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# **Influence of the Fast Spread of Bt Cotton on Organic Cotton Production - Examples from India and Burkina Faso**

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## Introduction

Cotton is grown in more than 120 countries by over 20 mio. cotton producers on 35 mio ha in 2012. (Truscot, 2010, [www.fas.usda.gov](http://www.fas.usda.gov)). In 2011, around 27 Mio. tons of cotton was produced, mostly by small holder producers in “developing” countries which cultivate cotton as a cash crop on their own land in average under 2 ha of size, or as contracted workers for bigger land owners. Cotton is usually grown as a monoculture. In industrialized countries, the level of mechanization is high, thus cotton production does not provide a lot of work in rural communities. In contrary to this, developing countries, where the cultivation and harvest is mostly done by hand labor and thus provides a lot of work for the rural population. Cotton, particularly as a monoculture, uses significant amounts of pesticides, fertilizers, fossil fuels and water (Truscott, 2010).

There are four commercially exploited cotton species: *Gossypium hirsutum* and *G. barbadense*, the “New World Species”, and *G. arboreum* and *G. herbaceum*, the Old World Species. Though Old World cottons are still grown in some areas of Africa and Asia, they were almost totally replaced by New World cottons. Most dominant today are *G. hirsutum* cultivars, which are spread across 45 countries. About 90 percent of the annual global cotton harvest is derived from *G. hirsutum*. One negative outcome of the wide cultivation of *G. hirsutum* cultivars are the increased pest attacks, particularly by the American bollworm. Hence, cotton cultivation had a very bad reputation as the single largest user of pesticides in the world (Truscott, 2010).

In the mid nineties, conventional cotton production posed a serious threat to the environment, farmers’ health and the economy. At one stage cotton accounted for the use of 15 percent of the world’s pesticides and 25 percent of the worlds insecticides. This tackled two major responses. One response was the development of Genetically Modified (GM) insect resistant cotton cultivars, which was rapidly adopted by many countries since its first commercial introduction in 1996. Approximately 82% percent of the world’s cotton growing area is grown under genetically modified cotton in 2011 ([www.ISAAA.org](http://www.ISAAA.org)<sup>2</sup>).

The other response was the adoption of organic methods of cotton production by farmers who believed that holistic, earth-friendly responses, optimized crop rotation and organic fertilizer could reverse the trend of the soaring use of chemical pesticides. The rapid spread of GM seeds in cotton has resulted in problems for the organic cotton sector, a few of which can be briefly examined, taking India and Burkina Faso as examples(Truscott, 2010).

## Organic Cotton

The production of organic cotton is rather knowledge intensive then resource intensive, thus less dependent on fossil fuels and synthetic inputs. Organic farmers rely on understanding the ecology of their farm in building up and maintaining an agro-ecological balance of the complex farm system, increasing soil fertility, micro and macro fauna etc. This investment in the ecology of the farm system in turn contributes to the efficiency – and quality - of crop production. Organic agriculture is proven to be highly suitable for small scale farming in developing countries (Truscott, 2010, IAASTD Report 2008).

Organic Cotton experienced years of unprecedented growth, 2005 only 0.1 % of global cotton production was organic, 2010 it was already 1.1 %, which is an increase of 1100 % in 5 years (Truscott, 2010). As by 2010, organic cotton was grown in 23 countries. The top 5 organic cotton producing countries were India, Syria, Turkey, China, Texas USA. Countries in West Africa, Latin America and the Middle East are also well-established organic cotton producers. Some organic cotton producers are also certified according to fairtrade standards ;

particularly in West Africa and Central – South East Asia (Truscott, 2010). More than 94 % of organic cotton was produced by India, Syria and Turkey alone in 2010 (Textile Exchange 2012). Neither recession nor unstable economies put damper on the growth of the organic textiles industry which grew 20 percent to an estimated \$5.16 billion in 2010 ([www.naturalnews.com](http://www.naturalnews.com)). Several brands and retailers more than doubled their usage of organic cotton alone and plan to do so in 2012 as well. Others with large programs are staying the course. As a result, Textile Exchange projects the global organic cotton market will increase another 20 percent to result in an estimated \$7.4 billion market in 2012 (Textile Exchange, 2011a). According to a very optimistic market analysis, the world market for organic cotton is projected to exceed \$19.8 billion by the year 2015, mainly driven by growing awareness and interest for eco-friendly products among consumers ([www.strategyr.com](http://www.strategyr.com)).

However, despite all this breath-taking developments, organic cotton production dropped by 37 percent in 2011 (Textile Exchange, 2012). This was especially true for India. One of the main reasons of the sharp decline of organic cotton production may be the rapid expansion of GM cotton in cotton producing countries. This dominance lead not only to the decline of diversity and neglectance of local/native species of cotton. Organic Cotton producers face new challenges as in some areas as the availability of appropriate Non-GM cotton seed became increasingly limited. Moreover the quality of such seeds are often of dubious quality. To overcome this problem, the role of local, native or specially bred cultivars should be recognized. The local varieties especially locally adapted species play an important role for conservation of a broad range of biodiversity of the cotton gene pool. Increasingly, the governments leave the seed sector to private companies and corporations. A considerable amount of resources are spent on R&D of GM seed development, hence, there is little interest and little funding and priority on improving non-GM seed. This leads to a dependency on a small number of patented brands/company monopolies.

GM cotton is found in at least 10 cotton growing countries now – and tested in others. The lobby promoted GM (supported by multinational agrichemical suppliers) is very powerful (Truscott, 2010). Organic production does not permit the use of GMO ([www.ifoam.org](http://www.ifoam.org)). Contamination issues are a severe thread to organic production: if organic cotton is contaminated by GM, organic certification is lost. Due to patents on GM crops, traditional seed exchange can not be practiced anymore, even among conventional farmers. Moreover, there is evidence now of secondary pest attack problems and pests exhibiting resistance to Bt cotton (TE Cotton Briefing 2011).

## **West Africa**

Most West Africa countries have ratified the Cartagena Protocol on biosafety; however, only Burkina Faso, Mali, Ghana and Nigeria have functioning legislation allowing field trials of GM products. Bt Cowpea expected to be introduced shortly in West Africa, which is the most important food crop in dry regions. ([www.aatf-africa.org](http://www.aatf-africa.org)). In Mali, authorities are allowed to approve applications for trials, there are no applications for trials to test GM crops yet, but they are likely to adopt Bt Cowpea ([www.nepadbiosafety.net](http://www.nepadbiosafety.net)). In Mozambique, the biosafety bill is on progress, an application for trials expected. Senegal has no functioning biosafety framework yet. Benin renewed in 2008 the five year moratorium set up first in 2002 and will again discuss and decide on matter in 2013 ([www.arkansasonline.com](http://www.arkansasonline.com)). Ghana has a functioning biosafety framework that allows trials ([www.nepadbiosafety.net](http://www.nepadbiosafety.net))

## **Burkina Faso**

In Burkina Faso, cotton is cultivated on a total of 424,810 hectares (ISAAA, 2012). Cotton farmers represented almost 1/6 of all rural households in Burkina Faso in 2006, being the largest employment groups in the country. 35% of GDP comes from the cotton sector, and about 18% of the people live from cotton growing ([www.cotton-made-in-africa.com](http://www.cotton-made-in-africa.com)). Cotton is generally produced by smallholder farmers with household labor. Former governmental company was split in 3 private companies working in assigned zones, SOFITEX, SOCOMA, and Faso Coton. Hence, there is a high market concentration. SOFITEX, being the former governmental company, still acts as a gatekeeper and dominates the sector. These companies also define the cotton cultivar(s) that have to be grown in their specific zone. The average area dedicated to cotton production is 45% of the total land available for a farm. Rural incomes are largely shaped by the seasonal cotton yield and market price. Conventional cotton growing relies heavily on costly agro-chemical inputs that leave producers indebted to the cotton companies, encourages ecologically questionable farming practices, and promotes a strong bias in favor of male cotton producers through extension services and access to credit (COULTER, 2011).

### **Bt Cotton in Burkina Faso**

In 2000, a joint collaboration between Burkina Faso's national cotton companies and Monsanto has started. Burkina Faso (like India) signed the Cartagena Protocol on Biosafety and put in place the regulatory process after GM cotton had been (illegally) tested in the country. NGOs have played a major role in ensuring that national legal frameworks for GM crops admission were implemented (KONE and LANTING 2011). Starting in 2003, official experiments with American GM cotton cultivars (DP50 and Cooker) were conducted under controlled conditions in research centers. In 2006, the Bollgard II event containing the stacked Cry 2 Ab and Cry 1Ac genes was transferred into local varieties. Monsanto assisted the introgression of these Bt genes into the two regional cotton varieties—STAM 59 and STAM 103—that were widely grown by conventional cotton farmers (VITALE, 2010).

In 2007, field trials were conducted to test these GM cotton with 20 participating farmers on 20 ha under control conditions. The 2006-bio-safety law was reviewed in 2008 and a contract signed with Monsanto. In 2008 an area of 8'500 ha was planted with Bt Cotton. Finally, in 2009, the first local cotton varieties containing Bollgard II were commercially released. This was the result of several years of coordinated efforts on behalf of various Burkina Faso cotton stakeholders. A large portion of the resources required for the testing and commercialization process was provided by Monsanto. In 2009, 125'000 ha of these local Bt cotton varieties were grown. In the season 2009/2010 Bt cotton was grown already on 128,563 hectares. (VITALE 2010). In 2011, Bt cotton area doubled to 247,000 hectares or 58% of the total cotton area ([www.isaaa.org](http://www.isaaa.org)), making Burkina Faso the second largest producer of GM Cotton in Africa behind South Africa. In Burkina Faso, Monsanto owns the events that have been introduced into commercial Bt cotton seeds, which entitles up to 28% royalties. The current model of seed sales in Burkina Faso gives about 60% profit to the seed farmers, 28% to Monsanto, and 12% to research. (KONE and LANTING, 2011)

### **Situation arising from Spread of BT Cotton for non GM cotton farmers**

The rapid large scale introduction of Bt cotton caused several disturbances. Due to price struggles with the companies, farmers decided to boycott cotton production. This matter led the main cotton company to subtle influence on farmers, which caused even riots and

deaths. With the increase in Bt cotton production on BF, often refuge zones between GM cotton and non GM cotton fields were neglected, which is against recommended practice and leads to genetic contamination of non GM cotton. However, leaving 100 m distance in a small holder context is difficult. There are now problems with contamination of non BT fiber due to improper handling during sales and transport. There is an emerging competition for availability of land for organic or conventional cotton and BT cotton (NGANG in DDS, 2012). However, four years after the introduction of GM cotton, there were reports that farmers were switching back to conventional, or non-GM seed. Many farmers in Burkina Faso experienced shorter fiber length which resulted in lower lower cotton prices than before. The GM cotton was introduced in the area with the promise of 30% higher yields, reduced pesticide use, and higher net income overall. After several years, none of these promises have been realized. Crop yields even dropped in some cases ([www.organiccotton.org](http://www.organiccotton.org)). The "rumours", that Burkina Faso farmers would abandon GM cotton were immediately denied and the success of GM cotton underlined by SOFITEX ([www.observateur.bf](http://www.observateur.bf)).

### **Organic Cotton in Burkina Faso**

In 2011, Burkina Faso produced 252 metric tons of organic cotton, 0.17 % of world organic cotton production and was ranking 13th in world organic cotton producers list. Compared to the previous year, there was a decrease of 15% (TRUSCOTT, 2010). The organic programs in Burkina Faso are in place since 2004 and operate under the direction of Helvetas, a Swiss non-governmental organization (NGO). Despite the high level of interest of rural producers in organic cotton production and the support of an NGO, there is a discrepancy between the ability to start such production and the demand of growers for market entry. Organic cotton programs operate under the auspices of the cotton company that controls the particular zone, and it is dependent on the good will of each cotton company. These three companies derive their profits from conventional and GM cotton. Thus, their support for the lower-yielding organic cotton is limited. Additionally, the recent introduction of genetically modified cotton further endangers the feasibility of organic cotton production. Organic farmers are concerned about contamination of their fields with Bt cotton, whereas cotton companies strive to expand the more profitable conventional and Bt cotton. There is a huge pressure on organic farmers, as GM contaminated cotton fibre obtain no organic premium price. Thus, their investments and efforts are at risk. These developments limit the interest of small holder producers and thus the expansion of organic cotton production. (COULTER, 2011). As the recruiting of new farmers became very difficult, the priority is set now to retain farmers who invested in organic. In 2010, the number of farmers dropped to almost one third of the amount of farmers participating in the programs the year before, which was around 7000. An explanation for this drop could be the stringent measures that farmers are required to take to minimize contamination.

Organic cotton can be contaminated in many ways. Organic cotton seed can be mixed with GM or conventional seed before planting. Cross-pollination is possible between neighbouring fields of GM or conventional and organic cotton. Contamination can occur through mixing (whether unintentional or intentional) during storage, transport or processing. Even under laboratory conditions, it is difficult to prevent contamination of pure varieties ([farm-hub.textileexchange.org](http://farm-hub.textileexchange.org)). Measures of organic producers to prevent GM contamination would be to keep 100 m distance between their organic and GM cotton fields, which is difficult in a small holder context and might be not enough to prevent cross pollination (PIERRE et al. 2010). The cultivation of GM, which is usually grown by men, and organic cotton, which is grown by women, on the same farm were banned. This led to exclusion of women.

## India

India was the only country to produce and market all of the four commercial cotton species (NEMES, 2010). In 2010, 80 % of the global organic cotton production was still grown in India, which was 195'412 metric tons (TEXTILE EXCHANGE, 2012). In 2011/12, total cotton production area in India was 12.178 mio ha. Total production of cotton was approximately 6 million t of cotton, mostly of *G. hirsutum*. (calculation based on figures from [cotcorp.gov.in/national-cotton.aspx](http://cotcorp.gov.in/national-cotton.aspx)). The history of cotton cultivation in India can be traced back thousands of years. At times of India's independence 1947, 97% of the cotton grown in India were the so called desi-cotton varieties, *G. arboreum* and *G. herbaceum*, which were adapted to local conditions after centuries of development and cultivation. Only 3% was *G. hirsutum*, which was introduced by the British by the end of the 18<sup>th</sup> century to cater their spinning mills. The American cotton species *G. hirsutum* has longer and stronger fibre than the desi cotton, but requires more fertilizer and are highly susceptible to drought, water logging, diseases and insect pests.. By 1965, after Indian scientists intensified efforts to breed American cotton for Indian conditions, the *G. hirsutum* was grown in 40% of the total area under cotton cultivation. The remaining area was under desi varieties. By 2002, when Bt cotton was introduced, desi cotton acreage was further reduced to 25%. At the moment, the area under desi cotton is estimated at 3% in the country ([www.financialexpress.com](http://www.financialexpress.com)).

India's seed industry was dominated by the public sector seed companies until end of the eighties. After India's decision to embrace biotechnology, the seed sector was deregulated and in 1988 a New Seed Policy was implemented. This development, as a means of achieving food security, has attracted several leading biotechnology-focused multinational seed companies to India. Nowadays, 60% of the turnover in the seed sector is made by private companies (SANGAR et al., 2010). In 1970 the Gujarat Agricultural University in Surat released the world's first intra-specific (*G. hirsutum* x *G. hirsutum*) hybrid (H-4) and in subsequent years further intra- as well as inter-specific (*G. hirsutum* x *G. barbadense*) hybrids were released (CICR 2010).

## Bt Cotton in India

In 2002, Mahyco (MAharashtra HYbrid Seed COmpany) in collaboration with Monsanto was the first to receive approval for three Bt cotton hybrids for commercial cultivation in the Central and Southern cotton growing zones in India. Around 54,000 farmers in India grew these Bt cotton hybrids on 50,000 hectares of land in 2002 (CHOUDHARI and GAUR, 2010, [www.isaaa.org](http://www.isaaa.org)). India ratified the Cartagena Protocol on Biosafety in 2003 ([www.siliconindia.com](http://www.siliconindia.com)). In 2003/4 Monsanto sublicensed Bollgard gene to other companies. India's 3<sup>rd</sup> Amendment to its Patent Act in 2005 has allowed patents for GM seeds, and created a situation where the importance and dominance of the public sector and state seed supplies has diminished. This has paved the way for the private sector to take more control of seed supply (TRUSCOTT, 2010). Until 2005, Mahyco-Monsanto Biotech (MMB) dominated the market for cotton hybrids, either directly through selling hybrid seeds or indirectly through sub-licensing the Bollgard events to private seed companies. India's regulatory system gave them a temporary monopoly on the Bt gene. Companies that licenced Bt had to pay a fee, leading to an increase in seed prices (ARORA and BANSAL, 2012). In 2006, the Indian government adopted a case-by-case method of approval, and shifted later to event based approvals.. Bt cotton hybrids are the principal commercial crops planted which increased from 3 Bt cotton hybrids in 2002-03 to 884 Bt cotton hybrids in 2011-12 ([www.isaaa.org](http://www.isaaa.org)). By 2009 the area under GM Cotton increased 168 fold to 8.4 mio hectares. The Indian seed market suffered of proliferation (RAMASWAMI et al. 2009). In 2010, already 780 Bt cotton

hybrids were on the market in India. Six events were approved by government (CHOUDHARI and GAUR, 2010). By 2011, 7 million farmers had adopted Bt on 26 million acres, around 90% of the total Indian cotton area (JAMES, 2011, in KATHAGE and QAIM, 2012). The march of time and commercially-prioritized technology poses a threat to agricultural traditions of centuries, and ironically in an era of the patent regime, make seed saving a criminal act punishable under Intellectual Property (IP) law. So far in India only BT Cotton allowed, while the release of BT eggplant and other food crops was turned down.

### **Organic Cotton in India**

For the first time in years, the global organic cotton production declined by 37%. India, which produced 80% of world organic cotton in 2010, experienced the greatest reduction, 48% less in 2011 compared to 2010 (TEXTILE EXCHANGE 2012a). Four reasons were found to have the most severe impact. To prevent fraud and control contamination, India mandatory implemented the comprehensive quality control system Tracenet by APEDA (the Agricultural Produce Export Development Authority). The additional cost caused by this system has to be borne by the organic sector. There is an environment of continued economic uncertainty, which keeps commodity prices down and endangers farmers' stability. A shift by some companies from established programs such as organic and fair trade to newer initiatives like Better Cotton Initiative with less strict regulations allowing the use of GM cotton as well as pesticides) offering a lower barrier to entry.

Due to the ubiquitous presence of GM cotton, it became increasingly difficult to produce organic cotton. There is a severe shortage in availability of non-GM cotton seed, and even this seed is often contaminated with GM cotton. The ways of contamination are numerous (see BLAKE, 2010) and force organic cotton producers to take measures which cause a lot of additional cost and effort (TEXTILE EXCHANGE 2012a). On the other hand, farmers have lost their traditional knowledge on seed production. Hybrid seeds have to be purchased each season and therefore organic cotton farmers depend today on a diminishing supply market of non-GM cotton seed (STONE, 2007).

Recent experience has been that available non-GM seed is of doubtful quality (expired, chemically pre-treated, segregating) and based on only a few hybrids selected for responsiveness to fertilizer and chemical pest control that might not be adapted to rain-fed and low input conditions (FELKL ET AL. 2010). While new cultivars are tested routinely under conventional growing conditions (SURULIVELU 2011 and RATHORE et al., 2011), no systematic cultivar trials were conducted for organic and low input farming. Moreover, there is a big risk of physical and genetic contamination of organic cotton with GM cotton and the loss of locally adapted genetic resources. It became very difficult to produce and maintain non-GM seed. A lot of cultivars are already contaminated (PATIL in FORSTER et al., 2011).

### **The Dharwad Declaration**

Stakeholders of the organic movement are highly concerned about this development in the cotton sector in India. Organic farming can only present a viable alternative to conventional production if farmers have access to suitable cultivars. A national workshop on 'Disappearing non-GM cotton – ways forward to maintain diversity, increase availability, and ensure quality of non-GM cotton seed' (FORSTER et al., 2011) initiated by bioRe India (Ltd.), the Research Institute of Organic Agriculture (FiBL Switzerland) and the University of Agricultural Sciences (UAS) Dharwad presents the first agreement, the "Dharwad Declaration" ([www.fibl.org](http://www.fibl.org)) to-

wards safeguarding the heritage of Indian Desi cotton, maintaining genetic diversity, avoiding GM contamination as well as supporting the organic farmers with suitable cultivars.

### **Outlook: The Green Cotton project**

FiBL together with bioRe and the University of Dharwad, took immediate action and started with preparations for a participatory breeding project in 2011. Participatory plant breeding is a proven method to develop locally adapted cultivars and to maintain and to increase the genetic diversity (Nkongolo et al. 2008; Djaboutou et al., 2007; Lancon et al., 2004) The short term aim of the project is to provide organic cotton farmers with high quality seeds. In the mid term, new cultivars need to be developed that fit the needs of organic cotton farmers and processors. Seed sovereignty and autarky of smallholder cotton farmers shall be improved by capacity building and establishing decentralized participatory breeding initiatives. Farmers' experience and breeders' knowledge is combined to develop cotton cultivars adapted to local conditions of organic cotton farmers. To achieve this goal following objectives were defined:

- (i) Networking with all stakeholders in the organic cotton value chain to achieve coordinated cooperation.
- (ii) Collection and conservation of genetic resources.
- (iii) Testing of existing cultivars under organic conditions.
- (iv) Training farmers in seed multiplication, crossing and selection.
- (v) Establishing participatory cotton breeding programs and
- (vi) Re-establishing the non-GM seed chain.

Currently, the following activities take place:

Fifty different non-GM cultivars provided by the UAS Dharwad are being tested 2012 under optimum and water stress conditions with low input organic management. Different cultivar types (*G. hirsutum* vs. *G. arboreum* (desi cotton) species, hybrids vs. varietal lines) are being tested assessing yield, resistance traits, and fiber quality according to the market demand. In addition, the optimal planting density for the different cultivar types is being tested. Workshops are conducted with farmers to teach them on cultivar testing, crossing techniques, selection of segregating material and cultivars and seed propagation. In these workshops, the farmers' knowledge is assessed to define most important traits and ideal cotton genotype under different growing conditions. Farmers manage themselves on-farm cultivar tests in different soil types with and without irrigation. Currently, a socioeconomic evaluation of different models for the establishment of a seed supply chain for non-GM cotton in India (Master Thesis) is carried out. For the future it is foreseen to build up further participatory breeding programs in various cotton-growing regions and countries (Tanzania, Uganda, Benin, Mali, Burkina Faso) by South-South transfer relying on our international networks (Messmer et al. ,2011; Roner ,2012; Roner et al., 2012.)

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