was the average yield last year and what is the expected yield this year?
13. From where (name of public/private entity) have the seeds been procured this year?
14. How many packets of seeds did you request and how many did you receive of which seeds?
15. Any changes since the existence of the project in: variety used; availability of seeds; seed producer; seed price; and yield? (Put an X to the option(s) applicable in your project)
   O No, there have been no changes regarding the seed procurement and yield.
   O Yes, farmers use different hybrids/varieties now than at the beginning:..............................;
   O Yes, it is much harder to get untreated, non-BT seeds;
16. How do you make sure seeds are GMO-free? (Put an X to the option(s) applicable in your project)

- Yes, seeds are purchased from a different source:..............................................................;
- Yes, the price has changed:................................................................................................;

17. What is your biggest concern regarding the seed sourcing? (Number in order of degree of concern: 1 meaning the least concern, 5 the highest, 0 no concern)

- contamination of seeds with Bt genes;
- contamination on the fields by neighbouring Bt fields;
- contamination of cotton with Bt cotton through processing (gining, spinning);
- defaulting farmers trying Bt seeds without announcing it;
- unavailability of non-Bt seeds.

18. Which public and private entities are you aware of are producing non-Bt seeds?

19. What according to your judgment is the most important reason for the lack of non-Bt cotton seeds in India?

20. What is the minimum distance that organic cotton farmers in practise keep from neighbouring Bt farmers in your project?

- 1-2 meters
- 2-10 meters
- 10-50 meters
- 50-100 meters
- above 100 meters

III. FUTURE PLANS

22. What measures have you taken to assure seed security? (Put an X to the option(s) applicable in your project)

- good relationship with seed company/public sector institutions;
- saving own seeds;
- in the search for locally-adaptable varieties/hybrids;
- still in the process of planning appropriate steps;
- other:........................................................................................................................................

23. What do you think can be done to assure seed security on the long term? (Number in order of relevance: 1 meaning the most relevant, 5 the least relevant)

- changing policies and legislation to ensure the integrity of non-Bt cotton production;
- public sector taking a lead in research and distribution of non-Bt seeds;
- creating companies that only produce non-Bt seeds;
- ban on GMOs on state/national level;
- own seed production.
ANNEX II

Questionnaire for Certification Bodies

1. Which organic cotton projects do you certify?

2. Which cotton hybrids and/or open-pollinating varieties are used by the cotton farmers under your certification in which states?

3. What are the main reasons that some farmers discontinue organic cotton production? (Number in order of relevance: 1 meaning the most important, 5 the least important, 0 not relevant)
   - Unavailability of non-Bt, untreated cotton seeds;
   - Contamination on the fields by neighbouring Bt fields;
   - Difficulty of controlling pests and diseases through organic methods;
   - Poor yield in organic field when compared to Bt cotton;
   - Organic farming is labour intensive.

4. What is your biggest concern regarding the seed sourcing? (Number in order of concern: 1 meaning the highest concern, 5 the lowest, 0 no concern)
   - Contamination of seeds with Bt genes;
   - Contamination on the fields by neighbouring Bt fields;
   - Contamination of cotton with Bt cotton through processing (ginning, spinning);
   - Defaulting farmers trying Bt seeds without announcing it;
   - Unavailability of non-Bt seeds.

5. How do you make sure that the cotton you certify is GMO-free? (Tick the box(es) applicable in your project)
   - You request GMO-free declaration from company/public entity?
   - You demand that the GMO-free declaration is to be accompanied by test results?
   - You conduct random testing of seeds before they are sown?
   - You conduct random testing of plant material before harvesting?
   - You conduct random testing of seeds after harvest?

6. Please describe how often it occurred that the samples collected were contaminated with Bt and what measures you took after the testing results proved positive!

7. What is the minimum distance you require organic cotton farmers to keep from neighbouring Bt farmers? (Tick the box applicable in your project)
   - 1-2 meters
   - 2-10 meters
   - 10-50 meters
   - 50-100 meters
   - Above 100 meters

8. What do you think can be done to assure seed security on the long term? (Number in order of relevance: 1 meaning the most relevant, 5 the least relevant, 0 no relevance)
   - Changing policies and legislation to ensure the integrity of non-Bt cotton production;
   - Public sector focus on organic cotton research and sales of non-Bt hybrids;
   - Creating companies only producing non-Bt cotton seeds;
   - Ban on GMOs on state/national level;
   - Own seed production.
Statutory Declaration

I,

Noémi Nemes, born on 7th April 1980, (matriculation number 437233)

hereby declare on my honor that the attached declaration,

Master Thesis

supervised by Prof Dr Volker Hoffmann,

has been independently prepared, solely with the support of the listed literature references, and that no information has been presented that has not been officially acknowledged.

I declare, here within, that I have transferred the final digital text document to my mentoring supervisor and that the content and wording is entirely my own work. I am aware that the digital version of my document can and/or will be checked for plagiarism with the help of an analyses software program.

I agree that the thesis will be placed in the department’s library and can be borrowed by third parties.

Bangalore, 12th March 2010.