

## Science &amp; Society

## A Black (White) Hole in the Global Spread of GM Cotton

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**Bt (*Bacillus thuringiensis*) cotton has been widely adopted, notably by smallholder farmers in developing countries. However, it has not been used in Central Asia, an important cotton-producing region. We discuss possible reasons and hypothesize that the most likely explanation is limited local demand for Bt owing to low levels of pest infestation. This would imply that global Bt cotton adoption rates may already be close to 100% when considering real demand for insect-resistant varieties.**

### Bt Cotton Adoption around the World

Genetically modified (GM) cotton is now the third largest biotech crop in terms of acreage. In 2014, GM cotton occupied 68% of the global cotton area, mostly involving insect-resistant Bt varieties [1]. Bt cotton is particularly popular in developing countries such as China, India, Pakistan, South Africa, Burkina Faso, and others. In these countries, Bt cotton is grown by over 15 million smallholder farmers, contributing to significant economic, social, and environmental benefits [2]. However, several low-income and important cotton-producing countries do not use Bt technology. None of the Central Asian cotton producers has yet approved Bt cotton (Table 1).

In the Soviet Union, over 90% of all cotton was planted in Central Asia. Uzbekistan was the most important producer responsible for about 60% of cotton production, followed by Turkmenistan (18%) and

Tajikistan (9%). Cotton has remained important also after the collapse of the Soviet Union. In Uzbekistan and Tajikistan, cotton now accounts for around 12% of total merchandise exports and almost 4% of gross domestic product [3]. In Uzbekistan alone, cotton farming employs more than 3.5 million people. Cotton policies differ by country [4]. In Uzbekistan and Turkmenistan, the cotton sector remains under state control, whereas in Kyrgyzstan, Tajikistan, and Kazakhstan it is essentially market-driven. Bt cotton has not been commercialized in any of these countries.

Bt cotton is grown in 15 countries, 12 of which are low- and middle-income economies (Table 1). Among the top-17 cotton producers there are only seven that have not adopted GM varieties. These seven include Greece, belonging to the EU with strict genetically modified organism (GMO) regulations, Turkey that has strong trade relations with the EU and strives to become EU member, and Mali in West Africa. The other four are Uzbekistan, Turkmenistan, Kazakhstan, and Tajikistan – all in Central Asia. We explore possible reasons for the lack of Bt cotton in Central Asia, first focusing on typical political-economy arguments before discussing factors related to climate and agroecology.

### Possible Consumer Aversion

One explanation for the lack of Bt cotton adoption in Central Asia could be consumer aversion. This is an important factor in the EU, partly influenced by negative media reports about GMOs [5]. However, consumer aversion and media influence are less likely explanations in Central Asia where political regimes are mostly authoritative and the media remain under state control. Public opinion does not play an important role in policymaking in Central Asia.

### Possible Fear of Losing Export Markets

Another hypothesis is that opposition in export markets – such as the EU – would

prevent the use of GM technologies. Studies have documented a negative relationship between GMO activities in developing countries and trade with the EU [6]. However, Central Asian cotton exports to the EU are small. Uzbekistan, Turkmenistan, and Tajikistan export mostly to other countries in Asia. In 2012, 90% of Uzbekistan and 50% of Turkmenistan cotton exports went to China and Bangladesh, countries that have commercialized GM crops themselves.

Unlike GM foods and feeds, fiber and textiles from GM cotton do not require labeling in the EU or elsewhere. Even if there were labeling requirements, experience with other types of western trade standards suggests that these do not necessarily impress Central Asian producers. Central Asia has long been criticized for using child labor and forced labor in cotton production. By 2014, there were more than 130 western companies that had condemned labor market practices in Uzbek cotton. In response, exports have shifted to countries where ethical issues are of less concern, such as China and Bangladesh.

### Possible Focus on Organic Markets

Related to exports there may also be a possible strategy to position oneself as an organic producer in international markets. In certified organic production, the use of GM varieties is not permitted. Turkey, which has not adopted Bt technology, is one of the major organic cotton producers in the world. However, in Central Asia organic cotton production is minimal. While there is some small-scale organic farming in Kyrgyzstan and Tajikistan, Uzbekistan and Turkmenistan are not involved in organic cotton production.

### Possible Lack of Regulatory Systems

The lack of regulatory systems for GMOs, which is indeed observed in Central Asian countries, might prevent local cotton producers from adopting Bt varieties.

Table 1. Top Cotton-Producing Countries in 2012<sup>a</sup>

Rank	Country	Production (thousand bales)	Total Cotton Area (million ha)	GM to Total Cotton Area (%)	Bt Cotton Area (million ha)	Exports (thousand bales)	Imports (thousand bales)
1	China	35 000	5.0	80	4.0	47	12 000
2	India	28 500	11.6	93	10.8	7750	1200
3	USA	17 315	5.0	94	4.7	13 026	10
4	Pakistan	9300	3.4	82	2.8	450	2200
5	Brazil	6000	1.1	50	0.5	4307	65
6	Australia	4600	0.5	99	0.5	6174	0
7	Uzbekistan	4500	1.3	0	0	3200	0
8	Turkey	2650	0.5	0	0	218	3692
9	Turkmenistan	1600	0.6	0	0	1000	0
10	Greece	1200	0.3	0	0	1200	20
11	Burkina Faso	1175	0.6	51	0.3	1150	0
12	Mexico	1090	0.2	97	0.2	225	950
13	Mali	880	0.5	0	0	875	0
14	Argentina	750	0.4	99	0.4	251	28
15	Tajikistan	550	0.2	0	0	650	0
16	Kazakhstan	415	0.1	0	0	350	5
17	Myanmar	270	0.4	84	0.3	65	0

<sup>a</sup>Source: presentation based on data from [1,3].

However, the lack of a legislative framework has not discouraged the cultivation of GMOs elsewhere. In several countries, Bt cotton was smuggled in from abroad or released without official approval. For instance, in Pakistan, India, and China, Bt cotton adoption started before the technology was officially sanctioned [2,7]. In Central Asia, Bt varieties could have been smuggled in from neighboring China.

Most cotton varieties used in Central Asia are of the upland type (*Gossypium hirsutum*) [8], for which a large number of Bt varieties are available in China [7]. Even backcrossing the Bt trait into local varieties would be relatively easy to carry out without requiring specific biotech capacities. Nevertheless, the presence of unofficial Bt seeds in Central Asia has never been reported. This is no proof that a black-market does not exist, but an indication that smuggled Bt seeds probably do not play an important role. On the

output side, farmers in Uzbekistan are occasionally known to smuggle cotton to neighboring countries to avoid taxation [9].

### Limited Demand for Bt Seeds

The most likely reason for the lack of Bt cotton in Central Asia is low demand by farmers – very different from other countries. In most cotton-producing regions of the world, insect pest control is a major concern. There are many species of insects that attack cotton at different stages of growth. Insect pest problems have been increasing together with the intensification of cotton cultivation. The most damaging pests are various bollworm species and other insects belonging to the order of Lepidoptera. Lepidopteran pests are effectively controlled by Bt technology. The large benefits of Bt cotton adoption in India, China, Pakistan, and other countries are directly attributable to reductions in the use of chemical pesticides against bollworms, lower crop

damage, and thus higher yields and profits [2].

However, pest infestation levels vary geographically. Table 2 shows that most of the major developing-country cotton producers outside Central Asia have high levels of pest infestation. By contrast, Central Asian cotton producers seem to face relatively low infestation levels (similar to Turkey and Greece). Hence the need to adopt Bt cotton is likely much lower. The agroclimatic environment in Central Asia is very favorable for cotton cultivation; biological control systems and harsh winters help to interrupt the insect lifecycle [10]. This is also reflected in an international comparison of cotton yields (Figure 1). Despite notable differences between countries, yields in Central Asia are not systematically lower than in countries that have adopted Bt cotton. All Central Asian producers have higher average yields than India, and this despite relatively low levels of chemical pesticide use. Experimental

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