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Global Cotton and Textile Product Chains

Identifying challenges and opportunities for China through a global commodity chain sustainability analysis

Jiahua Pan, Chengshan Chu, Xinghu Zhao, Yuqing Cui, Tancrède Voituriez

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This paper is the product of a joint initiative of the Chinese Ministry of Commerce (MOFCOM) and IISD), with the support of the Swiss State Secretariat for Economic Affairs (SECO).

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1.0 Executive Summary

The social and environmental impacts of globalization in the cotton/textile supply chain have had a high profile over the last five years in political debates across a wide range of countries. China is playing a pivotal role in the world cotton/textile industry as the major cotton producer and importer, and the major textile exporter as well. China's leading position is likely to be reinforced in the future. China's role in promoting—or neglecting—sustainability should hence play a decisive role in the crafting of a sustainable global cotton/textile supply chain.

Cotton is one of the most important and widely produced agricultural and industrial crops in the world. It is estimated that the crop is planted on about 2.5 per cent of the world's arable land, making it one of the most significant crops in terms of land use after food grains and soybeans. Cotton growing has potentially significant environmental impacts because of its high reliance on water and chemical inputs. Cotton production represents approximately one third of global pesticide use, leading to the damaging effects cotton growing inflicts on the environment when badly managed. The textile industry is potentially damaging for the environment. This stresses the necessity to anticipate what could be the environmental consequences of the increase of world cotton/textile's expected production for decades to come.

Challenges for China are not only from outside, but the domestic challenges arise equally, which have to be addressed by the Chinese government in near future. For the Chinese government, it is necessary and essential to make pre-assessments on the policies associated with the following issues: (1) the trade-off between potential lower environmental pressure and higher social costs associated with the growth of cotton imports; (2) an increasing number of trade frictions globally due to China's rapid cotton textile exports growth; (3) the deterioration of the environment, attributable to pollution generated during the cotton textile chain and the lifecycle process; (4) likely diminishing comparative advantage by China in the cotton textile sector owing to the rising labour cost and the internalization of environmental cost.

This report is aimed at analyzing the environmental and social impacts of China's cotton/textile production and trade growth on global and domestic factors for policy recommendations in the cotton/textile sector from a sustainable development perspective.

There are three main nodes in the supply chain: the cotton and cotton fibre production, the cotton textile production and the consumption node—wastes. In this analysis, the environmental impacts are examined throughout the process of cotton planting, cotton textile processing and production, consumption of cotton textile products and the disposal of textile wastes.

The impacts of China's cotton imports vary as well when it comes from different exporting countries. Social impacts of the cotton textile product chain include employment, production cost and return, fiscal revenue, consumer surplus, poverty reduction and rural prosperity, and so on. In the background of globalization, it is necessary to evaluate the social impacts from the domestic side and the international side.

It is highly unlikely that the cotton/textile industry is to move out of China on a large scale, due to plenty of natural materials and labour supply. And textile and apparel products have huge markets domestically and internationally. Considering its impact on employment and domestic production, textile and apparel industry is unlikely to be a sunsetting sector in China along with its industrialization process. While redistribution of the major production capacity from China to other developing countries will not take place, however, relocation of cotton/textile production capacity from the more developed coastal regions to inland areas has been taking place already.

China's role in promoting—or neglecting—sustainability

In the analysis of cotton textile product chain, four scenarios are examined: Scenario 1: baseline scenario, which represents the continuation of current trade practice; Scenario 2: trade liberalization without considering environmental cost; Scenario 3: trade liberalization with internalizing environmental cost; Scenario 4: the relocation of the cotton textile and apparel industry outside China. The base year is 2005, and the scenario analysis is made up to 2020.

To analyze the impacts of China's cotton textile product chain on economy, environment and society in 2020, in four scenarios, we must examine global cotton consumption, China's cotton production, consumption and the export/import for China's textile and apparel.

Under Scenario 2, the export of textile and apparel would increase one third more than in Scenario 1; the output of textile and apparel will increase by 10 per cent as compared with Scenario 1. However, in the printing and dyeing process, more environmental damages would be incurred by China. As a result, China has to bear the environmental costs associated with an increase in output of textiles under this scenario. As environmental costs are location-specific, the importing country benefits from importing from China.

The internalization of environmental cost is bound to increase the product cost to some extent. Under Scenario 3 of the trade liberalization scenario internalizing environmental costs, it can be seen that for the same output, Scenario 3 has less environmental impacts than Scenario 2. In social impacts, the textile and apparel industry will lose some employment; the profits of the whole industry would decline a little bit as well. Nevertheless, the internalization of environmental cost can win in terms of long-term, environmentally-friendly development at the cost of short-term interests.

Under Scenario 4, the relocation of the world textile and apparel industry, a variety of reasons will make the cost advantage of the Chinese textile and apparel industry vanish gradually. The severe competition will make the market share dwindle as well. The Chinese textile and apparel industry might be relocated to other developing countries (e.g. Vietnam); and the domestic competition could also lead a industry relocation from the east coast to inland, where labour and lands are much cheaper. The production will just tend to meet the domestic demand instead of export. Moreover, large quantities of textile and apparel might be imported to meet the domestic demand.

The total cotton demand would be mainly for the domestic market by 2020. By then, all the production of domestic textiles and apparel will be used to meet domestic demand and the export is assumed at zero. Cotton imports will be more beneficial to environmental protection than in China. And it will provide domestic employment for 3 million people and help to improve the income for 100 million cotton farmers.

Recommendations

Further trade liberalization of the cotton/textile sector provides a possible avenue for improved sustainability at the global level, mainly because the majority of trade distortions are in countries with the greatest environmental pressure. This is particularly true in the cotton sector, where a market shift from areas dependent on chemicals and irrigation, such as such as the U. S. and China, to rain-fed and less intensive areas such as sub-Saharan Africa and parts of Brazil and India, would bring significant net environmental value. Trade policy and patterns can be expected to play a critical role in determining the overall sustainability of the cotton and textile sector.

Still, negative trade-offs are likely to occur at a national level, and particularly in China, between environmental and social impacts, and cotton and textile economic performance. Combining trade and non-trade policies to tackle trade-related sustainability issues in the cotton/textile chain, therefore, seems required. The recommendations proposed in this report attempt to take into account the balance between improving the sustainability of existing cotton producers and shifting to other production locations where geographic conditions favour sustainable production. More specifically, our recommendations focus on three key strategies for improving the sustainability of global cotton and textile sectors:

- Improving the recognition of and demand for sustainable cotton and textile products.
- Improving the sustainability of Chinese cotton and textile production.
- Improving the "global sustainability" of the cotton and textile chains through a transition to higher levels of sustainable production in Africa.

Our specific recommendations:

Recommendation 1: Develop National Market Growth Strategy for Sustainable Cotton: Encourage the development and growth of sustainable cotton markets through improved information gathering and targeted economic policies favouring cotton from sustainable sources.

> ***Recommendation 1.1:*** Develop a National Information Strategy on Cotton Sustainability: Build an information base on the sustainability impacts of Chinese cotton production, processing and consumption. The information system should track basic science-based social and environmental indicators across foreign and national cotton production and textile manufacturing sources. Information gathering and analysis on cotton production may be made compatible with the International Cotton Advisory Committee (ICAC) data processes. The information base can be used as a starting point for determining sustainable trade policy in the cotton sector.
>
> ***Recommendation 1.2:*** Establish an International Standard for Sustainable Cotton Production. Join forces with the international community in reaching an internationally agreed upon definition of sustainable cotton production through active participation in the Better Cotton Initiative. Through its participation in the BCI, China could ensure that regionally relevant standards are developed under the initiative. China may enter such a process with the intention of using the standards developed under the initiative as the baseline for policy development in the cotton sector.
>
> ***Recommendation 1.3:*** Promote Sustainable Sourcing Through Green Trade Policy: Design cotton trade policy to encourage cotton production and sourcing from sustainable supply chains. Preferential fiscal, tariff and tax treatment should be provided to sustainable cotton production (in accordance with internationally accepted standards as per organic cotton principles, the Better Cotton Initiative above or an alternate international process which China might care to initiate) both domestically and internationally.
>
> ***Recommendation 1.4:*** Adjust Tariff Quota Policy to Promote Sustainable Production: Adjust its tariff quota allocation to state owned enterprises in order to encourage "environmental competition," by allocating import quotas on the basis of compliance with internationally recognized sustainability criteria.

Recommendation 2: Develop a National Strategy for Environmental Sound Cotton Production: Require domestic cotton and textile producers to adopt sustainable production practices in line with internationally recognized sustainability standards. Where compliance is economically unfeasible, assistance can be provided to Chinese producers to transition

out of cotton or textile production.

Recommendation 2.1: Invest and Promote New Environmentally Friendly Cotton Production Technologies: Invest in the development and application of new cotton technologies and varieties in order to meet the growing demands of technical and sustainability standards increasingly being applied in the cotton sector. Such support may be based on careful analysis of the long-term sustainability implications with special care being taken in the adoption or support of any GMO technologies.

Recommendation 2.2: Support Sustainable Cotton Production Through Green Box Measures: In order to stimulate the growth in market-led sustainable production from the pilot project level to mainstream production, WTO green box measures can be designed to prioritize income support towards covering the cost of implementing sustainable production practices at the domestic level.

Recommendation 2.3: Ensure Regional Social Harmony Through Balanced Application of Sustainable Cotton Production Policy: An intentional strategy for balancing the distribution of cotton and textile production, and benefits, across different regions within China can be designed with the objective of minimizing social and environmental impact, based on regional comparative advantages and needs.

Recommendation 2.4: Strengthen Regulation on the Use of Toxic Chemicals: Toxic chemicals associated with cotton production and textile processing should be formally identified and phased out through the use of a stringent monitoring and regulation at the regional and sub-regional levels. Regulatory action should be complemented with a targeted taxation scheme at the national level.

Recommendation 2.5: Promote the Use of Cotton By-products and Recycling: Promote the comprehensive use of cotton by-products such as stalks and cotton seeds and waste cotton apparel through the provision of tax incentives for enterprises reaching specified usage levels and investing in by-product utilization technologies.

Recommendation 3: Promote International Cooperation for Sustainable Production and Trade: Promote the development of Sino-African cotton trade by developing African capacity for sustainable production of high quality cotton and by reducing barriers to Sino-African cotton trade.

Recommendation 3.1: Eliminate Duties on African Cotton Imports: Eliminate duties on African cotton imports, in accordance with the commitments outlined within China's

African Policy White Paper.

Recommendation 3.2: Invest in Technological Development for Sustainable Cotton Production in Africa: In an effort to strengthen Sino-African Agricultural Cooperation as stipulated within China's African Policy White Paper, there is a need to intensify cooperation in agricultural technology to improve the sustainability and quality of African cotton; carry out experimental and demonstrative agricultural technology projects; and promote the adoption of best practices in cotton production and processing.

Recommendation 3.3: Improve predictability and Transparency in Sino-African Cotton Trade: In order to enable greater price stability in Sino-African cotton commerce, one option is to encourage the use of over-the-counter forward contracts between Chinese traders and traders operating in Africa. Additional price risk management mechanisms, such as hedging or insurance "capping" schemes, may also be explored for cotton production exported to China.

Table of Contents

2.0 Introduction

Cotton is one of the most important and widely produced agricultural and industrial crops in the world. It is estimated that cotton is planted on about 2.5 per cent of the world's arable land, making it one of the most significant crops in terms of land use after food grains and soybeans. Cotton is one of the most important textile fibres, accounting for more than half of all fibres used in clothing and household furnishing, and about 38 per cent of world fibre market. More than 100 million family units are engaged directly in cotton production. When family labour, hired farm labour and workers in ancillary services such as transportation, ginning, baling and storage are considered, total involvement in cotton sector reaches one billion people (International Cotton Advisory Commission, ICAC, 2005). It also provides millions of employments in allied industries such as agricultural inputs, machinery and equipment, cottonseed crushing and textile manufacturing. The above reasons explain why the social impacts of globalization in the cotton/textile supply chain had a profile over the last five years in political debates across a wide range of countries.

Cotton growing has significant potential environmental impacts because it is highly reliant on water and chemical inputs. Previous examples of environmental impacts, such as the Aral Sea drying up and record consumption of pesticides—cotton production represents approximately one third of global pesticide use—point to the damaging effects cotton growing inflicts on the environment when poorly managed. Dye production consumes energy and generates pollution, and the dyeing process generates waste water and poisonous substances. Water overuse and/or water pollution are common features of the current cotton/textile supply chain (WWF, 1999; UNEP, 2002). This current situation stresses the need to anticipate the possible environmental consequences of the expected increase in world cotton/textiles' production in the coming decades.

This question is of particular concern for China, because China is playing a pivotal role in the world cotton/textile industry as the primary cotton producer and importer, and the primary textile exporter as well. China's leading position will be reinforced by 2010 according to the latest forecast. China's role in promoting or neglecting sustainability should therefore play a decisive role in the crafting of a sustainable global cotton/textile supply chain. China's role is the main subject of this report.

China's challenges stem not only from international markets, but domestic markets as well. In particular, it is necessary and essential for the Chinese government to pre-assess the policies associated with the following issues:

- Importing cotton is important to maintain the competitiveness of China's textile industry, considering the decreasing arable land, and the small scale and high cost of cotton production inside China. However, the rapid growth in cotton imports will reduce the income of Chinese cotton farmers. It is extremely important for the Chinese government to stabilize or increase farmers' income since it is focusing on "Agriculture, Farmer, and Countryside" and the "New Countryside Construction" campaign. Therefore, the trade-off between potential lower environmental pressure and higher social costs associated with anticipated growth in cotton imports has to be taken seriously by the government when defining and implementing policies.
- The rapid growth of China's cotton textile exports leads to an increasing number of trade frictions globally, including anti-dumping from other countries (Tang Yiwen, 2005).
- Along with the deterioration of the environment and the increasing demand for high quality living environments, the pollutions associated with the cotton/textile lifecycle process have drawn more and more attention from the public inside and outside of China.
- With the rising labour cost and the internalization of environmental cost, China's comparative advantage in the cotton textile industry might gradually fade out. Therefore, there might be a possibility for the textile industry to shift from China to other developing countries in the medium term.

To tackle the problems above, it is urgent for the Chinese government to formulate policies to ensure China's high competitiveness in the world textile market by strengthening technological innovation and improving environmental management.

Strikingly, few analyses have focused on revealing the environmental and social impacts of China's cotton/textile production and trade growth so far, either on a global or domestic level. This report aims to fill this gap by providing research findings and policy recommendations in the cotton/textile sector from a sustainable development perspective.

3.0 Dynamics in Global Cotton Textile Supply Chain and Governance

China has a long history of cotton planting. There are five main cotton-planting areas from south to north: the South China Region, the Yangtze River Region, the Yellow River Region, the North Region, with a Special Early-Maturing Cotton Region and the Northwest Inland Region (China Agricultural Network, 2007). Among them, Xinjiang Autonomous Region (included in Northwest Inland Region) takes a significant position in cotton production in China. The total annual lint output in Xinjiang reached 1.08 million tonnes, which accounts for one sixth of China's total output (6.5 million tonnes) in 2006 (Xinjiang Production and Construction Group Statistic Bureau, 2006). Moreover, Xinjiang is the world's largest production base for coloured cotton, amounting to 95 per cent of China's total output.

China's cotton production has been growing rapidly since the 1980s. The total output in 2006 reached 6.5 million tonnes, nearly one fourth of the world's total output. China has become the largest cotton producer in the world.

Despite China's important role in the world cotton market, its cotton production is unable to meet huge domestic demand. China imports large quantities of cotton from the United States, Uzbekistan, Australia, Central Asia and African countries. According to statistics, China's cotton imports have increased from 46,238 tonnes in 1999 to 3.8 million tonnes in 2006.

In 2006, 46 per cent of China's cotton imports came from the U. S. (Figure 3.1), and 45 per cent of U. S. cotton was exported to China. The trade of textile displays a similar pattern between the U. S. and China: China ranks the first among U. S. textile and clothing imports (Figure 3.2). From the case of the cotton/textile trade between the U. S. and China, policies have played a notable role in China's trade performance over the last decade, and the relevant policies will continue to shape the market structure and trade patterns in the near future.

3.1 Historical perspective

The world cotton production concentrates on four main areas. The largest cotton planting region is located in Asia including China, India, Pakistan, Central Asia, Transcaucasia and some West Asian countries. Cotton output in this region accounts for about 50 per cent of the world total. The second largest region is located in the United States South, which produced 20 per cent of the world total cotton output over past years.

Figure 3.1: China's main cotton import partners

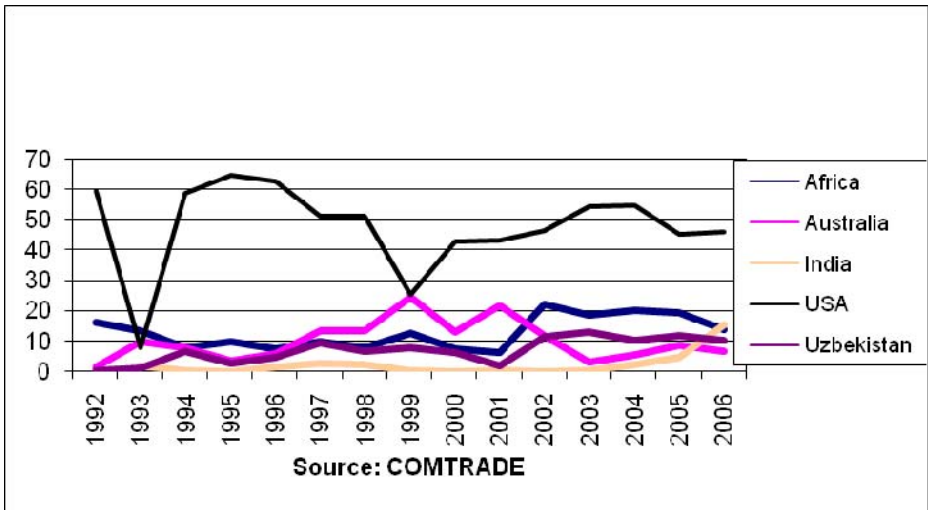
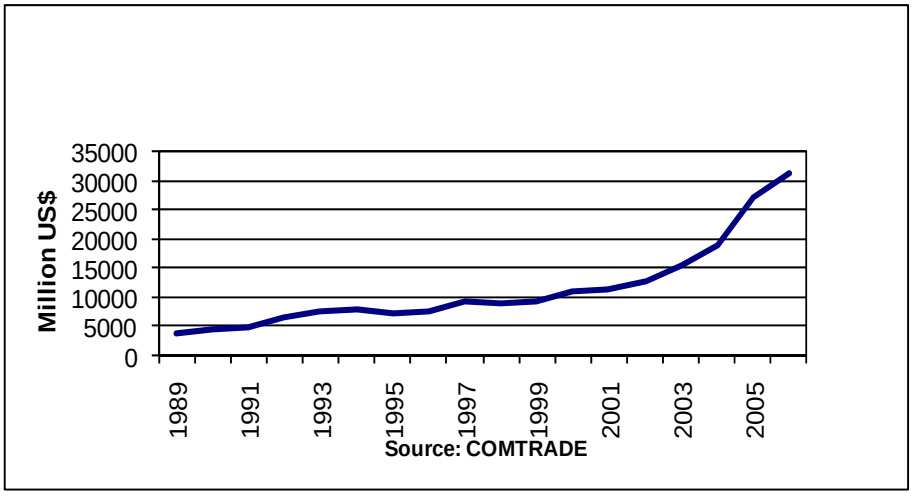


Figure 3.2: U. S. textile and clothing imports from China, 1989–2006



The U. S. is the largest cotton exporter in the world. Latin America is the third region with about 10 per cent of the world's cotton. Africa, as the major planting area for high-grade, long-staple cotton, is the fourth main cotton-planting region in the world (China Stocks Network, 2006).

For the last three decades, the four main regions have accounted for a rising share of world output. China, the U. S., India and Pakistan produced 48 per cent of world cotton in 1970–1971 and about 70 per cent in 2005. China is the main producer with an average of 24 per cent of total cotton output between 2003 and 2005, followed by the U. S. (20 per cent) and India (16 per cent). Much of the growth of cotton production after World War II is due to improved yield per unit rather than to the expansion of planting area.

Despite increasing local demand for cotton, especially in developing countries, cotton is still one of the most important traded agricultural raw materials. Almost one third of cotton production has been traded per year since the 1960s. In 1999–2000, 30 per cent of the cotton consumed in the world was traded across country borders; by 2005–06, it has risen to 38 per cent. China's imports have surged from a negligible level in 1999–2000 to 4.3 million tonnes in 2005–06, and now China has become the largest cotton importer (Figure 3.3). In 2007, customs sources show that the U. S. and India were China's two leading suppliers, accounting for 70 per cent of China's total arrivals.

The one-million-tonne tariff-rate quota (TRQ) in the negotiation of China's entry to WTO in 2001 has turned out to be in small proportion to China's needs. However, the TRQ is 2.6 times larger than China's average imports during the past 10 years according to the USDA (2007). China has regularly opened additional TRQs in recent years, which has increased the role of traded cotton in world cotton mill demand to levels not seen on a sustained basis since the late 1970s. In October 2007, the National Development and Reform Commission (NDRC) announced the 2008 import tariff quotas, application conditions and allocation principles for wheat, corn, rice and cotton. In 2008, China's cotton import tariff quota is 894,000 tonnes, 33 per cent of which will go to state-run companies.

On the export side, the United States has accounted for the lion's share of global gains, with 2.5 million tonnes of increased exports since 1999–2000, a significant portion of

which goes to China (Figure 3.4). India's exports are also on the upswing 700,000 tonnes higher in 2005–06 than in 1999–2000, and sub-Saharan Africa's exports grew nearly 500,000 tonnes, a 50 per cent increase. Central Asia's exports also went up after falling for several years. In addition, Brazil's exports reached their highest level since the late 1960s, 500,000 tonnes more than in 1999–2000.

Industrial consumption of cotton tends to concentrate on six processing countries: China, India, Pakistan, Turkey, U. S. and Brazil. Their market share rose from 51 per cent in 1980–1981 to 76 per cent in 2005. China's ginning industry processed about 9 million tonnes of raw cotton in 2005, which is 35 per cent of world cotton processing and about a 100 per cent increase since 1999–2000. This increase has been well reflected in China's growth of exports of textiles and clothing **(Figure 3.5).**

More than half the world's cotton is now imported by the countries that are also big cotton producers. In the 1990s, however, only 15 per cent of world imports went to cotton-producing countries. Therefore, the world market has been dominated by the countries interested in the well-being of their own cotton sector. Political economy, and even politics, must be taken into account when dealing with the cotton/textile economy.

Figure 3.3: China's cotton imports, 1992–2006

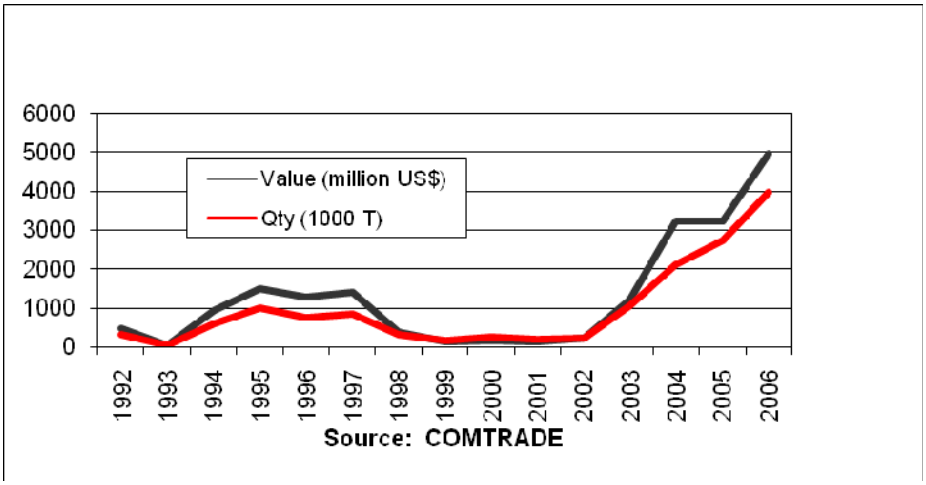


Figure 3.4: U. S. exports of cotton to China, 1989–2006

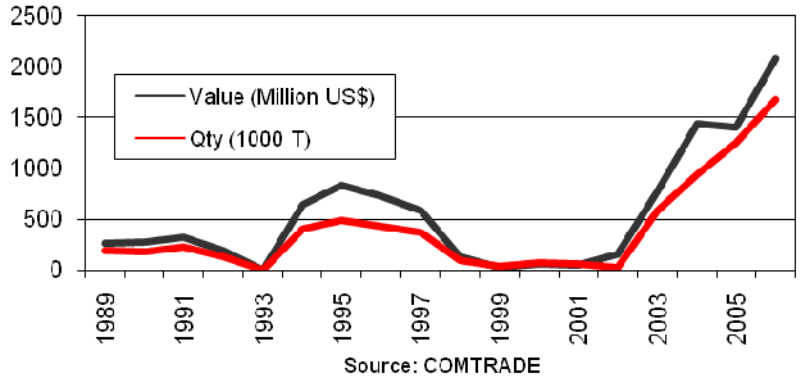
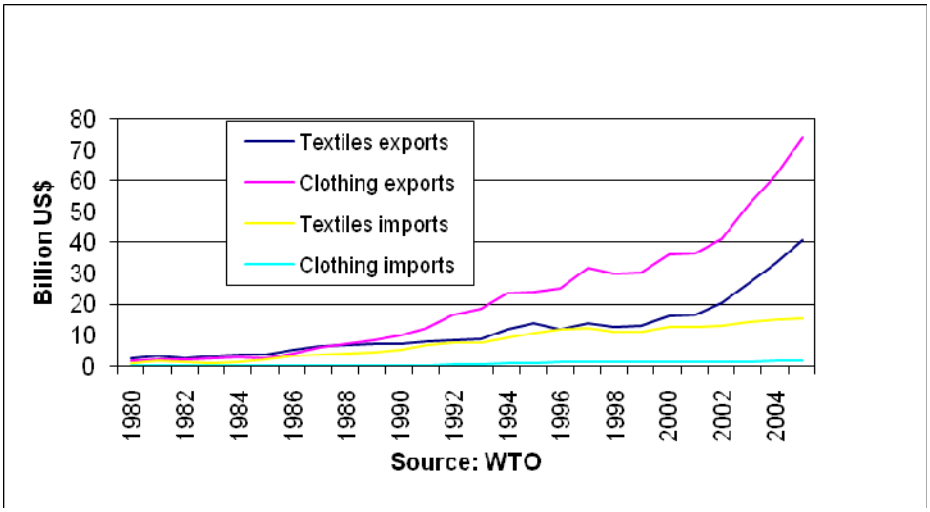


Figure 3.5: China's textiles and clothing trade



3.2 Market outlook

According to the International Cotton Advisory Committee (ICAC), global cotton production and consumption is projected to reach 27 million tonnes in 2010. Over the same period, international trade will amount to 9 million tonnes, of which an estimated 4 million will be imported by China. ICAC predicts that new technologies (e.g. GMO/biotech), in addition to the development of new areas of production (Brazil) and the continuation of subsidies (U. S.), will sustain growing cotton production in the medium-term.

Highest growth of cotton output is projected to occur in India, Africa (by yield improvement) and Brazil (by acreage growth). Biotechnology would contribute 50 per cent increase in world cotton production.

Chinese consumption of cotton will amount to 11 million tonnes in 2010, which is 40 per cent of the world industrial cotton consumption. A structural deficit of demand in China will tend to increase according to ICAC projections.

The findings above are also confirmed by world trade model simulations. The WTO trade liberalization agenda, called the Doha Development Agenda (DDA), has inspired numerous policy simulations with general equilibrium models for the cotton sector. In particular, the Cotton Initiative led by four African countries before the Cancun WTO Ministerial Conference (2003) has been the subject of many modelling exercises since it was established. In most economic assessments of DDA scenarios, the two main indicators are price and welfare changes. The main interest of the reports and papers reviewed[1] is that they tend to reveal a generalized agreement about the expected aggregate and allocation effects of trade liberalization under the auspices of the WTO. The magnitude of cotton output changes at global and country levels is valuable information for the analysis of the sustainable impacts of China's cotton import growth.

A second interesting point is that, with the exception of free trade, the magnitude of change is of rather limited range in DDA partial reform scenarios. For instance, Anderson and Valenzuela (2006) ran two free-trade alternative scenarios or "partial reform scenarios." In the first one, the U. S. is the only country to reform, and they do so in such a way as to fully comply with those WTO rulings. In the second free trade alternative scenario, the authors chose to

- Remove all cotton export subsidies globally;
- Remove tariffs on imports of cotton by all high-income countries (HICs) from pertinent UN-defined least-developed countries (LDCs, comprising South Asia excluding India, Pakistan and Sri Lanka, plus sub-Saharan Africa excluding Nigeria and the Southern African Customs Union); and
- Reduce by one third all applied cotton production subsidies in all HICS (not just in the U. S. as in the first free trade alternative partial reform scenario).

[1] see the background document prepared by Guérin and Voituriez (2007)

While price changes after reforms bolster cotton exports in countries such as Australia, sub-Saharan Africa and Brazil, and reduce exports in those providing subsides, such as the U. S. and the EU, the magnitude of change in production does not exceed nine per cent in the partial reform scenario. One exception is the EU, which is a particular and marginal case if we compare its production with global cotton output. China's production is somehow stationary, while imports are on a smooth rising trend. This confirms ICAC's predictions.

They are further confirmed by scenarios coupling U. S. and Chinese cotton policy reforms. This is the approach chosen by Pan et al (2005), which reveals that the impacts measured are actually associated with China's (and U. S.) behaviour (everything else being equal). Still, the magnitude of production changes induced by both China and U. S. trade cotton liberalization is almost nil according to their simulations.

3.3 Drivers for change

There are a number of drivers pushing the process of cotton/textile trading. Particularly notable in the cotton sector is the existence of highly interventionist international and domestic policies. World cotton trade and production are highly affected by government policy intervention, notably in the U. S., China and the EU. Direct support to growers through price interventions is of particular concern for trade in the global cotton market.

3.3.1 International trade policies

The attention to cotton under the current round of trade discussions is unprecedented, both in terms the degree of focus on cotton, and in terms of the degree of focus on a single commodity more generally. Cotton is an unlikely pivot point for international negotiations due to its being both a labour-intensive crop in developing countries and a capital-intensive crop in developed countries. Even though government measures in cotton constitute approximately one per cent of all support to agriculture in OECD (Organization of Economic Cooperation and Development) countries, it is commonly thought that the WTO talks in Cancun in 2003 unravelled over cotton. The EU is the largest import market for textiles in the world, and the U. S. is the largest retail market for cotton. As ICAC emphasizes, the U. S. industry and government contribute approximately US$60 million per year in domestic and international cotton market. These efforts, begun in the 1950s, are boosting world demand for cotton, "perhaps by

more than subsidies boost U. S. production" (USDA, 2007).

In 2004, the WTO Appellate Body upheld all major findings of an earlier WTO panel that ruled that U. S. cotton subsidies were in violation of WTO rules on agriculture and subsidies. Cotton debates have mostly evolved around one single issue: development assistance for economies where cotton has vital importance.

On November 19, 2004, WTO members set up a body to focus on cotton, as required by the August 1, 2004 decision—sometimes called the July Package—covering all the WTO negotiations. The agreement to create a body to focus specifically on cotton is part of WTO member governments' response to proposals from four African countries—Benin, Burkina Faso, Chad and Mali—to tackle the sector. The latest high-level session on cotton at the WTO in Geneva conceded that cotton needs a breakthrough in the Doha Round negotiations, and that more is needed to remove blockages on development assistance (Box. 3.1). China's possible policy initiatives toward developing countries' economies where cotton has vital importance should develop within this WTO development assistance framework.

Regarding the textile node, the removal of MFA (Multifibre Agreement) quotas has affected and will continue to affect the geographic distribution of textile and apparel production and trade, as lower wages, subsidies for capital investment and other factors favour clothing production in lower income countries. As a USDA (2007) report emphasizes, in 2000, 31 per cent of the clothing consumed in the world was imported. By 2004, this share had increased, approaching 90 per cent in the United States and Japan by some measures. In 2005, the world clothing trade was significantly liberalized as the import quotas inherited from the MFA were eliminated.

Box 3.1: Cotton development assistance and the WTO

One key task undertaken by the WTO Secretariat is a compilation of development assistance (see WTO document WT/L/670), which lists direct and indirect aid for cotton totalling US$6.85 billion. One of the problems discussed in WTO high level sessions on cotton is the mismatch between funds that donors are making available, and the requests of the recipient countries. Some African recipients said their needs were not being met; some donors said the recipients were not submitting enough suitable requests. Among the accounts of aid that countries are giving to the African cotton producers were statements from India, Brazil and China about the technical assistance they are offering. WTO Director General Pascal Lamy highlighted this "South-South" assistance as a valuable development.

Source: WTO website

Yet, there remain many unresolved issues regarding potential effects of quota removal on trade policy in importing and exporting countries. China imposed export duties on about 60 per cent of its clothing exports in December 2004, to help alleviate concerns about its post-MFA export prospects. Also, China's WTO accession agreement included provisions for importing countries to impose special safeguards on textile and apparel imports from China through 2008. The United States, Turkey and the EU have moved to impose some safeguards to help buffer their domestic industries from a flood of imports. Although the MFA quotas have been fully phased out, other policy instruments, such as safeguards, tariffs and preferential agreements continue to affect the global cotton market. While tariffs on textiles and clothing remain significantly higher than tariffs on most manufactured products, countries with preferential market access typically pay lower tariffs, influencing production trends. Consequently, the global landscape for textile and apparel production and trade continues to evolve. Adjustments will be seen for a number of years as further concentration of global textile suppliers is likely and competition for market share will continue (USDA, 2007).

3.3.2 National policy environment

In the last two decades of the twentieth century, all the cotton-producing countries attached great importance to price policy to promote cotton production. Since 1986, 25 countries have passed positive subsidy policies in terms of cotton price or farmers' income. The total cotton output of the world in 1986 is 15.26 million tonnes, 69 per cent of which came from the influence of subsidy policies. Since the 1990s, some counties began to resort to subsidy policy again due the descending of cotton price. According to the statistic of the ICAC, 50 per cent of the total cotton output in 1997–1998 came from the subsidy on cotton price or farmers' income. In 1998–1999, the

percentage reached 53 per cent and among 76 cotton-producing countries in the world, eight countries gave direct subsidy to cotton production, which included the U. S., Brazil, Egypt, Greece, Mexico, Spain, Turkey and China. The direct subsidy to cotton production in these eight countries was US$3.7 billion in 1997–1998 and surged to US$4.8 billion in 1998–1999 (Wang Shumin, 2000), and finally US$5.8 billion in 2001–2002 (Han Yijun, Zhang Haisheng, 2006).

Box 3.2: U. S. cotton policy

U. S. farm policy is an important factor in producers' decision making. Total planting flexibility, introduced in the 1996 Farm Act, enabled many cotton producers who had participated in previous commodity programs to shift areas to other crops (excluding certain fruits and vegetables), and producers of other crops to shift areas to cotton. The 2002 Farm Act extended this planting flexibility, but also introduced some new policies. It provides various forms of government assistance for major crops, including upland cotton. Programs include the marketing loan program, direct payments and countercyclical payments. In addition, the federal crop insurance program benefits cotton producers by guarding against crop or revenue losses. The 2002 Farm Act governed Federal farm programs over a six-year period (2002–2007).

The 2007 farm bill debate occurred at a time when there was concern over projected deficits in the federal budget, which could affect funding for domestic farm programs. This could result in potential changes to the overall level of spending and basic structure of commodity programs, or in modifications to the parameters of existing programs. For example, loan rates, direct and countercyclical payment rates, the use of commodity certificates, payment limitations and crop insurance provisions could be reconsidered.

Source: ERS-USDA

i) U. S. cotton/textile policy

The U. S. government is the number one cotton subsidy supplier in the world (see Box 3.2). As the world's second largest cotton producer and the world's largest cotton exporter, the U. S. views the cotton industry as a strategic part of its market economy. The competitive capability of U. S. cotton derives mainly from subsidy (Li Chongguang, 2000). According to data from United States Department of Agriculture (USDA), cotton producers in U. S. have received US$12.47 billion subsidy between August 1999 and July 2003, yet the production value of the same term was US$13.94 billion. The subsidy rate (i.e. the percentage of subsidy to total production value) was

89.5 per cent. In 2001–2002, the subsidy the American government paid to cotton producers was US$3.98 billion, which outreached its production value of US$3.08 billion, with a subsidy rate of 129.3 per cent (Han Yijun and He Binsheng, 2004).

High subsidies in the cotton market in the U. S. distorted the international cotton price and seriously harmed the interests of other cotton producers in the world, including Chinese cotton farmers. For African countries, which are highly dependent on cotton planting, it is no less than a catastrophe that dramatically exacerbates the poverty (Han Yijun and Zhang Haicen, 2006).

ii) The EU cotton/textile policy

The EU also has relatively high subsidies for cotton production. EU does not provide subsidy to cotton export, but provides financial support directly for cotton producers. The financial support for Spanish and Greek producers is 100 per cent higher than the international cotton average price. Compared with other produce, cotton receives among the highest subsidies in the EU—three to four times higher than corn and oil seeds; and seven to eight times higher than grains.

Subsidies depress cotton prices and depress international prices. According to Cotlook, international cotton price has fallen 50 per cent between 1997 and 2002 (Hua Zhong Cotton Trade Net, 2003). At the same time, subsidies disturb the distribution of cotton production. If it was put in to a liberal scenario with subsidies removed, cotton production in Europe would disappear completely, and the U. S. would reduce its production by one third. Nevertheless, the production in China would increase by ten per cent; and two to three million tonnes of cotton production would be redistributed amongst those competitive countries with lower cost.

iii) China cotton/textile policy

After the Third Plenary Session of the 11th Central Committee of the CCP in 1978, China has transformed from a planned to a market economy. State-owned textile and apparel companies have changed into private or joint venture companies. The depressed productivity of the cotton and textile industry has been released. During the period of the Tenth Five-year Plan (2001–2005), in medium and large scale companies,[2]

[2] Medium and large scale company, (Gui Mo Yi Shang Qi Ye) includes all the state-owned companies, and a part of non-state-owned companies with the sales volume over RMB 5 million. (National Bureau of Statistics of China)

the percentage of non-state-owned companies has increased from 80.5 per cent in 2000 to 95.9 per cent in 2005, with a notable surge in: the sales, from 81.2 per cent to 93.8 per cent; the profit amount, from 76.6 per cent to 99.0 per cent; the export delivery value, from 81.2 per cent to 93.8 per cent and employment, from 64.5 per cent to 88.0 per cent.

The textile industry is now more diverse and competitive. Productivity has been continuously reinforced (The Outline of Textile Industry in Eleventh Five-year Plan, 2006). In the period of the Tenth Five-year Plan, with the support of governmental industry policy, the cotton and textile industry has begun to walk out of the swamp by reform. The productivity has been improved greatly.

According to the commitment of China's entry to WTO, China cancelled all the import quotas in 2005. This provides the Chinese textile industry with plentiful and low-priced materials, but has had a negative impact on domestic farmers.

As of January 1, 2005, China had an export tax on 148 textile and apparel products in seven categories. This tax is partly a response to assertions from the U. S. and other countries about China dumping textile products in the world market, but it is also a means of promoting higher value textile products. There is evidence that this policy has assisted in optimizing the structure of China's textile industry, while promoting a more comprehensive, harmonious and sustainable development of China's textile industry.

"The Outline of Textile Industry Development in Eleventh Five-year Plan" was released in 2006. It emphasizes the following three principles: 1. improvement of printing and dyeing quality; 2. adoption of energy-saving technology; and 3. strengthening environmental protection. Based on these principles, the outline has focused on two specific themes, "environmental protection" and "energy savings," to promote the research and production of ecological textile and functional textile products; to expand advanced printing and dyeing technology; to prevent the pollution along production process instead of punishing infractions afterwards; and to increase law enforcement. The outline urges the textile and dyeing industry to keep improving technology upgrades and structural transformation.

The appreciation of the RMB reduced the low-price advantage of Chinese textiles,

though only marginally. On July 21, 2005, the People's Bank of China (the central bank of China) announced a revaluation of the RMB and ended the direct peg to U. S. dollars. China adopted a managed floating exchange rate mechanism, under which the RMB is no longer be tightly pegged to U. S. dollars. The RMB exchange rate will be determined in reference to a basket of currencies on the basis of market supply and demand. On the date of July 21, 2005, the exchange rate of the RMB was set at 8.11 to U. S. dollar, an approximately 2 per cent appreciation of the RMB. The exchange rate of the RMB will be allowed to fluctuate by 0.3 per cent in the foreign exchange market. From that day on, the RMB has been on its path of appreciation. Though the exchange rate of the RMB has fluctuated several times, it displayed a basically wavy appreciation, which changed from the original 8.2765 to 7.7758 on January 19, 2007 during eighteen months, appreciating by six per cent (Li Jun, 2007).

Nevertheless, the textile industry still has the largest export surplus in China, due to low export prices, rather than the production of value-added products. The appreciation of the RMB has lead to an increase in the cost of production, which has reduced Chinese competitiveness and overall profitability of the sector marginally over recent years.

The reduction of export tax rebate further marginalizes the profits of export companies. Since September 15, 2006, the tax rebate for textile export has been reduced from 13 per cent to 11 per cent (Feng Qiang, 2006). This policy further reduces the profit space of the textile industry, and makes it even more difficult for the companies that depend on lower-price strategy to survive.

According to statistics from Webtextile.com, the total sales revenue of the Chinese textile industry was RMB 2,168.9 billion from January to November 2006, with distribution costs of RMB 1,939.5 billion, and distribution taxes of RMB 8.36 billion. Thus, the gross profit was RMB 221 billion with a gross profit rate of 10.19 per cent. The total profit amount was RMB 76.8 billion, with a profit rate of 3.53 per cent (www.efu.com.cn, 2007). The tax rebate reduction on textile exports urges the textile and apparel companies to upgrade the product quality and establish their own brands.

iv) Cotton and textile policy in countries is of importance to China

With extremely low (and often non-existent) levels of domestic support to cotton growers, cotton producers based in developing countries must face a distorted market with virtually no safety net, stabilization or insurance programs. The situation in the textile sector is somewhat different. Many developing countries were badly hit when the Multi-fibre Arrangement, which restricted exports of Chinese clothes to rich countries, ended in January 2005. Two policy measures have been used by such countries to retain their comparative advantage in textile and garment exports: the implementation of restrictions on Chinese imports and the allocation of preferential market access to developed economies (for example: the African Growth and Opportunity Act [AGOA], the Economic Partnership Agreements and Everything but Arms initiatives of the European Union). The WTO has decided that rich countries should extend preferential access to all poor countries, not just Africa, by 2008. This should further divide the developing countries group into two categories: cotton growers and exporters, who are likely to gain from China's cotton imports growth, and textile exporters, who will find it hard to retain preferential market access to OECD countries in short- to medium-term—and which could, as a result, be affected negatively.

3.3.3 Technology and innovation

The planting area of cotton globally remained above 34 million hectares in 2006 for the third consecutive year, its strongest performance in over past 75 years. Around the world, new technology has made cotton more attractive to farmers in many countries, while policy reforms in other countries have increased farmers' willingness to plant cotton. Outside the U. S., the spread of biotech cotton has recently revolutionized India's cotton sector just as China's adoption has run its course. The cost savings of biotech cotton brought millions of hectares back into cotton production in China, and has also helped India's cotton area increase by more than one million hectares. Biotech cotton has also been adopted in smaller producing countries like Australia, Argentina, Mexico and South Africa.

The technology and growing practices used are key determinants of cotton yields and, in turn, of environmental impacts. All over the world, there is an extremely wide range of different cotton growing practices. These practices depend on a large number of key parameters, such as the climate, soil quality, available inputs and technical capacity of

growers, among other factors.

A simplistic picture of cotton production divides global productive capacity into two basic groups:

- a small number of big and rich farmers owing large-scale mechanized farms (e.g. U. S., Australia) ;
- a large number of small and poor peasants cultivating manually small pieces of land (e.g. China, West Africa).

Although this description could be said to bear some resemblance to reality, it would be inappropriate to consider this to be an accurate depiction of the sector as a whole. Indeed there are many different practices worldwide that form a continuous spectrum. Farmers from the same country use completely different methods to grow cotton—such as in the case of Brazil. Nevertheless, in order to bring our study to fruition, it is absolutely essential to classify (even roughly) the different cotton growing practices. Before everything, this sketchy classification has to be relevant regarding the environmental impacts associated with different growing practices. Across the wide range of the various agricultural systems existing worldwide, there are two broad categories of growing practices that are (relatively) well defined and interesting as far as environmental issues are at stake:

- Organic systems (sometime improperly called green or ecological systems)[3]
- Integrated Pest Management (IPM) systems[4].

All other cotton growing practices systems that cannot be considered organic or IPM systems are referred to as conventional systems. As a consequence, conventional systems are far more numerous than organic or IPM systems, and involve some very

[3] The EU gives a definition of organic systems that we will use: "organic production systems are designed to produce optimum quantities of products of high quality by using management practices which aim to avoid the use of agro-chemical inputs and which minimise damage to the environment and wildlife" (EEC, 1993)

[4] The Food and Agriculture Organization (FAO) defines IPM systems as a site-specific strategy for managing insect, weed, disease and other pests in the most cost effective, environmentally sound and socially acceptable way. IPM is not a rigidly defined form of crop protection, but a dynamic system that adapts and makes sensible use of local resources and the latest research, technology, advice and experience" (FAO, 2004).

different cotton growing practices (regarding the size of cultivated lands, the irrigation system if irrigation is applied, the quantity and toxicity of pesticides applied).[5]

As a result, the wide spectrum of conventional cotton growing systems have to be split into different categories specifying the environmental impacts associated with cotton production. To be as clear as possible, we will consider only a few key and clear-cut parameters that are particularly relevant to the environment:

- the use of water resources;
- the size of cultivated land (which is almost always directly linked to the presence or absence of machines to grow cotton);
- the quantity and toxicity of pesticides and fertilizers used (and their side effects on biodiversity and human health);
- erosion (and every other phenomenon leading to lower yields);
- GMO cotton.

The overuse or misuse of water resources is by far the most important environmental concern linked with cotton production (and agriculture in general). One hundred million hectares (eight per cent of arable lands worldwide) are now unfit for agriculture as a result of the unsustainable use of water resources in the past, with salinization being the main problem. Even within the organic and IPM systems, the environmental impacts associated with cotton production can vary widely because the definitions of organic and IPM systems do not say anything at all concerning the management of water resources, even though it is the number one cause of environmental damage.

Organic cotton is a new concept founded after the "sustainable agriculture" in mid-1908s United States. It refers to a new cotton production mode targeting environmental protection. Organic cotton refers to cotton produced in fields where chemical fertilizer and pesticide has been prohibited for over three years, cultivated mainly with organic fertilizer, using biological pest control and natural cultivation. To be organic, cotton needs to be certified by one independent institution (Chen Xin, 2006).

When compared with conventional cotton, the cultivation of organic cotton may save 75 per cent of water. Chemical pesticides are not used in the growing of organic cotton, which brings hope to the whole world including China, for whom 50 per cent of the

[5] See Guérin (2007) for a description of cotton growing practices in the main producing countries.

cost in conventional cotton cultivation is chemical pesticide and fertilizer, which in turn, leads to a host of environmental problems (Xin Yun, 2003).

However, the market share of organic cotton remains marginal at present. In 2000, the output of organic cotton in the world was 11,743 tonnes, accounting for less than 0.1 per cent of the total cotton output. In 1999–2000, the output of the largest organic cotton producer, Turkey, reached 51.8 per cent of the worldwide total output of organic cotton. The U. S. was second with 25.17 per cent. In China, 267 hectares were transformed from the conventional to organic cotton planting fields in 2000, and 20 tonnes of organic cotton has received certification; in 2001, the figures climbed to 466 hectares and 60 tonnes; and in 2002, the figures reached 733 hectares and 90–100 tonnes (Hu Botao, 2006).

Though organic cotton still holds a rather small share of the total cotton output at present, it is crucial to the theme of environmental protection. Theoretically, the environmental impacts of organic cotton can be tiny. Along with the demands of green consumption, the organic cotton industry will grow rapidly. The International Organic Agricultural Commission predicts that 30 per cent of the total cotton output will be replaced by organic cotton in the coming 30 years.[6] Natural colour cotton contains natural pigment and does not use a process of chemical dyeing. It is not only beneficial to environmental protection and health, but can also save resources and energy, and reduce production costs greatly (Guo Xiaoling, 2002). Furthermore, natural colour cotton is relatively insect, drought and alkali resistant. According to its features, natural colour cotton should be taken as an important part of organic cotton.

Organic cotton is an environmentally-friendly and good quality textile material (see Box 2.3). Textiles made of organic cotton is called organic textile or ecological textile. The research and development of organic textile has important implications for the sustainability of the textile industry in avoiding "green" tariffs in international trade, and in protecting the ecological environment and human health.

In the face of severe international competition and demand from consumers, organic textiles will become a strong tool in working towards sustainable development. Since China is a long way from transforming from conventional to organic cotton production, and the yield of organic cotton is lower than that of conventional cotton,

[6] www.agri.ac.cn/agri_net/12/12-3/12-3-1/0201kb.htm (2002)

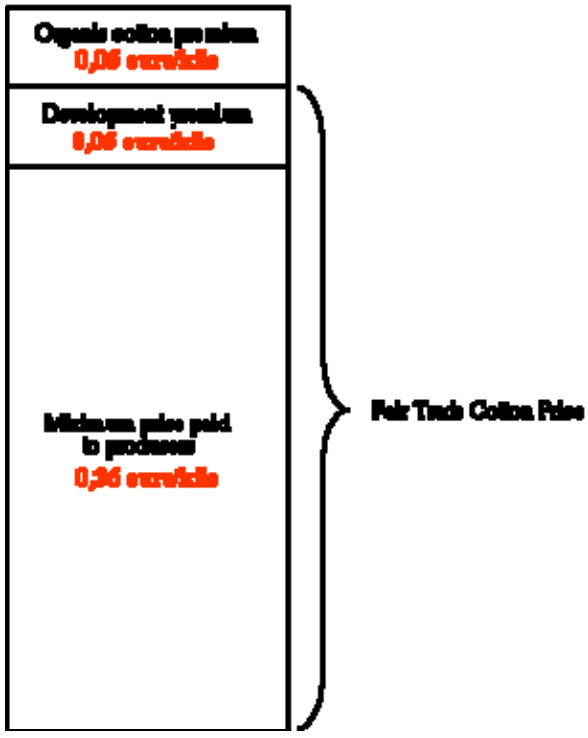
the government should provide incentives to producers with respective financial and technical support.

Box 3.3: Organic and fair trade cotton

In March 2005, the fair trade association Max Havelaar was the first to launch a fair trade label for a non-food commodity: cotton. To achieve its aim, Max Havelaar has worked with about 20,000 small producers from Cameroon, Mali and Senegal, organized as a cooperative association. Cotton farmers from these countries continue to account for the greatest share of the global fair trade cotton production at present.

In order to implement this new fair trade segment, Max Havelaar entered into a partnership with the French company DAGRIS and benefited from the financial support of several bodies (e.g. French Ministry of Foreign Affairs and the Centre for the Development of Enterprise). Fair trade cotton products are sold under different brand names (e.g. Armor Lux, Célio, Cora/influx, Eider, Hacot, Colombier, Hydra, Kindy, La redoute et TDV industries). In order to benefit from a better price (including fair trade premium) for cottonseeds (which corresponds, according to Max Havelaar, to an increase of 46 per cent compared to the price paid for the traditional cottonseeds originated from Senegal and 26 per cent compared to the price from Mali, over the period of 2004–05), producers must be certified (costs assumed by them). They also have to meet particular specifications (e.g. use cotton-made bags rather than polypropylene ones, ensure a better sorting of the cotton seeds).

Price granted under fair trade cotton seeds scheme



Source: UNCTAD Secretariat according to an article issued by Marchés tropicaux - March 11 2005

Box 3.4: "Buyer-driven" and "producer-driven" commodity chains

Commodity or value chains are defined as networks of production, distribution and marketing of particular products or groups of products. For most of the 1990s, the main components of a commodity chain were defined as comprising an input/output structure or configuration, a specific geography and an internal governance structure (e.g., Gereffi, 1994). The notion of "internal governance structure" was elaborated on in relation to the distinction between "buyer-" and "producer-driven" commodity chains, with the implication that it was the nature of specific categories of lead agents that determined both input/output structures and chain geographies. The category of "buyer-driven" recognized the heightened significance of the phenomenon of branded marketing. It also highlighted the previously unrecognized link between the rise of branded marketing, and the emergence of arm's length global production networks. Many GCC/GVC case studies deal with apparel, an exemplary "buyer-driven" chain (e.g., Appelbaum and Gereffi, 1994; Bonacich and Waller, 1994). Branded marketers and retailers seem able to externalize certain lower-profit functions to those "upstream" from them. So, for example, in the clothing chain, branded marketers have managed to redistribute most functions upstream from design to financially independent manufacturer-suppliers. At the same time, their supply-base of manufacturers has been organized in such a decentralized way that "buyers" could optimize the comparative advantage of different production locations (with regard to labour costs, delivery times, MFA quota availability, etc.).

Source : Gibbon (2003)

3.3.4 Main players and power distribution

The distribution of operation units throughout the chain, from cotton growers to clothing and apparel end-consumers, displays strong heterogeneity in the concentration of main actors at various nodes of the chain. While end-parts of the chain are composed of billions of actors (including cotton growers and apparel consumers, respectively), two distinct nodes deserve careful examination for being potential drivers of the whole chain (Box 3.4), namely the international trading and the giant retailer nodes.

International level

The global value chain framework provides useful insights about the transformations in production, trade and corporate strategies that altered the apparel industry over the past decades and changed the conditions for innovation and learning in the industry. A report by Unido, Gereffi and Memedovic (2003) describes the chain organization around five main parts: raw material supply, including natural and synthetic fibres; provision of components, such as the yarns and fabrics manufactured by textile companies;

production networks made up of garment factories, including their domestic and overseas subcontractors; export channels established by trade intermediaries; and marketing networks at the retail level. They further identified the cotton/textile chain as a buyer-driven value chain that contains three types of lead firms: retailers, marketers and branded manufacturers. With the globalization of apparel production, the authors report, competition among the leading firms in the industry has intensified as each type of lead firm has developed extensive global sourcing capabilities. We draw on Gereffi's (1997) work for the following descriptive elements of the international supply chain.

Global retailing is dominated by large organizations that are developing greater specialization by product and price. By the end of the 1990s, the 29 biggest retailers made up 98 per cent of all of the U. S.'s apparel sales. The top two discount giants, Wal-Mart and Kmart, control one quarter of all apparel (by physical volume, not value) sold in the United States. Although the degree of market power that is concentrated in large United States retailers may be extreme, a similar shift from manufacturers to retailers and marketers appears to be under way in other developed countries.

For buyer-driven value chains, the major significance of growing retailer concentration is the resulting expansion of global sourcing. "Whereas in 1992 about 49 per cent of all retail apparel sold in the United States was made in the country, by 1999 the proportion of domestically made United States retail apparel dropped to just 12 per cent. As each type of buyer in the apparel value chain has become more involved in offshore sourcing, the competition among retailers, marketers and manufacturers has intensified, leading to a blurring of traditional boundaries and a realignment of interests" (Gereffi and Memedovic, 2003). Retailers are competing with manufacturers; branded marketers are adapting, recognizing that overseas contractors can manage the whole production process, restricting their competitive edge to design and brands; branded manufacturers are learning to adjust, supplying intermediate inputs (cut fabric, thread, button and other trim) to extensive networks of offshore suppliers. These networks are typically located in neighbouring low-cost countries with reciprocal trade agreements that allow goods assembled offshore to be re-imported with a tariff charged only on the value added by foreign labour. This international subcontracting system exists worldwide.

A significant countertrend is emerging among established apparel manufacturers, however. They are reducing their production activities and building up the marketing side

of their operations by capitalizing on both brand names and retail outlets. Implications for the governance of a sustainable cotton/textile are examined in Section V.5 below.

China

China's textile and apparel production remains concentrated in small and medium-sized firms in the coastal areas, although this is changing, both as firms move inland in search of cheaper labour, and as larger firms—with advanced forms of supply chain management—become more central. Cao Ning (2005) identifies three kinds of supply chain management that are found in China: vertical integration, traditional purchasing and third-party coordinated.

In vertically integrated supply chains, retailers have internalized the supply chain, at the least owning their own assembly plants, and sometimes achieving additional backwards integration through ownership of yarn and textile factories and even cotton farms. Hong Kong SAR's Esquel Group, "one of the world's leading producers of premium cotton shirts," is an example. Esquel produces its own brands as well as producing for other major labels. Overall, the firm's 47,000 employees manufacture 60 million garments annually, with factories in China, Malaysia, Vietnam, Mauritius, and Sri Lanka, as well as cotton farms and yarn factories. Equel's retail outlets in Beijing, which carries its "Pride" series clothing, provides an example of vertical integration: "From the cotton field to the retail outlet, Esquel is the absolute coordinator" (Cao, 2005). According to its website, "Esquel's vertically integrated operations ensure the highest quality in every step of the apparel manufacturing process. Production begins in Xinjiang province in north western China, where the Group grows its own Extra Long Staple (ELS) cotton and organic cotton, and continues through spinning, weaving, dyeing, manufacturing, packaging and retailing. Esquel's textile and apparel production is complemented by strong product development capabilities. The Group's design and merchandising team work closely with its research and development centre to create unique finishings such as wrinkle-free and nanotechnology performance qualities that consistently give Esquel the cutting edge in the apparel industry" (Appelbaum, 2005).

The second kind of supply chain management, according to Cao (2005), is the familiar traditional purchasing supply chain, in which the retailer contracts with independent manufacturers to produce garments according to specification (original equipment

manufacturer[7]). Either the retailer or the manufacturer can assume responsibility for supply chain coordination. The latter is of special interest, because it signals a shift in control from retailer to manufacturer. Such "vendor managed inventory" is illustrated by the Hong Kong-based TAL Apparel Ltd. TAL Apparel Ltd., founded in 1947 as a single textile spinning mill in Hong Kong, has grown into one of the major apparel manufacturers, incorporating design, logistics, and fabrication. Its global workforce of 23,000 employees, producing annual sales of US$600 million, are found in factories in Hong Kong SAR, Thailand, Malaysia, Taiwan province of China, mainland China, Indonesia, Vietnam, Mexico and the United States. TAL's clients include Brooks Brothers, L. L. Bean, J. C. Penney, Giordano, Land's End, Liz Claiborne, Nautica and Tommy Hilfiger, with the majority of its sales to retailers. TAL accounts for one out of every eight dress shirts sold in the U. S. Its success is attributed to its ability to manage its supply chain efficiently (Koudal and Long, 2005).

The third kind of supply chain management, according to Cao (2005) is the *third-party coordinated supply chain*, in which garment trading companies provide the coordination, oversee quality control and sometimes provide fashion design. The prime example of this is Li & Fung Group, the giant multinational trading company based in Hong Kong SAR, with a staff of 12,000 distributed across 72 offices in 41 countries and territories. Trading companies such as Li & Fung have reportedly become more powerful, taking the lead in supply chain management (Kahn, 2004b; Punngai, 2005). Li & Fung is organized into three core businesses: exporting services, value chain logistics and retailing. Li & Fung Retailing Ltd. operates more than 324 retail outlets in China, Singapore, Malaysia, Thailand, Indonesia and South Korea for Toys 'R'Us, Circle K and Branded Lifestyle. Branded Lifestyle represents major European and U. S. brands in Asia, seeking to establish a consciousness of "brand values" for its clients (these include Salvatore Ferragamo and Calvin Klein, among others).

3.4 A summary of implications for China

A series of characteristics, firstly, and of implications, secondly, can be wrapped up from the above analysis:

[7] Original equipment manufacturer, or OEM, is a term that refers to a situation in which one company purchases a manufactured product from another company and resells the product as its own, usually as a part of a larger product it sells. OEM is the company that originally manufactured the product.

Characteristics 1: On both the production and consumption side, even though trends and figures are highly dependent on policies (production) and standards (consumption), which may change over time, the current trends of key players are rather conservative—players are known.

Characteristics 2: Predictions in the medium term are conservative as well (i.e. no shocks expected) according to USDA, ICAC and most world trade model simulations.

Characteristics 3: The progressive substitution of China's cotton production—and of environmental impacts attached to it—with foreign supply over the next two decades leaves room to net environmental effects of ambiguous scope.

- Indeed, the scope and magnitude of such a net impact depends on policies and growing practices, which in turn depend on local constraints such as land and water availability, across world cotton suppliers.
- If "bad" cases (Uzbekistan, under certain hypotheses) and "good" cases (Africa, under certain hypotheses) emerge rather clearly because of opposite water and chemical use patterns, most other situations can either turn into "good" or "bad" cases with no clear trend at the moment.
- For instance, U. S. agriculture is not very intensive on average: cotton average yields are far lower in the U. S. than in China, Brazil or Australia. As a consequence the negative environmental impacts of cotton are less important in U. S. than in other intensive producing countries.
- In Brazil, discrepancy in growing practices across regions makes average figures very difficult to interpret.

Implication 1: Though a catastrophic scenario of irreversible environmental impacts magnified by a China cotton imports upsurge might not be averted, a more reasonable range of possible scenarios leads to differentiated and contrasted environmental effects of Chinese import-led world cotton production growth. To turn it in another way, if some severe damages may be fostered in particular countries or parts of countries, the emergence of a "global public bad" phenomenon induced by China's cotton imports might not be a central scenario to work on, at least in short- and medium-term.

Implication 2: Global value chain analysis suggests marketing spending (cotton promotion) and technical standards setting (fibre quality) as key drivers of power distribution throughout the cotton/textile chain.

Implication 3: Against this background (no public bad or only at the margin; country-specific impacts depending on policies and standards; standards setting existing schemes and drivers), the social and environmental concerns over cotton/textile production among OECD consumers of textiles and apparel create an appeal for sustainable development standards initiatives, as already observed on various commodity markets. These in turn will depend on China's practices in her own market.

4.0 Environmental Impacts throughout the Chain

To understand the environmental impacts of the cotton textile chain systematically, a supply chain structure will be introduced in this part (Figure 4.1). The spectrum of environmental impacts analyzed here includes the process of cotton planting, cotton textile processing and production, consumption of cotton textile products and the disposal of textile wastes. In this part, examination is made along with the cotton/textile supply chain.

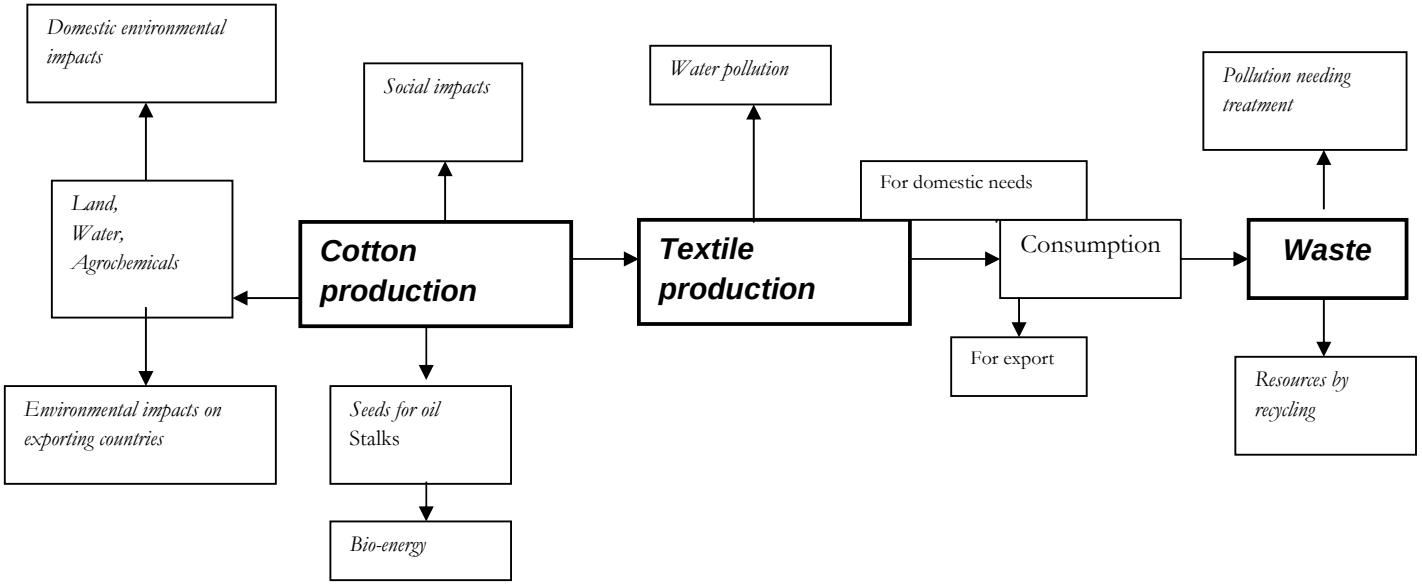
4.1 Supply chain structure

As illustrated in Figure 3.1, there are three main nodes through the supply chain. At the first node, cotton and cotton fibre are the main products. During the process, inputs including land, labour, water and agrochemicals are required, which have clear environmental, economic and social impacts. Besides, there are by-products as well: cottonseeds and stalks. These by-products potentially have positive roles as a source of bioenergy that has a positive effect on climate change mitigation.

At the second node, cotton textile production requires energy, water, dyes and labour inputs, and generates pollution, especially a large quantity of polluted water. In addition, chemical dye is used in this process and the production of dye also has a negative impact on environment.

The consumption node concerns end-users, both inside and outside of China. Its structure is relatively simple. Consumption of textile and apparel is not the end of the lifecycle analysis—wastes have to be considered. Waste can be treated in two ways: discarded, burned or left in a landfill to pollute; or reused and/or recycled as resources.

Figure 4.1: Cotton textile product chain and environmental impacts



Compared with the U. S., the cotton production in China is labour-intensive, scattered and dispersed. Domestic producers work on a small scale generally with a lower level of efficiency and technology. Intensive cultivation makes crops vulnerable to natural risks. The quality of cotton products are on the low side.

Most Chinese farmers are planting individually with a small scale. Eighty-five per cent of the farmers cultivate no more than one hectare of land; the exception is some farmers in Xinjiang Autonomous Region who cultivate more than 4 hectares. However, in developed countries, cotton production is owned and run by large land owners or collective farms. In the U.S., for example, most cotton producers own large parcels of land. Generally, each farmer runs about 2,000 hectares of land, and the cotton area is about 600 hectares (www.amoney.com.cn, 2005).

Small Chinese farmers do not have the scale economy that their U. S. competitors do. After the entry to WTO, most governmental subsidies have been removed and the farmers can only receive technological support and guidance on cultivating plans from the government. In the open market, Chinese farmers are faced with huge risks and opportunity cost.

For the international cotton producers, the characteristics of cotton production and supply vary with the local social and economic systems. In developed countries, cotton production is a capital-intensive industry. The planting areas of big farms are usually hundreds of hectares, which make it easier for them to get subsidies from the government and get credit from banks. In African countries, cotton production belongs to labour-intensive industry. In francophone Africa, the cotton production in the high lands is mainly run by small-scale farmers. Their planting areas are from 0.5 to 10 hectares with the average of 1–1.5 hectares (Li Hongmei, 2005). Since the cotton production industry plays an important role in these countries, the governments set up special research institutions to improve technology and seeds, to construct and improve the infrastructure in rural areas, and to train technicians to improve soil quality and pest prevention. Furthermore, some state-owned companies also provide relevant services to farmers including the supply of agricultural materials and guarantee of purchase.

Since the technology and policy standard vary in different countries, the impacts of cotton production in different countries are also diverse. For example, protective purchasing price leads to more severe competition. Farmers tend to use large quantities of chemical fertilizer and pesticide to get a high yield. The impact on environment and health can be high. And when the governmental policy tends to encourage the production of organic and ecological cotton, the negative impacts on the environment can be greatly reduced.

Cotton is the primary material of the textile industry, and hence, the main demand for cotton is textiles. As the cotton textile industry is labour-intensive with low value added,

most spinning and apparel companies are concentrated in developing countries. Since the domestic cotton output cannot meet the demand of Chinese textile industry, and sometimes the domestic cotton cannot beat quality and price of the import cotton, China keeps importing cotton in recent years.

The Chinese textile and apparel industry mainly are located on coastal areas, especially in Changjiang Delta (Yangtse Region) and Zhujiang Delta, with a new trend towards moving inland. The huge demand of the population of 1.3 billion makes China an immense market for textile and clothing. The overseas markets, including developed countries and developing countries, are massive as well.

4.2 Cotton production impacts

4.2.1 Environmental impacts on cotton production in China

Cotton planting requires significant inputs in the form of arable land, water and agrochemicals such as pesticide, chemical fertilizer, film, defoliants, etc. These inputs can increase yields greatly, but negative environmental impacts such as land degradation, water shortage, non-point source pollution, etc. follow.[8]

Per capita, arable land in China is 0.106 hectares, which is only 43 per cent of the average figure for the world (China Environmental Gazette, 1999). As a matter of food security, there can be no question that feeding its 1.3 billion people, and therefore foodstuff planting, must remain a policy priority for China. Due to land degradation and rapid urbanization, the quantity of arable land in China is decreasing overall, making the additional "pressure" from cotton on available arable land increasingly unsustainable from a food security perspective. One of the major social-environmental impacts of cotton production is the reduced levels of arable land available for foodstuffs.

Cotton production requires vast quantities of water. Based on existing practices, studies estimate that Chinese cotton requires between 5,250 and 9,000 m^3 of water per hectare. The ration of irrigating is 2,550 to 3,600 m^3 per hectare in average year (Wang Derong, 2001). Since most cotton planting areas are concentrated in the dry and semi-arid areas to the north of the Yangtze River, Chinese cotton production has a tendency to place a heavy burden on scarce water resources in the region. Moreover, the high water consumption levels of Chinese cotton production increases the cost dramatically for the farmers. In the Bukesaier Borough of the Xinjiang Autonomous Region, cotton production has adopted a water ration system. In Xiazigai County and Shituoluogai County for example, the water ration is 200 m^3 per mu[9] in winter and 370 m^3 per mu in summer at the ration price of RMB 0.065 per m^3, while the price for the excessive usage of water is RMB 0.12 per m^3. In practice, the ration is basically enough for the fields

[8] Since it focuses on environmental impacts of cotton production, the analysis will only consider the material input, without regard to the input of labour and machine.
[9] Land area measurement unit commonly used in China. 1 ha = 15 mu.

above average in quality, while fields that are worse than average have to use up to 700 m^3 water per mu of high-priced water.

In Chahete Ecological Agriculture Exploitation District, south of Xinjiang, the normal price of water is RMB 0.125 per m^3, while the high price is RMB 0.195 per m^3, so the expenditure of water per mu reaches RMB 90, accounting for 10 per cent of the total input. In these areas, the cotton producers should construct the agricultural infrastructure; use new irrigating technology; exploit anti-seeping and anti-leaking irrigating systems; try drip irrigation, spray irrigation and micro-irrigation modes; irrigate at nights and so on, to improve the efficiency of water usage and reduce production cost. The town of Wuluquele in Awati County, Xinjiang built a model project—2,100 mu high standard cotton fields of dripping irrigation. The project reduces seeping and leaking, and avoids evaporation through laying ramose pipes above the land. Data displays that 150 to 200 m^3 water can be saved per mu, which is about 20 per cent of normal irrigation and it also helps to save labour by 30 per cent (Statistic Bureau of Xinjiang Production and Construction Formation).

Conventional cotton production takes advantage of the achievements of the chemical industry, such as chemical fertilizer, plastic film, pesticide, herbicide, defoliant, etc. These chemicals strengthen people's managing capability over cotton production, and have an important effect on improving the growing conditions in inferior cotton planting areas and increasing yields. However, the chemicals accumulate into poisonous substances in the soil annually, degrading soil quality and polluting the environment at the same time (Xu Wei, 2000).

The use of plastic film can effectively raise soil temperature, restrain the salinity and optimize the ecological environment. However, due to lack of plastic film recycling technology in planting areas, the large quantity of used plastic film (three kilograms per mu) destroys the soil structure and degrades soil quality. Meanwhile, the poisonous substance generated by degradation of film may clog the growth of root and reduce the output. The used film, without recycling, leads to white pollution that seriously affects the environment.

Cotton is the single most important source of pesticide use in China. According to statistics, the chemical pesticide used in cotton production accounts for 30 to 40 per cent of what is used in all crops. However, the effective utilization rate of pesticide is just 10 to 30 per cent; of the rest, 20 to 30 per cent enters into the atmosphere and water system and 50 to 60 per cent is left over in the soil (Li Fuguang, 2005). A virulent pesticide can prevent cotton diseases and insect pests, but it can also kill beneficial animals and the natural enemies of pests, which leads to reduced biodiversity and, ironically, may lead to still more severe damage by insect pests. The leftover pesticide in soil can be absorbed by crops, and be harmful to humans. It is estimated that one kilogram of pesticides is needed in cotton production per mu. Genetically modified organism (GMO) cottons,

such as Zhongmian 29, 30, 31 and 32, have a distinct insect-resistant capability and can reduce pesticide pollution (Liu Xiandong and Zhai Baoping, 2002), but may also have negative impacts on biodiversity.

Cotton growth requires a large amount of fertilizer input. In China, the effective utilization rate of chemical fertilizer is only 30 per cent. The other 70 per cent, evaporates into the atmosphere or leaks into the soil and water system. Currently, cotton production requires 110 kilograms of fertilizer per mu. Frequent use of synthetic fertilizer can lead to the eutrophication of water areas and excessive nitrate levels in drinking water. At the same time, inefficient use of fertilizer may harden the soil, degenerate the quality and lower its productivity. Some experts predict that if China does not exploit organic cultivating methods and promote environmentally friendly forms of cotton, the soil may not produce cotton by the end of the twenty-first century. To avoid the negative impacts of chemical fertilizer, China should carry on the research and expansion of technology to improve the effective utilization rate. If the effective utilization rates can reach 45–50 per cent, the amount of usage can be reduced substantially (Zhou Shudong, 2001).

Leftover pesticide and fertilizer contaminates soil, water and atmosphere. Toxic chemical elements and biological pollution in soil can affect the product, which can harm human health through food and drinking water.

Meanwhile, the chemical plants that produce fertilizer, plastic film and pesticide not only consume a great deal of resources and energy, their emissions are also apt to lead to acid rain, water eutrophication and contribute to the greenhouse effect. If the current cultivating methods cannot be radically improved, cotton productivity will continue to decrease while producing increasingly serious environmental consequences.

4.2.2 Environmental impacts on cotton-supplying countries

Since China does not have the advantage of large scale agricultural production, China's cotton production can be expected to decline in the future—at least under current small-scale production practices. This trend is particularly likely in light of the priority that must be granted to food crops in the place of cotton production to feed China's growing population. As such, cotton imports will be increasingly critical to the ongoing sustainable development and maintenance of the Chinese textile industry.

Though cotton imports will reduce our foreign exchange reserve and cut down the domestic employment, it can alleviate the pollution and deterioration of the environment caused by pesticides and fertilizer, and will have a positive impact on sustainable development in China to some extent. The cotton import has two positive impacts on environment in China: on the one hand, the reduction of the cotton planting area decreases agrochemical usage; on the other hand, the lower price of imported cotton makes the farmers reluctant to use fertilizer and pesticide to increase output. Nevertheless, if the cotton imports to China stay at the present large scale, they will have

an obvious impact on the international market. And they will also mean a series of environmental problems in the exporting countries.

Cotton production has inevitable negative impacts on environment. But due to different natural resource conditions, environmental policies and technology in different countries, the environmental impacts of cotton production vary accordingly (Table 4.1; ICAC, 2005). Consequently, the impacts of China's cotton imports vary depending on the country from which it is sourced.

Cotton grown in the developed countries, such as the U. S. and Australia, two of the most important source countries for Chinese cotton imports, has to meet high environmental standards, apply advanced processing techniques and planting technology. Importing from such countries therefore has a lower per-kilogram environmental impact than cotton produced in China. An increase in imports from the U. S. and Australia can therefore be expected to lead to net reductions in the overall impact of the global cotton/textile supply chain by leading to lower impact replacement of Chinese cotton.

Across many of the poorer cotton producing countries in Western Africa, on the other hand, production is marked by a complete absence of sophisticated production. Although the low level of technological inputs used in Western Africa leads to persistently low per-hectare yields (and therefore potentially high per-volume environmental impacts), the climatic conditions allow for rain-fed production, which effectively eliminates one of the main sources of environmental degradation arising from cotton production (Li Hongmei, 2005). Moreover, due to the low density of cotton production, less chemical fertilizer and pesticide and lower machinery use, cotton produced in the Western African region has very low environmental impact. Perhaps even more importantly, cotton exports are all-important for the economy and employment in the Western African region. Across Benin, Burkina Faso, Mali and Chad for example, cotton production, depending on the country, accounts for between three and six per cent of their GDP, which in turn accounts for 50 to 70 per cent of all agricultural income, and 20 to 37 per cent of total agricultural export value (Tian Caiyun, 2005). Besides, 95 per cent of their total output of cotton is exported, which provides higher rates of employment, directly and indirectly. The importance of cotton production as a source of foreign currency and employment across the Western African regions is critical in the social and economic development of the area.

Table 4.1 Description of conventional cotton production practices in the main cotton producing countries

Main cotton producers	**Size of the exploitations (manual /mechanised production)**	**System of irrigation if irrigation is used (and management of water resources in general)**	**Quantity and toxicity of pesticides, fertilizers and defoliants used**	**Erosion of soils (and every other phenomenon leading to lower yields)**	**GMO cotton**
China	Farmers are cultivating very small pieces of land: all the exploitations measure less than 6 H (average size of parcels used to grow cotton: 0.3 H). Cotton is grown manually.	Cotton production is irrigated. Irrigation: - flood: 90 per cent - furrow: 5 per cent - drip: 3 per cent - sprinkler: 2 per cent.	Fertilizers: - N: 225 to 300 kg/H - P: 50 to 150 kg/H - K: 100 to 220 kg/H Pesticides: Approximately 20 sprayings per season on average. Among the most widely used pesticides: - 1 very hazardous - 3 moderately hazardous - 3 slightly hazardous - 2 unlikely to present acute hazard Defoliants: Used on 5per cent of cultivated lands. The most widely used is slightly hazardous.	Yields are very high: 1200 kg/H of cotton lint on average. Nature of cultivated soils: - sandy loam: 60 per cent - clay: 30 per cent - sand: 10 per cent Rotation cycle with wheat is common (1 year cotton 1 year wheat).	66 per cent of cotton fields are GMO.
USA	Farmers own very big farms: all the exploitations measure more than 100 H (average size of parcels used to grow cotton: 1200 H).	Approximately 40 per cent of cotton fields are irrigated. Irrigation: - flood: 50per cent - sprinkler: 50per cent The sustainable / unsustainable	Fertilizers: - N: 100 kg/H - P: 90 kg/H - K: 80 kg/H Pesticides: 25 per cent of pesticides are used in cotton production whereas it is only cultivated	Yields are high: 960 kg/H of cotton lint on average. Mono cropping (no rotation).	80 per cent of cotton fields are GMO.

		management of water resources is very different from 1 region to another and data are missing.	on four per cent of the agricultural lands. Pesticides used are scoring from "highly hazardous" to "unlikely to present acute hazard depending from the way they are applied." Defoliants: Used on 70 per cent of cultivated lands. The most widely used are slightly hazardous or unlikely to present acute hazard.		
India	Generally farmers are cultivating small exploitations: 90 per cent of parcels used to grow cotton measure less than 6 H and only two per cent more than 20 H (mostly in the North of the country)	Approximately 30 per cent of cotton fields are irrigated.	Fertilizers: 50 per cent of cotton fields are fertilised with farm yard manure, 30 per cent with chemical pesticides and 20 per cent are not fertilized. - N: 85 to 100 kg/H - P: 30 to 50 kg/H - K: 0 to 50 kg/H Pesticides: Approximately eight sprayings per season on average. Among the most widely used pesticides: - 2 highly hazardous - 6 moderately hazardous - 2 slightly hazardous	Yields are very low (the lowest among the main cotton producing countries): 429 kg/H of cotton lint on average. Nature of cultivated soils: - black soil: 50 per cent - loamy soil: 25 per cent - red soil: 15 per cent In the smallest exploitations cotton is part of a mixed cropping system.	10 per cent of cotton fields are GMO.

			- 1 unlikely to present acute hazard Defoliants: Not used.		
Pakistan	Generally farmers are cultivating quite small exploitations (average size of parcels used to grow cotton: 2 H): 95 per cent measure less than10 H.	Cotton production is irrigated. Irrigation: - flood: 70 per cent - furrow: 30 per cent	Fertilisers: 13per cent of the fields are fertilised with farm yard manure, 87per cent with chemical fertilisers. - N: 75 to 150 kg/H - P: 40 to 50 kg/H - K: 25 to 50 kg/H Pesticides: Among the most widely used pesticides: - 1 highly hazardous - 5 moderately hazardous - 4 slightly hazardous - 2 unlikely to present acute hazard Defoliants: Not used.	Yields are correct: 780 kg/H of cotton lint on average. Nature of cultivated soils: 75 per cent: silty loam 80 per cent of cotton is in rotation with wheat (1 year cotton, 1 year wheat).	Licensed GMO cotton is not authorised in Pakistan (the State is developing its own varieties).
Brazil	Cotton growing practices are very different between regions. There are three main regions which do represent the wide range of the different practices: - Mato Grosso: exploitations from 800 to 3000 H (more than 50 per cent of the national production) - Parana: from 15 to 250 H - Paraiba: from 1 to 50 H (production volume is very low)	Practically no cotton is irrigated.	Fertilizers: - in Mato Grosso (intensive cropping practices): - N: 180 kg/H - P: 120 kg/H - K: 220 kg/H - in the other regions: Only 50per cent of farmers are using synthetic fertilizers. - N: 30 kg/H - P: 60 kg/H - K: 40 kg/H Pesticides:	In Mato Grosso cotton is in rotation with soy (1 year cotton, 1 year soy). Yields are very high: 1290 kg/H of cotton lint on average. In the other regions yields are much lower: 370 kg/H of cotton lint on average. Rotation schemes are much more	The Brazilian government authorised GMO cotton in 2005.

	Thanks to mechanisation and large scale economies Brazil will probably expand cotton production in Mato Grosso. Since we are doing in a (quite) long term analysis, particular attention has to be paid to data of this region.		Among the most widely used pesticides: - 1 highly hazardous - 6 moderately hazardous - 1 slightly hazardous - 2 unlikely to present acute hazard Defoliants: The most widely used is slightly hazardous.	complicated. Natures of cultivated soils: 50 per cent oxisoils	
Uzbekistan	Data concerning this country has to be handled with an extreme care (especially when it comes to yields). - 10 per cent of the exploitations measure less than 6 H - 40 per cent measure between 6 and 20 H - 5 oper cent between 20 and 100 H But there is a partial reform of the agricultural sector underway resulting in a noticeable decrease of the average exploitations size.	97 per cent o cultivated lands are irrigated. The Aral Sea has long been and still is the theatre of massive environmental damages directly linked to cotton production and unsustainable use of water resources.	Quantitative data concerning the (over)use of pesticides and fertilizers is not available. Defoliants are applied on 75 per cent of cultivated lands.	Since the 1980s, cotton production dropped from 50 per cent (Aral Sea disaster).	No GMO cotton
West Africa	The 3 main cotton producing countries are Benin, Cameroon and Mali. Farmers are cultivating very small exploitations: almost all of them measure less than 6 H (average size of parcels used to grow cotton: 1 H in Benin, 3 H in Cameroon and 5 H in Mali). Almost all cotton is grown manually.	Practically no cotton is irrigated.	Fertilizers: In Benin and Cameroon farmers are using almost exclusively synthetic fertilisers. Benin: - N: 74 kg/H - P: 46 kg/H - K: 28 kg/H Cameroon: - N: 42 kg/H - P: 27 kg/H	Yields are low: - 500 kg/H of cotton lint on average in Benin - 580 kg/H in Cameroon - 430 kg/H in Mali Nature of cultivated soils: - sandy loam soils in Cameroon - clay soils and	No GMO cotton

			- K: 24 kg/H In Mali 40 per cent of farmers are using farm yard manure. For the 60per cent others: - N: 44 kg/H - P: 33 kg/H - K: 18 kg/H Pesticides: Among the most widely used pesticides: - 2 moderately hazardous - 6 slightly hazardous - 2 unlikely to present acute hazard Defoliants: Practically not used.	sandy clay grits in Mali	
Turkey	Farmers are cultivating small- or middle-sized exploitations: - 50 per cent measure less than 6 H (mainly in the South) - 20 per cent measure between 6 and 20 H - 3 0per cent between 20 and 100 H (mainly in the South West)	In the South (20 per cent of production) cotton production is irrigated. In the West and South West precipitations are more abundant and as a consequence these regions depend less on irrigation. But only 8per cent of cultivated lands are not irrigated Irrigation: - flood: 9 per cent - furrow: 78 per cent - sprinkler: 5 per cent	Pesticides: Among the most widely used: - 6 moderately hazardous - 4 unlikely to present acute hazard Defoliants: Practically not used.	Yields are very high: 1330 kg/H of cotton lint on average varying from 1600 kg/H in the South West to1289 kg/H in the South Nature of cultivated lands: - in the South - 60 per cent entisola fluvent soils - 40 per cent vertisols - in the South West and West - 70 per cent alluvial soils - 30 per cent vertisols Generally cotton is in	Officially there is no GMO cotton in Turkey. In reality the share of GMO cotton is not known.

				rotation with wheat and maize in small exploitations.	
Australie	Farmers own very big exploitations: they all measure more than 100 H (average size of parcels used to grow cotton: 800H). Practically everything is mechanised.		Fertilisers: - N: 200 kg/H - P: 80 kg/H - K: 45 kg/H - 5 moderately hazardous - 2 slightly hazardous - 3 unlikely to present acute hazard Defoliants: Fields are sprayed with a defoliant unlikely to present acute hazard.	Yields are extremely high (the highest among the main producing countries): 1760 kg/H of cotton lint on average. Cotton is grown on the same parcels every year. .	80 per cent of cotton fields are GMO.

Central Asian countries such as Uzbekistan show specific features. These countries have dry or semi-arid climates, similar to Xinjiang of China, suitable for cotton production. Its quantity of degree-days is somewhat less than Xinjiang, but rainfall is more. Most of Uzbekistan cotton land relies on irrigation (Lanlan, 2007). Because the cotton production there uses a large quantity of defoliant, the large scale production of cotton will deteriorate its water shortage and local ecological system. If China imports cotton from these countries, it will have a negative impact on the local environment. Comparatively speaking, however, the negative impact of cotton production in central Asia may be less than in China.

Whichever country China imports cotton from, the exporting country can gain benefits from its cotton export and increase their financial capacity for environmental protection. The environmental impacts on the exporters can be positive or negative, but on the perspective of the global environment, the impacts might be assessed as positive.

A Chinese strategy to import cotton can alleviate the pressure on environment caused by cotton production. But if China over-depends on import, the fluctuation of international cotton price may seriously harm the Chinese textile industry.

4.3 Printing and dyeing processes

The Chinese cotton textile and clothing industry is still defined principally as a high input, low output, heavy pollution, low-safety sector. As such, the recently massive growth of the sector has come at the cost of enormous resource use and environmental destruction.

The pollution from textile printing and dyeing includes two aspects: first, the process of dye production consumes energy while generating air and water pollution; second, the process of dyeing itself consumes energy and generates waste water containing poisonous substances, etc. Here, we only consider the negative impacts on the environment during the process of printing and dyeing itself.

The textile printing and dyeing industry is one of the biggest water consumers in China. The water usage of the textile industry in China is about 191 tonnes per RMB10,000 production value, which is higher than the national average. In the printing and dyeing industry, the water usage is three to five tonnes per 100 metre cloth, which is two to three times that of the international level. The coal usage for printing and dyeing for 10,000 metre cloth is about 1.8 times the international advanced level. According to 2003 statistics, the waste water discharge of the textile printing and dyeing industry ranks fifth of all the industries in China, with a total discharge of 1.413 billion tonnes. This number accounts for 7.5 per cent of the total waste water discharge of industries, and the recycling rate is less than 10 per cent. Of this 1.413 billion tonnes of waste water, 1.13 billion tonnes are from printing and dyeing. After China's entry into WTO, the output of the Chinese textile industry has developed rapidly, and waste water has increased accordingly. The fact that the recycling rate of waste water in printing and dying is currently extremely low suggests that there is also a considerable opportunity for reducing the negative impacts of the sector within China through improved water management, planning and recycling.

In the meantime, traditional textile printing and dyeing generates a large quantity of waste water, which has a complicated composition with high chroma and a sharp fluctuation of pH. The waste water is difficult to process through the normal biological method. The discharge of COD in textile printing and dyeing ranks the fourth of all industries and it is still on the rise. From 1998 to 2003, when COD discharge is going down in paper making and food industry year by year, the COD of textile printing and dyeing industry, as well as chemical industry, was going in the opposite direction. The COD percentage of textile printing and dyeing industry has increased from 4.7 per cent to 5.6 per cent in five years.

Since the standards of waste emission vary across regions (though the national standard is equal for all regions, many local governments allow companies to emit waste beyond the limit to attain a higher local gross domestic product [GDP]), and the skills and technology are also diverse in companies, it is difficult to obtain credible data that reflect the real pollution profile before and after the printing and dyeing processes. Therefore, in our quantitative analysis, we will take the Standard II in the HJ/T185-2006 Textile Industry (Dyeing and finishing of cotton) Cleaner Production Standard[10] as our analytical standard.

[10] This is an industrial standard divided into three levels. Level 1 is the strictest discharge standard, while level 3 is the lowest. In some

Table 4.2 the Index Standard of Clean Production of Textile Industry

	Index	Standard 1 (International Clean Production Advanced Level)	Standard 2 (National Clean Production Advanced Level)	Standard 3 (National Clean Production Fundamental Level)
1	Water (tong/100 metre cloth)	≤2.0	≤3.0	≤3.8
2	Electricity (kilowatt-hour/100 metre cloth)	≤25	≤30	≤39
3	Coal (kilogram/100 metre cloth)	≤35	≤50	≤60
4	Waste water generated (ton/100 metre cloth)	≤1.6	≤2.4	≤3.0
5	COD generated (kg/100 metre cloth)	≤1.4	≤2.0	≤2.5

According to HJ/T185-2006 Textile Industry (Dyeing and finishing of cotton) Cleaner Production Standard, in following chapters, we will take Level 1 as the "International Cleaner Production Advanced Level Standard" for assessment internalization of environmental cost.

In addition, textile production generates noise and dust pollution, which have serious, harmful effects on workers. For example, cotton textile plants use large quantities of shuttle looms, which cause noise levels as high as 90 to 100 db, exceeding the highest safety limit of 85 db.

4.4 Cotton by-products and textile waste

At the first node of the cotton supply chain, cotton and fibre are main products. However, in producing the main cotton outputs, significant quantities of by-products are also generated in the form of seeds and stalks. Through the strategic use of these by-products, additional economic benefits can be secured by cotton producers, while leading to an overall reduction in the environmental burden generated by cotton production more generally.

Cottonseeds can be used to produce oil, while the stalks can be used as organic fuel, which can lead to a decrease in CO_2 as compared with petroleum products. The ashes of burnt cotton stalks can also be used as potash fertilizer. It is estimated that every tonne of cotton lint can generate 1.6 tonnes of seeds. Cottonseed oil, cottonseed cake and the cottonseed hulls, all products of the cottonseed, have extensive uses. Cottonseed oil is one of the main edible oils in China, and is also a chemical material for soap and paint. Cotton hulls can produce pyromucic aldehyde, sodium acetate,

developed regions in China, level 1 is adopted, but in most other regions level 3 is in use.

alcohol, acetone, phytohormone etc. After watersoaking and sterilizing, cottonseed hulls are the most economical substrate for mushroom, fungus, agaric and hydnoid production. The cottonseed cake contains abundant protein. Once the toxic gossypol is removed, it can be made into a concentrated protein, artificial milk powder, artificial meat, etc. (Song Anjun, 2006). At present, cottonseed cakes are mainly used as organic fertilizer and animal feed.

The main use for cotton stalks is as a source of energy. Cotton stalks can be burned directly for heat or used to generate electricity indirectly. If, according to statistics, every 100 kilograms of lint can yield 400 kilograms of stalks (Zhao Xiaoyi, 2004), then the total annual output of six million tonnes of lint is 24 million tonnes of stalks each year. Each kilogram of stalks has 4,000 kilojoules of energy (Shi Xiaojing, 2005); a tonne of standard coal has 7,000 kilojoules. If all the cotton stalks in China transformed into energy, it could result in a savings of 13.7 million tonnes of standard coal. Compared with the fossil fuel combustion, the burning of cotton stalks produced lower levels of CO_2. Meanwhile, the ashes of the burnt stalks can be used as organic fertilizer, leading to still further environmental benefits.

While the efficient use of cotton stalks can have many environmental benefits, standard practice in China at present involves the open air burning of stalks resulting in lost energy and increased air pollution associated with cotton production.

Similarly, by-products from the textile production stage of the supply chain, such as used and waste textile scraps, can potentially reduce cotton production requirements by recycling fibres for reuse in textile production. Waste textile can also be processed into wrappers and composite floor board.

Large quantities of Chinese produced textiles and clothing are unnecessarily disposed of each year—both within China and globally.[11] Recycling and reusing textiles and apparel waste could be a new method to alleviate the material shortage.

4.5 International impacts

The United States

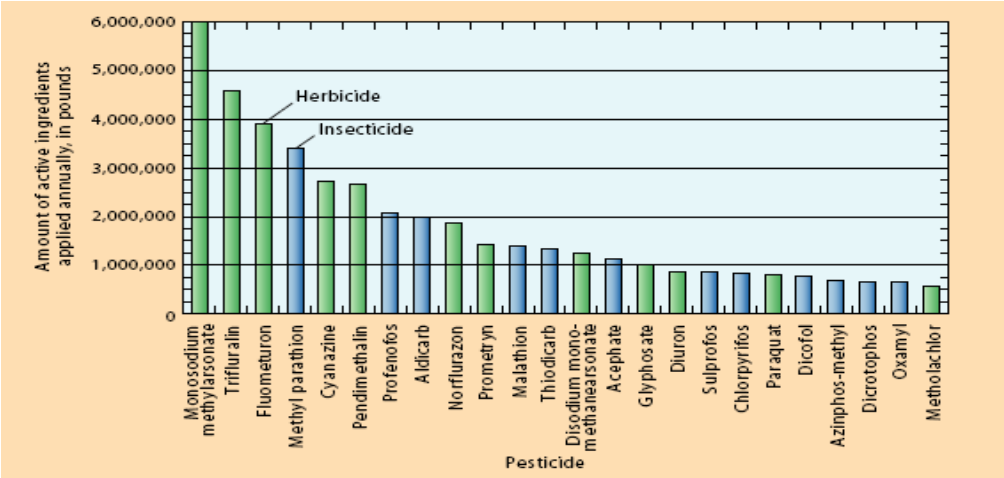
The cotton belt includes the states of Arkansas, Louisiana, Mississippi, Texas, Arizona, and California. Lesser amounts of cotton are grown in the states of North and South Carolina, Georgia, Alabama and New Mexico. These eleven states make up an area known as the "cotton belt." Along the cotton belt, there are five "hot spots" of cotton production: the Mississippi Delta, the high plains of West Texas, the southern tip of Texas, the arid desert region of Southwest Arizona and the Southern Valley of California. These hot spots are in vastly different climatic regimes, exhibiting different precipitation levels, weed pressures and runoff and leaching potentials. Because of these considerations, the types of herbicides used and environmental impacts vary considerably.

[11] www.stdaily.com/gb/misc/2007-03/11/content_647308.htm,2007

As a general rule, cotton production in the U. S. implies significant use of pesticides. The most concentrated use of pesticides is found in Louisiana and Mississippi where humidity and heat also provide an optimal climate for the boll weevil—one of cotton's most persistent pests. Pesticide use in cotton production is approximately three to five times greater per hectare than applications of pesticides to corn and soybean in the U. S. The intense application of pesticides to cotton is one of the most important environmental issues affecting both water and soil quality.

The first regional study of pesticide use in the cotton belt is that launched by the U. S. Geological Survey (USGS) Organic Geochemistry Research Group in the late 1990s, which specifically investigates the use and transport of agricultural chemicals in the environment. Their original research focused on the Mississippi Embayment, which is a major cotton producing area. The area consists of parts of Arkansas, Kentucky, Louisiana, Mississippi, Missouri and Tennessee. The ranking of major pesticides used is in this region is similar to national usage levels (Figure 4.2).

Figure 4.2: Cotton pesticide usage in the United States, 1990–93



Source: Thurman, Zimmerman, Scribner and Coupe (1998)

In general, cotton pesticides are slightly soluble in water from 0.3 to 1,000 mg/L. Further, experience from studies in the corn and soybean growing areas of the U. S. indicates that in water solubility greater than 5mg/L, compounds are readily carried by surface runoff and occur in surface water.

The USGS survey detected the presence of pesticides and their metabolites, as well as herbicides in the surface water of the Mississippi Embayment. Among the major herbicides detected, three have water solubility greater than 5 mg/L. The most frequently detected insecticide (Dicrotophos) is extensively used in the U. S. and found to be highly soluble (1,000 mg/L). Of the organochlorine insecticides that were detected, endosulfan was detected most frequently and in the highest

concentration. Work with other measuring devices show that DDT and other organochlorine insecticides are present in surface water at detectable levels (Bastian et al., 1997). Endosulfan is now the only organochlorine that can be used legally in U.S. cotton-growing areas.

The significant presence of pesticide residues in surface water has led the cotton lobby to react vigorously. Cotton Incorporated, for instance, displays a "Proven Track Record on U.S. Cotton & the Environment" on its website (www.cottoninc.com). According to the Cotton Incorporated site, due to the extensive use of GMO varieties and tighter environmental legislation, cotton no longer poses significant threats to the environment in the U. S., at least as compared to other U. S. agricultural crops.[12] While it is true that the environmental impact of U. S. cotton is significantly lower than it was under older production conditions, high irrigation requirements suggest that cotton nevertheless places an important burden on the environment, and certainly more of a burden than many West African cotton-producing countries that use rain-fed systems.

West Africa (Mali)

In the early 1960s, cotton culture in francophone Africa spread over 600,000 hectares. At the time of the initial establishment of cotton production in Africa, yields were below 300 kg/ha. Today, cotton acreages amount to two million hectares; three quarters are located in West Africa, with yields exceeding one tonne per hectare on average. Surface expansion growth rate has been roughly 3.5 per cent per year during this period, with yield growth averaging five per cent to the end of the 1980s. Yields in the African regions are currently stable. Due to the socio-political context of agricultural production in West Africa, as well as the high levels of rainfall, cotton grown in West Africa has the potential to provide substantial sustainability benefits as compared with other, more intensive production regions such as the U. S., Australia and Central Asia. The principal factors providing for this potentially advantageous result are as follows:

- In terms of land area, food crops still account for the vast majority of West African agricultural production. With 70 to 80 per cent of all agricultural land committed to food, cotton is rarely produced as a solitary monoculture crop, but instead as a rotating crop with various food alternatives. The share of food crops amount to between 70 and 80 per cent of cultivated land area. The diverse production systems in West African countries promote soil health, productivity and biodiversity—all key components of sustainable cotton production.
- As far as intensification is concerned, which is the key determinant of cotton yields and returns, some points are to be kept in mind in the West African context:
    - cotton in West Africa is a rain-fed crop;
    - mechanization is very limited and restricts to soil preparation and crop maintenance, with small material (animal traction) and surfaces (less than 1 ha on average);
    - the levels of fertilizers and pesticides are far below current levels in OECD countries, and particularly the U. S. (see Table 4.3)

[12] "More importantly, with the advent of new technology, the number of pesticide applications has dropped dramatically in the United States. Farmers who live and work on their land have every personal and economic incentive to use FEWER chemicals in production, not more! Globally, only 8.5 per cent of all pesticides applied to crops are used to grow cotton" (Cotton Incorporated).

Table 4.3: Cotton growing practices in several countries

	China	US	Brazil		Mali
			Mato grosso	Other Brazil	
Fertilizers					
N (kg/ha)	225 to 300	100	180	30	44
P (kg/ha)	50 to 150	90	120	60	33
K (kg/ha)	100 to 220	80	220	40	18
Pesticides					
Spray per season	20	6*	8**		5
Hazardous	6	wide range	8		8
Defoliants					
% cotton area	25	60	20		
Hazardous	Slightly	Slightly	Slightly		Almost nil
GM					
% cotton area	66	76 (2004)	20		0

* GM cotton (Monsanto figures)
** Integrated Pest Management (IPM)
Source : Guérin (2007) after Icac.

- The semi-intensive cotton-growing practices found in West Africa can play a decisive role in the long term sustainability of agricultural production systems by promoting the use of more effective seed selection, crop rotation, crop maintenance and crop protection through phytosanitary treatments.

The main determinants impacting Africa's ability to sustainably increase its cotton production and exports to China will be fertilization capacity and phytosanitary protection capacity. The former will determine whether or not West African nations can improve yields sufficiently to meet growing Chinese demand while the latter will determine whether or not African growth in cotton production is possible along a trajectory that is sustainable over the longer term.

Fertilization

The degradation of soil fertility by continuous cropping is a well known and a growing problem for rural agricultural producers. For the most part, soil degradation is due to a progressive depletion of soil nutrients and to organic imbalances, which in the long term, destroys soil integrity. Holistic farming techniques using a combination of chemical and organic fertilization as well as basic anti-erosion practices can reduce the environmental impact of cotton substantially. The implementation of such practices however, faces serious economic constraints.

Today, chemical fertilization is the most predictable, practical and profitable way to improve yields and ensure soil fertility for rain-fed crops. In combination with crop rotation, periodic liming and organic fertilization, it can stabilize and restore soil health. This combined system of soil maintenance is widespread in cotton cultivation in West Africa and indirectly benefits the whole rotation system through cotton-grains rotations. With 400,000 tonnes distributed to cotton societies

per year, this makes up to 90 per cent of fertilizers consumed in savannah areas for all crops. The volumes used per hectare remain modest however, with about 70 units of active fertilizer ingredients spread per hectare on average.

As a consequence, fertilizers used for cotton are deemed insufficient to make up for mineral losses and cannot compensate for the degradation of savannah soil fertility. From an environmental perspective, the problem in West Africa does not reside in excess fertilizer use (as in the U. S.), but rather in under-use of mineral fertilizers. Table 4.1 details the fertilizer gap currently present in Mali and West Africa more generally.

Calcareous and magnesium crops, interventions designed to curb soil acidification under continuous cropping, remain fairly marginal in West Africa. Organic fertilization, which is indispensable to complement chemical fertilizers, remains poorly developed, even if some progress has been made over the last decade in historical cotton zones such as Koutiala and Sikasso in southern Mali where land pressure is the highest.

Although there is definitely room for improvement, the environmental risks are deemed highly manageable for West Africa to improve cotton yields. Environmental constraints in West Africa are much less restrictive than current policy and market constraints. Indeed, state-owned cotton companies, such as the Compagnie Malienne pour le développement des textiles (CMDT), which organizes fertilizer and pesticide distribution and pre-financed cotton campaigns with minimum guaranteed prices, are now bankrupt, while privatized companies in other countries face efficiency losses because of crippling market failures.

Phytosanitary protection

Phytosanitary protection by chemical means has potentially devastating environmental effects, though it remains an indispensable means to grow cotton in tropical areas. Traditional knowledge, which is efficient to protect crops once harvested, is powerless against parasitic attack in fields. Without chemical phytosanitary protection, it will be difficult to pursue profitable cotton production in West Africa. The main challenge, then, will be to ensure such protection in a sustainable manner.

To date, at least in francophone Africa, phytosanitary protection has been implemented with decent cost-efficiency ratios for cotton growers. Pesticide consumption did not grow and even slightly declined over last years. The fact that state-owned cotton companies controlled the selling and marketing of pesticides has constrained the proliferation of unreliable middlemen with a history of pushing dangerous products and promoting the overuse of pesticides. Counter-examples can be given by Thailand and some Central America countries where cotton production collapsed because of pesticide overuse and pest resistance. In the sample of countries examined, Mali is the best-ranked in term of pesticides spray per season (Table 4.2). All pesticides detected in surface water are

below the quantification limits of measuring devices (Table 4.4, to be compared with U. S. case above).

Table 4.4

Pesticides detected	Samples below the quantification limit[2]		Samples above the quantification limit		Range concentrations (µg/L)
	Number	%[3]	Number	%	
Lindane	1	12	0	0	ND[4]-(<QL[5])
Endosulfan I	6	75	0	0	ND-(<QL)
Endosulfan II	5	62	0	0	ND-(<QL)
Endosulfan sulfate	4	50	0	0	ND-(<QL)
Dieldrin	1	12	0	0	ND-(<QL)
P,p-DDD	3	37	0	0	ND-(<QL)
P,p-DDE	6	75	0	0	ND-(<QL)
Atrazine	1	12	1	12	ND-1.4

[1]n = 8 water samples analyzed.
[2]Samples residues were detected below the quantification limit, therefore residues were not quantified.
[3]Percent of samples.
[4]ND = Not Detected.
[5]Quantification Limit (QL) is 0.1 µg/L for all pesticides detected in water except atrazine (1.1 µg/L).

Source: Berth, Cobb, Mullins (2007)

The risk of pesticide resistance is nonetheless growing in West Africa where the rise of periurban farming significantly increases pesticide use without control.

Overall, the environmental balance of cotton growing in West Africa shows that an integrated commodity chain with centralized control of pesticide has lead so far to a relatively quick and relatively balanced development of cotton production, all the more so we compare it with other cash crops in the region such as groundnut, rain-fed rice, yam, and with cotton in other developing countries. It notably contributed to curb sanitary protection-induced pollutions and land degradation.

The sustainability of cotton production in West African countries cannot simply be assumed. A list of comprehensive policy measures has been identified by French experts, which includes land tenure rights, fertilizer subsidies for farmers, improved food marketing techniques, the application of anti-erosion practices and livestock development among growers.

Direct interviews in Mali convey the idea of very slight support in this direction so far. Chinese buyers describe themselves as "doing business," hence, being sensible to cotton quality and price, but rather indifferent to the origin country of the cotton purchased through international traders and brokers.

No momentum for a China-West Africa cooperation deal on cotton at the moment

Cotton is not a strategic product for China in West Africa when compared to oil and minerals. Our interviews among Chinese and Malian in Bamako (Mali) suggest that there is no political will from China to make cotton a priority in trade and investment in this region.[13] We could, for instance, imagine that China would decide to grant zero-tariff access to West African cotton in China. China imports 190 products without any duty from Africa's least developed countries, Mali included. Still, the cotton does not appear in such product lists, and no discussion seems to be planned on this issue. American subsidies are denounced eloquently but no initiative is actually taken for their removal by China, mainly because China is the primary beneficiary of U. S. cotton subsidies, having hence more to lose than to win from their removal.

In the same line of thought, the cotton commodity chain in West Africa is not supported by Chinese cooperation at the moment. During every meeting between Chinese and Malian officials, the issue of Chinese overseas development assistance to the cotton/textile commodity chain is emphasized. Mali is expecting China to invest in companies processing cotton and textile so as to export "Made in Mali" apparel and clothes.[14] But so far, investment and support fall short of expectations. China could be interested in buying the state-owned cotton company, Compagnie malienne pour le développement des textile (CMDT), when privatized. Discussions are in progress with DAGRIS, the former Compagnie française pour le développement des textiles (CFDT), on this issue. What comes out clearly from discussions is that the Chinese government won't save the CMDT and the whole cotton integrated commodity chain in Mali, which is in economic distress, on vague and ideological South-South solidarity grounds. Nor will DAGRIS and any private operator. China will invest in and support West African cotton when economic expected returns will have resumed. At the moment, the CMDT is simply not a profitable business.

[13] Guérin E. (2007). "La présence chinoise au Mali," mimeo Iddri, Paris.
[14] Xinhuanet. Chine Mali : transformation locale du coton malien grâce à l'aide chinoise. January 15, 2006.

5.0 Social Impacts of the Cotton Textile Supply Chain

Besides environmental impacts, there are social impacts along the cotton and textile supply chain, domestically as well internationally. The analysis of it can help to evaluate the impacts of China's cotton import and textile export to global environment and society objectively. Social impacts of the cotton textile product chain include employment, consumer surplus and poverty reduction, as main criteria.

5.1 Domestic social impacts in China

Cotton production is second in economic importance only to foodstuff planting in China. About 100 million farmers depend upon cotton for their livelihoods in China alone. As such, the economic viability of cotton production is linked not only to the economic sustainability of many rural farmers, but indeed, entire rural farming communities.

Similarly, the cotton textile industry plays an important role in China's industries. It is crucial to steady domestic market, increase foreign exchange, increase employment and improve welfare. Due to the relative advantage of China in natural resources and labour, China is the main exporter of natural fibre, cotton yarns, cloth and apparel all along. China's cotton export is important in meeting the consumptive trend as back-to-nature, and also in international division and cooperation.

- From 2003 to 2005, the number of medium- and large-scale textile companies increased from 4,449 to 7,632, a growth rate of 71.54 per cent. Employment has increased 13.54 per cent from 2.28 million to 2.59 million. Total profit has surged 123.58 per cent from RMB 7.17 billion to RMB 16.0 billion, and profit per capita has increased 100 per cent from RMB 3100 to RMB 6200. It is very clear that employment in the textile industry has been on an upward trend; total and per capita profits have both increased rapidly. These statistics reveal that the value added and product quality have improved over the past several years, and GDP and fiscal revenue has increased accordingly.
- From 2003 to 2005, China's cotton imports have risen from 0.87 million tonnes to 2.57 million tonnes, an increase of 195.26 per cent. The consumption of cotton has increased by 41.2 per cent, from 6.8 million tonnes to 9.4 million tonnes. Cotton imports rose quickly, indicating there is a vigorous demand in the domestic textile market, which has also increased the employment and income in exporting countries. At the same time, domestic growth is also stimulating domestic cotton production, improving cotton farmer income overall.
- In 2005, the output of cotton yarns has increased 55.1 per cent from 9.28 million tonnes in 2003 to 14.4 million tonnes. The production value of cotton cloth has increased 67.65 per cent from RMB 291.6 billion to RMB 488.8 billion, and the value of cloth per metre has

increased from RMB 23.23 to 24.87, indicating that the quality and technology of Chinese textile and apparel has notably improved.

- The export value of cotton textile and apparel has increased from RMB 27.6 billion to RMB 41.1 billion, at a growth rate of 51.32 per cent. Textile exports have increased by 30.53 per cent; cotton apparel exports have increased by 65 per cent. Textile and apparel imports also increased 15.51 per cent, from RMB 4.67 billion to RMB 5.39 billion; of that, cotton textile imports increased by 12.25 per cent and cotton apparel increased by 39.5 per cent respectively. It is obvious that the exports increase much faster than the imports, which leads to a trade surplus. This shows that the competitiveness of Chinese textile products has been greatly fortified, which is important to increase the foreign exchange reserve and improve China's status in international economic societies.
- A significant portion of the total output of China's textile and apparel is for export. China has become the biggest textile and apparel exporter in the world. Chinese textile and apparel manufacturers have a comparative advantage for two reasons: first, China has abundant natural fibre resources and cheap labour; second, the environmental cost of textile and apparel production has not been counted into the total production cost, which allows the private cost to deviate from the full social cost (Samuelson, 1999). The externality of environmental cost means the environmental cost of exported products is left for China to bear alone for the most part. The importers gain a high consumer surplus because of China's cheap labour and absence of environmental cost. Thus, the import countries have gained in environmental interests, yet stand a loss of employment at the same time.
- The demand for cotton and textile and apparel exports in 2005 has increased greatly compared with 2004 due to the elimination of global quotas as of January 1, 2005.
- From the data of January to October 2006, the numbers are higher than that of 2005, indicating Chinese cotton textile and apparel industry keeps growing.

The analysis above shows that the cotton textile and apparel industry contributes much to the growth of GDP, the increase of fiscal revenue and foreign exchange reserve as well as employment by rapid growth these years.

5.2 International social impacts

To assess the impacts of China's cotton textile supply chain on the international environment and consumers, it is necessary to identify the final consumption of Chinese textiles and apparels, that is, the percentage of domestic and foreign consumption.

The exports of textile and apparel products account for one third of the total production of China. Due to lack of data of total sales income of cotton apparel, it is not possible to get an accurate export value of textile and apparel to total sales income of textile and apparel ratio. Thus, we use the ratio of export value of textile and apparel to total sales income of textile to indicate roughly the proportion between domestic and foreign consumption. The ratio we get this way will be bigger

than the real one, because the denominator does not account for the value added taking textile to cotton apparel and the increment in the process. But it is still feasible and reasonable to show the consumption destination. Two conclusions can be drawn from the comparison of revenue and export volume in cotton/apparel over the last three years:

1) A huge part of Chinese cotton textiles and apparel are exported.
2) China imports a large quantity of cotton, which may have negative impacts on the exporting countries' environment to some extent. But China is a world workshop, and the textile and apparel products made from the imported cotton are massively consumed by other countries. The perception about the Chinese textile and apparel industry's negative impacts on the international environment is hence incorrect.

Chinese textile and apparel can be divided into three parts: one third is for export which is expanding yearly; one third is for the Chinese urban market; and one third is for rural areas in China. One third of Chinese textile and apparel is exported overseas, while the cotton imported by China is less than one third of global total cotton consumption. On this point, China's "net imported cotton" is a minus. Though China imports cotton from the international market, the exported textile and apparel from China is much more than that, and a part of domestically produced cotton is also consumed outside China. This could verify the fallacy of negative impacts on international environment caused by China's huge import cotton.

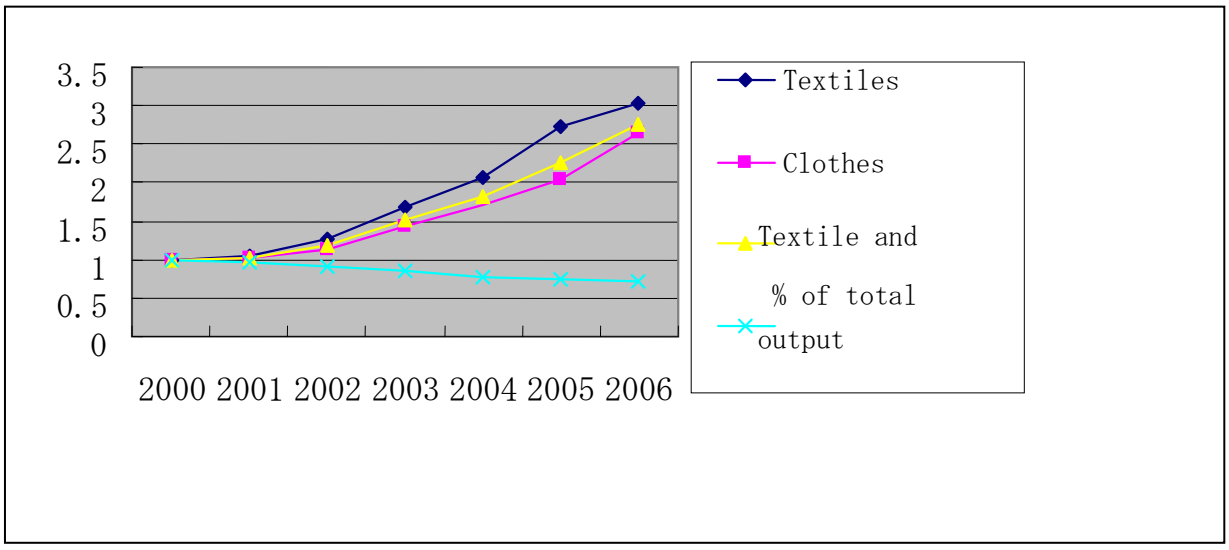
Although there is a lack of specific data about the consumption destinations globally, we can use the destination countries to display the distribution of Chinese textile and apparel products in the world. According to the literature, in 2005, the export value of textile and apparel was US$117.5 billion, representing an increase of 20.69 per cent over 2004, and accounting for 15.42 per cent of China's total export value. Exports to the U. S. were US$19.6 billion, an increase of 66.09 per cent, while the exports to the EU were US$18.9 billion, with a growth rate of 55.03 per cent; the exports to Japan reached US$18.1 billion, representing an increase of 5.54 per cent over 2004 (www.zhtex.com, 2006).

In 2006, the export value of textiles and apparel reached US$143.99 billion, representing an increase of 22.51 per cent, and accounting for 14.86 per cent of the total export value. The U.S. is still the single most important importer; with the EU and Hong Kong SAR ranking second and third respectively. The export value to the U. S. in 2006 was US$20.3 billion; while the export value to the EU and Hong Kong SAR during the same year was US$18.2 billion and US$15.5 billion respectively. The exports to America and EU add up to US$38.5 billion, accounting for 26.77 per cent of the total textile and apparel export value. The exports to non-EU and non-U. S. countries amount to US$195.4 billion, accounting for 73.23 per cent of the total exports, representing an overall increase of30.87 per cent over 2005 (www.ccp.com.cn, 2007.1).

The main export destinations of Chinese cotton products are therefore developed countries/regions, including U. S., EU, Hong Kong SAR and Japan. It is worth noting that through the provision of

high subsidies to U. S. and EU domestic cotton production, the principal export markets for Chinese cotton products are able to benefit from reduced overall textile prices on the global market.

Figure 5.1: Cotton textile export and its share in total export, 2000–2006 (per cent)



The following conclusions can be drawn from Figure 5.1 and data above:

- Although the export value of textile and apparel products continues to increase on an annual basis, the proportion of the whole export value of China is declining. This suggests that the position of textiles and apparel in GDP and international trade is going down year by year, and it will be replaced by other industries, following the track of the textile industry in developed countries.
- The huge volume of Chinese textile exports demonstrates that the Chinese sector still exhibits a strong price advantage internationally, thus providing a significant consumer surplus to international consumers.

China continues importing cotton to meet its demand for exports. Amongst the cotton exporters, the U. S. and African countries are important to China. USDA statistical data reveal that:

- The export volume of U. S. cotton accounts for 70 per cent of the total U. S. output of in last five years.
- In last ten years, U. S. cotton output has been on an upward path amidst declining domestic consumption—a feature enabled by growth trends in cotton exports.
- Since the cotton production in the U. S. has not implemented intensive cultivation, its yield per unit is lower than that of China. Thus, there is still a huge space for the increase of U. S. cotton production. If its yield per unit gets close to China's standard—that is, if its yield per hectare increases 100 kilograms—the U. S.'s total output will increase over 500,000 tonnes per year, which will accordingly increase the amount of exported cotton in the world.

- Because in the U. S. cotton production per unit needs less energy input and generates less pollution than in China, it is beneficial to global environmental protection as a whole when China imports large quantities of cotton from the U. S.
- Due to the substantial subsidies for cotton production from the U. S. government, cotton imports from the U. S. will be favourable for Chinese domestic companies as a means for lowering production cost.

Cotton production has grown rapidly over the past four decades in Africa generally, and in francophone African regions in particular. This growth has accelerated over the past several years due to growing global demand, particularly from China. The total cotton planting area in Africa has increased from 3.83 million hectares in 1961 to 5.18 million hectares in 2003. The output of seed cotton has increased from 2.21 million tonnes in 1961 to 5.1 million tonnes in 2004 (Li Hongmei, 2005). The production processes and growing conditions of central and western African countries are quite similar, as well as their cotton quality. Cotton fields across Africa are almost 100 per cent rain-fed. After the five-month rainy season, there is generally little risk of rain during the ripening period, rendering virtually ideal conditions for cotton production. As a result, the need for chemical fertilizer, pesticide as well as machine, animal and irrigation technology are reduced significantly, giving rise to comparatively low economic and environmental costs associated with production.

Since Africa's textile industry remains underdeveloped, most African cotton is exported. In sub-Saharan Africa, the total cotton output and export amount was 940,000 tonnes and 550,000 tonnes respectively in 1992 and 1993. Those figures had grown to 1,200,000 tonnes and 960,000 tonnes by 2002–2003. Exports currently account for almost 85 per cent of the total output. The francophone African regions, except Zimbabwe, have undergone a notable increase in the exports of cotton in last 20 years. In 2004, the exports in the francophone area reached 870,000 tonnes, accounting for 12.6 per cent of the global export total. It has also exceeded Uzbekistan and become the second biggest exporting region after America (Li Hongmei, 2005).

However, the yield per unit in Africa is very low, only one third of that in China, so there is a wide space for African countries to improve their yield. Without increasing planting area, if the yield per unit can improve to two thirds of that in China, total African cotton output would double, providing a substantial basis for improved livelihoods among African cotton producers.

It is particularly noteworthy that the development of the Chinese textile and apparel industry has attracted a great deal of foreign investment into China. At present, the textile exports of foreign companies have accounted for one third of the total export value. In 2005 when the quota was cancelled, 70 per cent of the increased export value that year was by foreign companies. At the same time, the Chinese textile industry is still at the stage of processing and manufacturing in the global product chain. The average profit rate of textile exporting companies is just three to five per cent,

and the exports mostly take the form of manufacturing for OEMs, with only 10 per cent own-brand production. In the performance of OEM contracts, Chinese companies receive roughly 10 per cent for processing and manufacturing, with the majority of market profits being distributed to foreign companies (www.texnet.com.cn, 2006). The liberalization of Chinese textile and apparel production and trade did not lead to massive dislocation of existing production and supply chains as was once predicted.

5.3 Textile industry: Sun setting in China?

Considering China's huge import of cotton, the many frictions in international trade and cotton/textile environmental cost, a question worth asking is whether China's cotton textile and apparel industry will follow the same pattern of industrial transformation as occurred in the West, diminishing in the foreseeable future.

In the nineteenth century, the U. K. was the number one textile producer in the world. As its industrialization went from the labour intensive textile/apparel industry to capital intensive sectors, the textile/apparel industry gradually moved out of the country. This pattern repeated in Japan when labour-intensive industry was a somewhat dominating sector in the early twentieth century. However, it is highly unlikely that China will follow suit for a number of reasons.

Natural resources give China an advantage in developing its textile and apparel industry. First, China has plenty of natural materials. China is the biggest producer of cotton, silk and hemp. The capability of plant fibre processing is improving annually. Second, China is sufficient in cheap but quality labour supply. The wage per hour for a Chinese textile worker is only 4.84 per cent of the U. S. level, and 2.64 per cent of the Japanese level. This guarantees the low cost of Chinese textiles and apparel in the international market.

The Chinese textile industry has strong productivity along the supply chain. China ranks first in world production of yarn and cloth, apparel and other finished products.

Textile and apparel production remains a profitable industry in China. The current situation of China's labour market can be described as having sufficient labour supply and high unemployment rate. Surplus of rural labour is about 150 million people. The urban unemployment figures are 14 million with 10 million added each year. The pressure of employment is very high. Textile is a labour-intensive industry, which is also related to agriculture. Thus, the growth of the textile and apparel industry can promote the urbanization and industrialization.

Textile and apparel products have huge markets domestically and internationally. Besides the huge global market of 6 billion people, textile products are widely used in other industrial sectors. The more advanced a country, the higher the demand for textile and apparel, as testified by the history of

both the EU and the U. S. In less developed countries, the development of economy is boosting the demand for textile and apparel consumption as well.

In the domestic market in China, amongst the 1.3 billion residents, about 10 million rural residents transfer into urban areas every year, and the number of migrant workers increases by 5 million each year. All these changes will enlarge the consumption of textile and apparel products. It is estimated that the population of China would peak at about 1.5 billion in 2030 with a net increase of up to 10 million per year. China undoubtedly is the biggest market for textile and apparel, and the market demand will be met by domestic production instead of imports. At present, average consumption of fibre is about 10 kilograms per capita, as compared to 22 kilograms in the EU and 30 kilograms in the U. S. There is still a potential for further development.

The textile and apparel industry is crucial to China's national economy, which plays an important part in China's industrial system. The total value of this industry accounts for about 10 per cent of the total industrial value in China. The supply chain of cotton and textile is associated with many other industries. According to the Statistics Bureau of China, every unit input in the textile industry can generate an influence coefficient of 1.25 on national economy, which is 25 per cent higher than average. Besides, textile and apparel exports have a prominent contribution to maintaining trade surplus for China.

From the history of the textile industry in the world, the prosperity for a textile production centre can last about 20 years. China's textile industry bogged down in 1990s. After three years of reform since 1997, it made up deficits in 1999 and began to turn a profit in 2000, thus China's textile industry is on an upward path. It can be assumed that China's textile industry can hold on to its strong competitiveness at least until 2020. The sun is still rising on this industry in China at present, and it is not likely to transfer to other countries or regions in the near future. Considering its impact on employment and domestic production, the sun will not soon be setting on the textile and apparel industry sector in China, along with its industrialization process.

While relocation of the major production capacity from China to other developing countries will not take place, relocation of cotton/textile production capacity from the more developed coastal regions to inland areas has been taking place already.

While relocation of the major production capacity from China to other developing countries will not take place, relocation of cotton/textile production capacity from the more developed coastal regions to inland areas has been taking place already. There are many reasons for this relocation, such as is the case in the industrial transformation in the developed world. The first one is the introduction of more stringent pollution control measures and more rigorous environmental regulation enforcement in the richer, but more heavily polluted, coastal region. Environmental assimilation capacity might explain a small part of such a relocation, as there is less pollution in inland areas. The pollution case

applies to both industrial point sources and agricultural non-point sources. The second reason lies in the fact that labour cost in the coastal region is growing fast and there is a shortage of low-cost labour supply. A third reason relates to the comparative advantage of land assets. In the coastal regions, agricultural and industrial lands become more expansive and the return from cotton and textile production is being increasingly marginalized. In the Yangzhe and Zhjiang Deltas, for example, no new investment is allowed in the conventional dyeing and textile industries and many of such existing capacities are moving to inland areas such as the central and western parts of China. In Shangdong province, our visit to farmers confirms that labour intensive cotton production has been substantially reduced.

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6.0 China's role in Promoting—or Neglecting—Sustainability

In the following section, we analyze the expected social and environmental impacts of three different trade scenarios for China based on the following trade and policy environments: 1. status quo; 2. free trade with no internalization of environmental costs; 3. free trade with full internalization of environmental costs; and 4. the worldwide impacts of the relocation of the cotton and textile industry.

In order to simplify and accord with the reality and the intending trend, we make some common assumptions:

- The planting area keeps stable in 5.1 million hectares, and the increase of cotton production is attributed to technological progress.
- The shortage of cotton supply for textile production in China will be met by import.
- The inputs in cotton production in different countries are assumed in line with the numbers as given in Table 6.1
- The stock of cotton is assumed to be zero at the end of every year.
- The effective component of fertilizer in cotton production is nitrogen, so the amount of fertilizer needed in the process is measured as the amount of N, when comparing the environmental impacts between China and exporters. The benchmark of N will be the median drawn from Table 6.1.
- Since cotton planting and picking methods vary among countries, there is no common basis for the comparison of defoliant and plastic film. Thus the environmental impacts caused by defoliant and plastic film will be neglected. The impacts of agrochemicals will be indexed according to toxicity in Table 3.1. High Toxicity will be given the high index number of 9; Medium Toxicity: 6; Low Toxicity: 3; Nontoxicity: 0. The agrochemical toxicity index of different countries is calculated using "weighed average."
- Due to a lack of U. S. data about the rank and ratio of agrochemical toxicity, the number is assumed to be similar to that in another developed country: Australia. Similarly, for the Central Asian countries, e.g. Uzbekistan, which is adjacent to China, the environmental impacts of cotton planting can be seen as the same to China. It is hypothesized that imports from these countries will have the same environmental impacts as planting in China.
- Import from India will not be considered in the scenario analysis, for the Indian textile industry is expanding rapidly and China's imports from India are very limited.
- To simplify analysis, it is assumed that 50 per cent of imports of cotton are from the developed countries such as the U. S. and Australia, and the other 50 per cent are from the developing countries such as West Africa.
- From items 5, 6 and 7, we get the data of environmental impacts in China, in the U. S. and in

West Africa (shown in Table 6.1). This shows that the toxicity level of pesticide aroused by cotton planting in China is higher than that in developed countries like the U. S. and in undeveloped countries like West Africa.

- When analyzing the social impacts of textile industry in 2020, the data will be taken from the Statistics of textile and clothing production and trade in China in 2003–2006 and the relevant standard will be based on data of 2005.
- The base year is 2005, and the scenario analysis is made up to 2020.

Table 6.1 Data of environmental impacts caused by cotton planting in China, in the U. S. and in West Africa

Country / Items	China	U. S.	West Africa
Cotton yield (kg/ha)	1200	960	503
Nitrogen used per hectare (kg/ha)	263	100	53
Nitrogen used (t/t)	2.19	1.04	1.054
Toxicity that aroused by cotton planting	3.4	2.4	2.0

6.1 Baseline scenario

Market conditions greatly improved for China after its entry into the WTO. It has led to increasing Chinese cotton textile/apparel exports, as well as an enhanced position in international distribution. On January 1, 2005, the world textile trade entered into a post-quota era when the quota was abolished around the world. The distortion in cotton textile/apparel trade was corrected substantially after the abolishment, which promotes the technology innovation, boosts the redistribution of resources around the world, reduces the price of cotton textile/apparel and benefits all the members in the long term. It will stimulate and release the productivity of the global textile industry and realize integration in the world at last.

The abolishment of quotas is very important for a great power in the textile industry like China. Without the shackles of quotas, markets for China's textile/apparel exports are fairer and freer. However, OECD countries will try to protect their domestic textile/apparel industries from dying away when they have to compete with the products from China.

As members of the WTO, these countries must obey the Agreement on Textiles and Clothing (ATC) and abolish quotas. However, they are likely to set up other non-tariff barriers, because of the

importance of the textile/apparel industry. The measures and approaches include technical barriers, special guarantee measures, anti-dumping measures, social responsibility and free trade areas (Yang Danhui, 2005).

1) Technical barriers. Among existing technical barriers to trade, methods protecting the environment are most attractive: the so-called "green barriers." "Green barrier" means that the importer sets a series of technical standards—green environmental labels, green packaging, green quarantine system and so on—that are used to confine imports to protect domestic environment and natural resources. It is obvious that the green barrier is a double-edged sword: it is positive in protecting the environment and human health, in spite of a possible misuse as disguised domestic market protection (Tang Ren Wu, 2004).

The trade of textile/apparel is greatly influenced by the environmental technical standard, so it is undeniable that the developed countries will enhance the green barrier to protect the environment and the trade after the abolishment of quota.

2) Special guarantee measures in transitional period. According to the protocol China signed when joining the WTO in December 2001, members of WTO can set "special guarantee measures" or quotas on Chinese textile/apparel before December 31, 2008, whenever they think the export of Chinese textile/apparel has disturbed their market or is about to disturb it (Chen Li Hu, 2005). The item enables the U. S. and other WTO members to negotiate with China about how to avoid disturbance or menace from Chinese products. Obviously this item is extremely disadvantageous for the Chinese textile/apparel trade.

3) Anti-dumping. Anti-dumping has been used by OECD countries as a method to limit Chinese textile/apparel imports, though its original intention was to fight against unfair competition. A question that would have dramatic consequences on China's dumping calculation, and was as yet unsettled when China joined the WTO, was whether WTO members such as the U. S. could and should consider China a non-market economy. Furthermore, the pouring of Chinese textile products has become pretence for the U. S. and EU for anti-dumping claims.

4) Social responsibility barrier. Social responsibility is a new and emerging barrier in international trade, imposing the fulfilment of strict criteria pertaining to human rights, working conditions, fireproofing methods and employee welfare in the production process (Zhang Jian Xia, Liu Lian Zhi, 2006). The regulation or criterion accelerates the movement of the textile/apparel industry in export countries toward international levels and improves the working conditions and social welfare in textile/apparel firms domestically. But at the same time, it is an obstacle to the textile/apparel exports. It weakens the competitiveness of the Chinese textile/apparel industry in international market.

5) Formation of free trade areas is becoming a way to disguise trade protection. The principle of the most favoured nation clause has been adjusted to regional free trade, so that discrimination between insider and outsider countries does occur. It will be disadvantageous to the Chinese textile/apparel trade as long as China cannot access free trade areas of interest for its textile/apparel sector.

In recent years, the textile/apparel industry has been characterized by overproduction and declining profits worldwide. Especially in the lower end of the textile/apparel industry, more and more developing countries entered the textile/apparel trade, and along with that has come the relocation of industry from developed countries to less developed economies. This shift leads to sharp competition in the world. Without the restriction of quotas, the supply of textile/apparel will increase sharply, and the price and profit will reduce accordingly.

Against this backdrop, it seems likely that China will have to adapt to non-tariff barriers in international competition. Consumers are paying increasing attention to environmental and social conditions of production—a trend that is leading industrial traders and retailers to pass sustainability requirements to textile/garment manufacturers and cotton producers. Although the transition will no doubt take time, one can expect that cotton/textile products will, in the medium-term, no longer be accepted by consumers in international markets unless they meet minimum sustainability requirements.

Therefore, the textile companies should promote the production of ecological and environmentally-friendly textiles, reinforce the social responsibility system and implement ISO 14000 Environmental Management Systems Standard. Though the upgrading of standards may increase production costs in short term, it can also help to improve the product profile and value added.

To analyze the impacts of China's cotton textile product chain on the economy, environment and society in 2020, it is necessary to predict the global cotton consumption, China's cotton production, China's cotton consumption and the export/import of China's textile and apparel. Following the predictions of IMF, we assume that the world economy will increase at an annual rate of 4.3 per cent from 2005 to 2010. We further assume that the global fibre consumption and textile/apparel trade will increase at a rate of 4.3 per cent in the coming 5 years (National Development and Reform Commission, Industry, 2006, 1072). China's share in the world market will increase further, though the growth rate of the textile/apparel industry will slow down after the post-quota era.

Predictions about global cotton consumption in 2020

Referring to an article in "Shida Futures" on December 12, 2004, we do the linear regression on the basis of global cotton consumption from 1961 to 2004, and get the model of global cotton consumption:

Equation 6-1: $Ln(Y) = 0.0178X + 16.125$

Where Y = global cotton consumption and X = data of year (1960 = 1)

From equation 6-1, the global cotton consumption is predicted to reach 29 million tonnes in 2020.

Predictions about China's cotton demand in 2020

Based on the data supplied by USDA, the cotton imports from China and their consumption from 1960 to 2005 are shown in **Table 6.2.** For simplicity, the year 1960–1961, referring to the period from August 1960 to July 1961, is used as the year 1960.

Table 6.2 Cotton import and consumption in China from 1960 to 2005

Year	Imports (1000 bales)	Total Supply (1000 bales)	Exports (1000 bales)	Total consumption (1000 bales)
1960/1961	300	6500	100	5900
1970/1971	500	13300	100	10500
1980/1981	3550	17498	6	15100
1990/1991	2205	26884	928	20000
1995/1996	2908	35586	20	18825
2000/2001	230	42908	442	22700
2005/2006	19284	58547	36	42850

Our exponent regression is based on China's cotton demand from 1960 to 2006 (conversion of "1000 bales" to "million tonnes," [where 1 bale=480 pounds=217.82 kg]), which gives the following equation:

Equation 6-2: $Ln(Y_i) = 4.963e0.0063^i$

Where Y_i = China's cotton demand in the year of 'i'. Since 1961 is the first year, 'i' equals 1. From the equation 6-2 we can predict China's cotton demand in 2020 will be about 14 million tonnes. China's textile and apparel industry still has a prosperous term to go.

Projection of China's cotton production in 2020

Applying historical cotton production statistics in China via the relevant logarithm, we apply a least square regression, which provides the following equation:

Equation 6.3: $Ln(Y_i) = -0.0002\times(i)^2 + 0.043\times(i) + 4.5863$

Where: Y_i shows China's cotton production in the year 'i', and 1951 is the first year. Using equation 6-3, we can predict that the China's cotton production is 7.5 million tonnes in 2020.

Projection of cotton import in 2020

From the analysis above, we know that the cotton consumption in China will be about 14 million tonnes in 2020, which accounts for near the half of world total consumption. At that time, China's import of cotton will be 6.5 million tonnes which is about 90 per cent of the total cotton production, and 50 per cent of the total demand in China.

We assume that half the deficit cotton in China in 2020 (i.e. 3.25 million tonnes) comes from developed countries such as the U. S., and the others come from less developed countries like the Western African countries. Evidently, the China's cotton imports can be beneficial to the world environment based on the information given in Table 6.3.

Table 6.3 Comparison of environmental impacts in China and other countries (for the production of 6.5 million tonnes of cotton)

Items	Produced in China		Produced in other counties (half from the U. S. and the half from Wes-Africa)	
	Standard	Total	Standards	Total
Nitrogen	219166.67 (t/million tonnes)	1424583.36(tonnes)	104767.23 (t/million tonnes)	680987.00 (tonnes)
Toxicity of pesticides	×	3.4	×	2.2

Predicting cotton yarn and cloth production in China in 2020

Because of a lack of historical data about cotton yarn and cloth, we take the cotton consumption in 2005 as a baseline, and assume that the cotton yarn and cloth in 2020 is in proportion with cotton consumption. Cotton yarn and cloth in China will then be 21.4 million tonnes[15] and 30 billion metres.

Predicting textile/apparel exports for China in 2020

Similarly, if we take the textile/apparel exports in 2005 as the baseline, and assume textile/apparel exports in 2020 are in proportion to the cotton consumption, the textile/apparel exports will equal US$63 billion.

Table 6.4: Scenario 1. Business as Usual: Comparison of environmental impacts between 2005 and 2020

Item	**Standard**	**Environmental impacts in 2005 (production of cloth: 19.66 billion metres)**		**Environmental impacts in 2020 (production of cloth: 30 billion metres)**	
		Unit	**Total**	**Unit**	**Total**
Water demand	3(t/100M)	Million tonnes	589.74	Million tonnes	900.00
Electricity demand	30(kw.h/100M)	Million kw.h	5897.40	Million kw.h	9000.00
Coal demand	50(kg/100M)	Million tonnes	9.83	Million tonnes	15.00
Waste water discharged	2.4(t/100M)	Million tonnes	471.79	Million tonnes	720.00
COD	2(kg /100M)	Million tonnes	0.39	Million tonnes	0.600

[15] This number is higher than the projected production of 14 million tons of cotton because other fibres are added.

During the era of quotas, the competition of cotton textile/apparel export among firms was regulated due to restriction. The textile/apparel industry has a lower barrier to entry. Thus when the quota was abolished, the firm did not need to spend money on bidding for quota any more. Without the restriction of quota, some Chinese firms shifted into the textile/apparel industry. Simultaneously, the firms did not care about the treatment of pollution and waste, since the environmental cost has not been internalized at all. The technology in the textile/apparel industry has not improved remarkably, so the increased production will inevitably consume more energy and damage the environment.

It is estimated that water consumption in printing and dyeing will be 900 million tonnes in 2020. The detailed parameters of environmental impacts are shown in Table 6.4.

China's cotton demand will be 14 million tonnes in 2020, which will supply 4 million positions for employment and improve the income of 100 million farmers.[16] The export of textile/apparel will reach US$ 63 billion.

6.2 Trade liberalization scenario neglecting environmental costs

In a completely free and fair trade environment, the Chinese cotton textile and apparel sector does not suffer from the restrictions associated with non-tariff barriers such as anti-dumping and special guarantee measures (though technical standards and social responsibility still exist). Without internalizing the environmental cost, the producer can use public resources freely or pay less than what the environmental resources bring to him. As a result, the individual cost is lower than social cost, which will make it easier for Chinese cotton textile and apparel to enter into the international market, increase the market share and gain more profits. Due to the liberalization environment and lower barriers to entry, more and more capital and firms flow into the textile/apparel industry. The domestic competition becomes increasing severe, and the repeated constructions and investments in textile/apparel industry occur frequently.

We assume that because the demand of the international market is limited, being up against more market supply, the importers can adopt strict technical and social responsibility standards to get low-cost products and meet their demands. In order to participate in the international competition, Chinese companies need to improve their competitiveness and simultaneously reduce production cost to supply eligible products. Therefore, the enterprises are urged to improve their product quality and improve product structure in order to get close to the technical and social responsibility standards. From the effects of technology and product structure, these will have positive effects on the domestic cotton textile/apparel industry, though the environmental pressure owing to the large scale of the industry may offset the positive effects.

[16] In China, farmers are multiple crop growers, meaning that cotton growers may have other crops as well.

In the trade liberalization scenario neglecting environmental cost, individual firms compete with each other through lowering price repeatedly. To maximize the profit, the firms are induced to increase their production, which will stimulate the cotton production accordingly. Under these conditions, the contamination and abuse of resources aroused in the process of production, transportation and consumption are likely to rise. An extreme scenario would be that China becomes more attractive to low-level cotton textile/apparel producers. The result would be the acceleration of resources abuse and deterioration of the environment in China.

However, this kind of trade conditions has some positive effects in the short run. It can improve the welfare and consumers' surplus internationally; and domestically it can drive the economy further along the cotton textile product chain, alleviating poverty and increasing fiscal revenue to a certain extent. However, by ignoring the reasonable use and protection of environment and resources, this development model is short-sighted and unsustainable.

Facing complete trade liberalization, the importers will set up non-tariff barriers to replace the measure of quota. We can assume that the gap in textile and apparel export between Scenario 1 and 2 are induced by quotas, and we can thus get the result of environmental and social impacts in 2020. According to a Tom Net,[17] quota was a major factor restricting the textile and apparel export, and influenced export can account for a third of the total textile and apparel export. Therefore, the export of textile and apparel in Scenario 2 trade liberalization scenario neglecting environmental costs would increase one third more than in Scenario 1. And because one third of China's total textiles and apparel are exported, it can be believed roughly that the output of textile and apparel in Scenario 2 will increase by 10 per cent compared with Scenario 1.

From the analysis above, in 2020 the demand of cotton in China will reach 15.4 million tonnes; cotton production will reach 8.2 million tonnes with a deficit of 7.2 million tonnes. Table 6.5 shows the comparison of environmental impacts of these 7.2 million tonnes cotton between import and domestic production. It can be seen as well that China importing cotton will be more beneficial to the world environmental protection as a whole.

[17] http://news.tom.com/1003/20040923-1350589.html, 2004

Table 6.5 Comparison of environmental effects between China and other countries (for the production of 7.2 million tonnes of cotton)

Items	Produced in China		Produced in other counties (half from the U.S. and the half from West Africa)	
	Standard	Total	Standards	Total
Nitrogen	219,166.67 (t/million tonnes)	1,578,000.02 (tonnes)	104,767.23 (t/million tonnes)	754,324.06 (tonnes)
Toxicity of pesticides	×	3.4	×	2.2

When China consumes 15.4 million tonnes of cotton in 2020, the output of cotton cloth will reach 32.2 billion metres and it will bring about 4 million jobs and attain an export value of US$67.4 billion. At that time, the waste water in printing and dyeing processes will arrive at 772.8 million tonnes. Other data of environmental impacts are given in Table 6.6.

Table 6.6: Scenario 2. Trade liberalization without consideration of environmental impacts: Comparison of environmental impacts between in 2005 and in 2020

Item	**Standard**	**Environmental effects in 2005 (production of cloth: 19.658 billion metres)**		**Environmental effects in 2020 (production of cloth: 32.2 billion metres)**	
		Unit	**Total**	**Unit**	**Total**
Water demand	3 (t/100M)	Million tonnes	589.74	Million tonnes	966
Power demand	30 (kw.h/100M)	Million kw.h	5897.40	Million kw.h	9660
Coal demand	50 (kg/100M)	Million tonnes	9.83	Million tonnes	16.1
Waste water	2.4 (t/100M)	Million tonnes	471.79	Million tonnes	772.8
COD	2 (kg /100M)	Million tonnes	0.39	Million tonnes	0.644

6.3 Trade liberalization scenario with internalization of environmental costs

At the early stage of socialism, poverty was the primary challenge facing China. The first and foremost priority in meeting this objective (poverty alleviating) was through economic development. Toward this end, and in an effort to strengthen Chinese competitiveness in the international market, the Chinese textile and apparel industry was not required to take many environmental externalities into consideration—the priority was given to economic development rather than environmental quality.

With the recent and rapid expansion of the production and trade of cotton in China, unsustainable production and consumption levels have exceeded the tolerance of the domestic environment. The conflict between environment and trade is due to the fact that the expense of exploiting the environment has not been counted into production cost. Because producers and consumers can use public environmental resources for free, or with a fee that is much lower than its real value, the market promotes the over-exploitation and abuse of natural resources and the degradation of the environment.

However, if the true environmental costs can be included in the price of products and services, the pricing system can give market signals that ensure the efficient allocation of environmental resource use. In particular, the internalization of social and environmental costs within the pricing mechanism allows the market to determine which markets have the capacity to protect the environment most efficiently, thereby leading to overall optimal social welfare results. In the short run, the application of full cost pricing may increase the production cost for the companies; but in the long run, it will enable companies to improve the production infrastructure, strengthen R&D and upgrade technologies to reinforce their competitiveness and reduce pollution.

According to the characteristics of the cotton textile product chain, the following is a brief list of tools for internalizing environmental costs associated with cotton and textile production:

- By levying an environmental pollution tax on the minimally effective chemical fertilizer and highly toxic, high remnant pesticide to increase their prices. Income taxes can also be used to provide farmers with subsidies to buy high efficiency/low impact fertilizers and pesticides. This approach can reduce environmental pollution from the origins of the product chain.
- By increasing the rate of recycling plastic film. The cost of film recycling can be imposed upon film producers in the form of a tax. The tax revenue could be used to subsidize the recycling of plastic film. In addition, there is a need to raise the awareness of sustainable ecological agriculture with farmers.
- By levying an environmental pollution tax on the conventional toxic dye and ancillary ingredients, and using the tax income to promote the research and exploitation of green dye and ancillary ingredients.
- By collecting a discharge fee on waste water in the printing and dyeing processes to reduce discharge and use. This will add to the production cost, urging the companies to change production technologies and increase the productivity.
- By levying an environmental protection tax on domestic textile and apparel consumption. Domestic consumption includes two parts: imports and domestic production. Income taxes can be used to stimulate reuse and recycling, so as to reduce the impact of textile and apparel waste on the environment.

- By implementing a cotton textile environmental tariff policy (in accordance with the principal of non-discrimination). Environmental tariffs include export duties and import duties. Import duties can increase the cost of importing products, which can make up the cost difference between domestic and foreign products and weaken the competitiveness of importing goods, leading to a general protection of domestic industries. Export duties can be used to discourage the wasteful use of domestic resources, safeguarding the domestic demand.

The internalization of environmental cost may make the comparative advantage change accordingly. For the high-polluting companies, the cost of internalization may weaken and diminish their comparative advantage; but for the low-polluting or zero-polluting companies, the internalization may strengthen their comparative advantage.

To maintain the competitiveness after the internalization of environmental cost, the textile companies have to strengthen their R&D, improving the original technology, to import or exploit technology to meet the requests of environmental standards and product quality. Thus, the companies with rich capital and high technology will get stronger and bigger during competition; while the companies that cannot keep up with the demand will be washed out of the market.

The internalization of environmental cost greatly decreases the number of companies. The adoption of new technology makes the textile and apparel industry change from labour- and resource-intensive to technology- and knowledge-intensive. The quality of products and value added is also increasing, and the waste in process is decreasing dramatically. Fewer companies also mean the vicious competition will be mitigated to some extent.

However, even under the liberalization scenario, the importing countries do not relax the technical and social standards for the exporting countries. Chinese textile and apparel still face these two big barriers. Some experts argue that as long as the environmental cost has been realized, the current trade barriers will become unnecessary, and all the countries in the world will face a more liberal international trade system. Due to the diverse conditions and technology levels in different countries, it is very difficult for the developing countries to be higher than developed countries in terms of technological and social standards. On the contrary, developing countries usually have a lower technological standard, so even after the internalization of environmental cost under free trade, the exports of Chinese textile and apparel still encounter technological barriers.

The internalization of environmental cost is bound to increase the product cost to some extent. Research, released by the International Institute of Sustainable Development in Canada indicates that the cost caused by environmental protection accounts for one to three per cent of the total

product cost. Here, we assume the total product cost of textile and apparel will increase two per cent due to the internalization of environmental cost.

Increases in textile and apparel costs will have a net effect on firm sales and profits. Given that one third of the Chinese textile and apparels are exported, while one third are sold in the domestic urban market, with the rest going to rural China, one can expect the one-third output for the export market to be the hardest hit; due to the severe competition in the international market, it will be difficult to maintain market share within the context of increasing production costs. Thus, in theory, environmental costs will have to be absorbed by producing firms themselves cutting the profit by two per cent.

For the one third of products going to domestic rural market, the increased costs caused by internalizing the environmental cost can be passed on to consumers due to the lower elasticity of demand within the domestic market (due to the Chinese government's ability to regulate production and consumption domestically). Therefore, the impacts of internalization on the production of textiles and apparel can be assumed to be minimal in the case of domestic consumption.

It is reasonable to believe the demand is stable for the one third of products destined for China's urban market. Thus, whatever environmental cost is allocated between firms and consumers will not influence the production for domestic urban consumption. However, the market share may be redistributed among different firms; that is, those firms that have a lower social and environmental cost will gain market share, while those with a higher social and environmental cost will lose market share.

From the analysis above, the internalization of the environmental cost will principally impact the one third of textile and apparel produced for export by reducing the textile and apparel industry's profits by two per cent. Based on our calculations, this would lead to a two per cent reduction in the volume of exports. Since the exports account for only one third of the total output, the difference in textile and apparel output before and after the internalization can be expected to be less than one per cent.

Based on the assumptions above, the change of cotton import, consumption, textile production and trade under Scenario 3 is as the same as Scenario 2. The alleviation of the environmental impacts after the internalization of environmental cost results from a higher standard for resources consumption and environmental protection.

Under the trade liberalization scenario internalizing environmental costs, the discharge of printing/dyeing waste water will reach 515 million tonnes; other data about environmental impacts can be found in Table 6.7. For same output, Scenario 3 has less environmental impact than Scenario 2, as shown in Table 6.6.

Table 6.7: Scenario 3. Trade liberalization with internalization of environmental externalities: Comparison of environmental impacts between 2020 and 2005

Item	Standard	Environmental impacts in 2005 (production of cloth: 19.658 billion metres)		Environmental impacts in 2020 (production of cloth: 32.2 billion metres)	
		Unit	Total	Unit	Total
Water demand	2 (t/100M)	Million tonnes	589.74	Million tonnes	644
Power demand	25 (kw.h/100M)	Million kw.h	5897.40	Million kw.h	8050
Coal demand	35 (kg/100M)	Million tonnes	9.83	Million tonnes	11.27
Waste water	1.6 (t/100M)	Million tonnes	471.79	Million tonnes	515.2
COD	1.4(kg/100M)	Million tonnes	0.39	Million tonnes	0.45

As a general rule, then, the internalization of environmental costs can help to upgrade the industrial structure of the textile and apparel industry by reallocating resources through competition. Firms that are able to survive the competition will presumably continue to enlarge their scale with the total number of firms declining. With a drop in the absolute export quantity of Chinese textile and apparel products, the quality and value added should be improved.

This result would, however, produce some potentially negative social impacts, as the Chinese textile and apparel industry will probably lose some jobs if the whole industry's profits can be expected to decline somewhat. Nevertheless, the internalization of environmental costs can result in a net social "win" when the massive social and environmental impacts of production are considered over the long term. Cost internalization is the most efficient way to tackle environmental pollution and ecological destruction, while improving resource utilization efficiency, giving rise to an overall win-win outcome for Chinese trade and development.

6.4 Relocation of worldwide textile and apparel industry

Looking at the history of the worldwide textile industry, there have been three distinct industrial relocations, and we are presently moving out of the third. It is currently shifting from South Korea, Japan, and the Taiwan province of China to other Asian countries or regions, principally, mainland China. Industrial relocation of the textile and apparel industry is a trend from the perspective of industrial history, but this industry does not seem to follow the historical trend to be shifted away from mainland China.

The theory of comparative advantage proposed by David Ricardo explains that the production of different commodities in different countries need different resource densities, which vary in countries, leading to the cost difference of the same commodity in different countries (Mankiw, 2001). In principle, each country should specialize in and produce the goods that it efficiently produces, exchanging those goods for others that it is less efficient at producing. The textile industry belongs to the group of industries in which China has a comparative advantage because:

- The labour-intensive industry, to a great extent, depends on the labour cost and labour force, and China has an apparent advantage on human resources;
- China has a unique source of natural fibre and is the biggest cotton producer in the world;
- China's textile industry has a geographic and price advantage. On the one hand, China's economies of scale are notable due to the size of its industry. On the other hand, the externalization of many of the basic social and environmental costs associated with Chinese cotton production has resulted in lower overall cotton prices for Chinese cotton.

The competitive advantage is rooted in the perceived value that consumers see in a product, versus its production cost. However, as we have discussed, the lower-cost advantage of the Chinese textile industry is often at the cost of resources and environment. There exists the market failure and negative externality. If the development of the textile industry cannot be sustained along with the scientific exploitation of natural resources and environmental protection, the harmonious and sustainable development of the economy and environment will not be reached.

Though the Chinese textile industry has had some comparative advantages in the international cotton market, a series of growing challenges threaten China's advantage in the short- to medium-term, including:

1) Most Chinese textile companies currently operate inefficiently in terms of resource utilization. After entry into the WTO, though Chinese textile and apparel exports increased rapidly, the quality and grade are still low. Many companies choose price competition as a main measure.
2) The low-cost advantage mainly relies on the endowment of cheap labour and natural resources. However, this advantage has shown a weakening trend along with the rapid growth of Chinese economy. The population increase, as well as the shortage of arable lands and water, will lead to shrinking cotton output if there is not a distinct technology improvement. The resource advantage of natural fibre is weakening and the increase in wages, land-value, raw materials and energy price puts much pressure on the producers, impairing the price advantage. At the same time, the adjustment of export tax rebate policy has impacts on the textile and apparel exports.

3) From the field survey on cotton production in Ningyang County, Shandong Province, we know farms have less incentive to grow cotton, and the cotton-growing areas are decreasing little by little. For a lower cotton price, the farmers' income per mu is only yuan1600 or so, but the cost of fertilizer, pesticide, cottonseeds and irrigation fees amount to yuan350 or so. At the same time, cotton is the typical labour-intensive agricultural product; it is estimated that the labour spent on cotton production per mu will be RMB100 for small-scale grower. Compared with other high-value crops such as organic vegetables, farmers get lower incomes from cotton-growing activities. However, with the movement of large numbers of migrant workers from rural to urban areas, there is an obvious shortage of rural labourers in agriculture production, especially in the busy farming seasons. The example from Ningyang County covers a common phenomenon around China. It is not surprising that the comparative advantage on natural fabric will be lost in the coming years in China.
4) There is a lack of core competitiveness in the Chinese textile and apparel industry. There is a huge potential for technology innovation, product exploitation and brand operation. Though Chinese textile technology has made much progress, compared with developed countries it is still at a low level. There is still a big gap between domestic and international textile apparel companies, especially in design and brand operation. Many companies do not have their own development departments and designers, and to seek instant profits, many companies adopt the mode of processing on order and OEM, or simply imitate and copy products overseas simply. This leads to low-level expansion in the industry. Along with the severe competition and increase in cost, this mode will be washed out of market.
5) Along with development, people are demanding respect for human rights and better living standards. The textile and apparel industry needs to improve its working environment and fulfill its social responsibilities. As part of internalizing environmental costs, companies should pay for the high pollution cost, which will weaken the competitive capacity of Chinese textiles and apparel.
6) The limited resources and energy will instigate a shift from the traditional industries like textiles and apparel to some capital and technology intensive industries, such as medicine, manufacturing and the electronic industry, to seek a better return.
7) Some South and Southeast Asian countries such as Bangladesh, Indonesia, Thailand and Vietnam have much cheaper labour inputs, and cheaper prices for land, water and energy. Thus, the cost of investment and manufacturing there can be lower than in China (www.dressoem.com, 2006). Along with the improvement of the management and product quality, Chinese textile products do not have an obvious advantage any more, and in fact, are at a disadvantage in terms of quota and cost. So the ability to compete does not look very promising for the Chinese companies in the future. According to a Liz Claiborne representative, the company did not have any suppliers in Vietnam two years ago (Jingwei Net, 2003, 12), but two years later, Vietnam has become the second textile and apparel supplier after China. It is notable that the change in comparative advantage has caused this shift in profits from China to Vietnam.

For a variety of reasons, the cost advantage of the Chinese textile and apparel industry will vanish gradually. The severe competition will make the market share dwindle as well. The survivors will concentrate on the winners through brand and quality competition. At that time, the Chinese textile and apparel industry might be relocated to other developing countries (e.g. Vietnam). The domestic competition will also lead an industry relocation from the east coast to inland where labour and lands are much cheaper. The production will just tend to meet the domestic demand instead of exports. Moreover, large quantities of textiles and apparel will be imported to meet the domestic demand.

According to the Eleventh Five-year Plan, cotton fibre consumption per capita will reach eight kilograms in 2010 (www.cncew.com, 2006.8). During the redistribution period of the world textile and apparel industry, if cotton fibre consumption per capita in China is also eight kilograms in 2020 (the shortfall will be met through exports), then the volume of all cotton fibre consumed in 2020 will be 11.2 million tonnes, when the population is 1.4 billion. Then all the production of domestic textile and apparel will be used to meet domestic demand and the exports will be zero. If the output of cotton is still 7.5 million tonnes, China will have to import 3.5 million tonnes of cotton. If we assume that half of the exports, that is 1.75 million tonnes of cotton, are from developed countries (for example, the U. S.), and the other half is from less developed countries, then cotton imports will be more beneficial to environmental protection than cotton produced in China (assuming that China and other developing countries have the same impacts on the environment), as shown in Table 6.8.

Table 6.8: Comparison of environmental impacts in China and other countries (for the production of 3.5 million tonnes of cotton)

Items	Produced in China		Produced in other counties (half from the U. S. and the half from West Africa)	
	Standard	Total	Standards	Total
Nitrogen	219,166.67 (t/million tonnes)	767,083.35 (tonnes)	1047,67.23 (t/million tonnes)	366,685.30 (tonnes)
Toxicity of pesticide	×	3.4	×	2.2

The production of cotton cloth is also based on the consumption in 2005. With the assumption that the increase of cloth production will keep the same pace with cotton consumption until the year 2020, the production of cotton cloth in 2020 will reach 23.5 billion metres. The waste water discharged in printing and dyeing will reach 7.28 billion tonnes. The related environmental impact indexes are given in Table 6.9.

Table 6.9: Scenario 4. Relocation of cotton/textile industry outside of China: Comparison of environmental impacts between in 2005 and in 2020

Item	Standard	Environmental impacts in 2005 (production of cloth: 19.658 billion metres)		Environmental impacts in 2020 (production of cloth:23.5 billion metres)	
		Unit	Total	Unit	Total
Water demand	2 (t/100M)	Million tonnes	589.74	Million tonnes	470
Power demand	25 (kw.h/100M)	Million kw.h	5,897.40	Million kw.h	5,875
Coal demand	35 (kg/100M)	Million tonnes	9.83	Million tonnes	8.23
Waste water	1.6 (t/100M)	Million tonnes	471.79	Million tonnes	376
COD	1.4 (kg/100M)	Million tonnes	0.39	Million tonnes	0.33

At the same time, it will provide employment for 3 million people and help to improve the income for 100 million cotton farmers.

6.5 The sustainability case for West African cotton

As we have seen, cotton cultivation is associated with potentially irreversible damages on water and soils. Notwithstanding the potential environmental pressures associated with cotton production more generally, African production offers the potential for minimizing negative impacts while maximizing positive social impacts related to cotton production. The fact that cotton production in Africa is rain-fed and that pesticide use is limited means a significantly reduced environmental impact as compared with irrigated countries such as Uzbekistan or parts of the U. S.

If the potential for sustainable cotton (when compared to other countries) is real, hurdles remain, mostly pertaining to:

- decline in soil fertility;
- erosion ;
- human health problems caused by pesticides misuse;
- poverty trap because of the "low productivity/low market prices/low income" spiral.

In 2005, the United Nations Environment Program (UNEP) and the Food and Agriculture Organization (FAO) launched an initiative to "increase the environmental benefits and the production of sustainable cotton in West Africa through a market-based approach." A preliminary

report sketches out several paths toward sustainable cotton (Man, 2006). In this report, radical and long-term options such as stopping cotton cultivation and/or developing downstream and more value added industries such as garments and textile were not considered feasible in the short-term. Focusing on the short term, the report concludes that a strategy for sustainable cotton in the African region should revolve around two basic priorities improving and promoting the quality of West African cotton and increasing farmer share in total value added. Practical options that appear most conducive to sustainable development are fair trade cotton, organic cotton and the Integrated Production and Pest Management (IPM) approach. The first two options are being explored both in Mali and Burkina Faso, but still represent a very tiny share of total cotton production in these countries. There are also some concerns about cotton quality and yields resulting from these production methods. IPM seems very promising in the region but is not widely disseminated at the moment.

At this stage, two parameters must be brought into the sustainable cotton equation: the potential demand for West African sustainable cotton on the international market, and the capacity of the whole commodity chain to organize and meet such a demand. To document them, we draw in the following subsection on the UNEP-FAO workshop "Supplying Sustainable Cotton from West Africa to International Markets: Challenges and Opportunities" convened in Paris on February 28 and March 1, 2006 (UNEP-FAO, 2006a). Representatives from key international cotton traders, textile retailers and manufacturers, cotton producer organizations and ginners from West Africa, international agencies and nongovernmental organizations reviewed existing experiences and constraints and confronted perspectives and options for improving the sustainability of cotton production in West Africa (with a focus on Burkina Faso and Mali) and for expanding world market demand for sustainable cotton.

Exploring the Perspectives for a West African Sustainable Cotton

The demand for more sustainable cotton, which may be different from organic and fair trade, is expressed by a growing number of retailers, some of whom attended the UNEP-FAO workshop referenced above. Participants recognized that unless sustainable methods different from organic and fair trade are developed and implemented on a wider scale, conventional cotton production will continue to supply the vast majority of international demand, with often dramatic consequences on farmers' health and ecosystems.

The main incentive for sustainable cotton production for well-known brands and companies is reputational risk management. Some of the retailers noted that their consumers are increasingly demanding supply chain transparency to allow the identification of cotton sources and production practices. Furthermore, the UNEP-FAO initiative found that for the majority of players in the cotton and textile chain, sustainable cotton is an emerging issue. The awareness of the opportunities for sustainable cotton from West Africa is still low in spite of initiatives such as the Better Cotton Initiative (BCI). The BCI is a process initiated by WWF and the International Finance Corporation,

which engages public and private sector stakeholders in defining and implementing criteria that promote more sustainable cotton growing globally. Several large retailers and textile brands are participating in the BCI.

Four categories of retailers can be broadly distinguished:[18]

1) Retailers who cannot be expected to become active on sustainable cotton in the short term (representing the majority of retailers);
2) Retailers who mainly follow a policy of supply chain and brand risk management (representing a fairly large number of retailers);
3) Retailers who are also motivated to build up integrated supply chains and increase the share of sustainable cotton in their supply; and
4) Retailers who have a clear focus on markets for "sustainable" cotton such as organic and/or fair trade.

For the retailers of Category 2 (driven by reputation risk mitigation), the most attractive option is to participate in an industry-wide initiative. The most obvious candidate is the ongoing Better Cotton Initiative. A number of companies have an interest in the implementation of the BCI globally, most probably through regional standards and criteria. UNEP-FAO interviews show that there is no clear business case for chain-of-custody certification and/or labelling for this category of retailers.

For the retailers in Category 3, (integrated supply chains), no clear possibilities are likely to emerge in West Africa until a more integrated textile sector has been developed in the region.

Last, the retailers of Category 4 are expected to continue to expand their volumes of organic and organic-fair trade cotton from Africa, help farmers to improve their production methods and promote projects that monitor sustainability changes. The supply chain is of the business-to-business kind. This approach does rely on a price premium, and, as noted above, there are likely to be tight limits on the total volume of cotton that can be supplied from such systems.

The triggering role of giant retailers

The organization of the cotton/textile commodity chain is complex and suffers from a generalized lack of transparency. The cotton supply chain is made up of a wide variety of stakeholders serving different sized markets. Some of the larger players represent five per cent of globally traded cotton, while others are highly local spinning and garment factories. Generally, large retailers and name

[18] This analysis is proposed in more detail in the Workshop Background Study *Promoting Sustainable cotton production in West Africa: potential supply chain strategies* (UNEP/FAO, 2006b) and the Business Case Paper *Promoting sustainable cotton from West Africa: the Business case for private sector involvement* (UNEP/FAO, 2006c).

brands do not pay explicit attention to supply sources or conditions. Exceptions, of course, are those participating in organic and fair cotton production (Box 6.1).

Box 6.1: Initiatives for sustainable cotton

- Organic cotton is the most well-defined and established type of "sustainable" cotton production and trade. The market is currently growing rapidly, but remains shallow. According to Organic Exchange Conference figures in 2005 (Calahan Klein 2005), 60,000 has of a total of 35 million ha are certified organic (e.g. less than 0.2 per cent of world cotton land area). Within China, some major producers are beginning to promote organic production. The Esquel Group, one of the largest textile companies in China, has implemented a number of organic production projects in Xinjiang province. Meanwhile, a number of other forward-looking companies in China (Highwaystrategy, T-Passion, Central Textiles) have begun organic cotton production in Jiangxi province. Migros (Switzerland) works with the NGO Helvetas and the cotton trader Reinhart on Bio cotton in Mali, but only marginal amounts are involved. Coop Suisse works with the cotton company REMEI on bio cotton projects in Tanzania.
- The market for fair trade cotton is also budding but remains rather tiny. In March 2005, Max Havelaar, one of the main fair trade associations, launched the first fair trade label for a non-food commodity: cotton. Max Havelaar has worked with an association of about 20,000 small producers from Cameroon, Mali and Senegal organized and certified by the international standardization body Fairtrade Labelling Organizations International (FLO). Cotton farmers from this country are likely to account for the greatest share of the global fair trade cotton production. In order to implement this new fair trade segment, Max Havelaar entered into partnerships with the French company DAGRIS and benefited from the financial support of several bodies (e.g. French Ministry of Foreign Affairs and the Centre for the Development of Enterprise). Fair trade cotton products are sold off by using different brand names (e.g. Armor Lux, Célio, Cora/influx, Eider, Hacot, Colombier, Hydra, Kindy, La Redoute et TDV industries). In order to benefit from better prices (including fair trade premium) for cottonseeds (which corresponds, according to Max Havelaar, to an increase of 46 per cent compared to the price paid for the traditional cottonseeds originating from Senegal and 26 per cent compared to those from Mali, over the period of 2004–05), producers must be certified (costs assumed by them), and have to meet particular specifications (e.g. use cotton-made bags rather than polypropylene ones, ensure a better sorting of the cottonseeds, etc.).
- A recent initiative worth mentioning is the Cotton Made in Africa (CmiA) project developed by the German group OTTO. CmiA's aim is to start trading at least 10,000 tonnes of cotton originating from Africa—and sold as such—less than one per cent of the sub-Sahara's total cotton production. Initiatives are in progress in Benin, Burkina Faso and Zambia, and under study in Uganda and Tanzania.

Sources : De Man (2006) ; UNCTAD (http://ro.unctad.org/infocomm/anglais/cotton/market.htm#fair)

Retailers interviewed within the UNEP-FAO project agree that additional costs by sustainable cotton should be limited and compensated by a more efficient governance of the whole chain. This is why they seem to reject the idea of a (costly) certification by an international standardization body such as FLO in fair trade. Indeed, if they are ready to incur some limited costs for sustainable cotton monitoring at the field level, they are opposed to any extensive certification throughout the "chain of custody" and any significant costs incurred by transparency in sustainable cotton processing.

The pivotal role of international traders

There is a fundamental role for cotton companies and traders (especially traders who have established joint ventures with cotton companies) to help implement West African sustainable cotton projects and convey the demand for sustainable cotton worldwide. No detailed data are found in ICAC statistics on volumes traded by international traders' main companies, only categories: very big (more than 200,000 tonnes), big (between 50,000 and 200,000 tonnes) and medium (between 20,000 and 50,000 tonnes). Published data on volumes traded are scarce, though an exception is COPACO, which, in the DAGRIS 2004 annual report declared 250,000 traded tonnes and euro314 million in sales. Experts assert that cotton trading is characterized by a low level of concentration, although the trading "is more concentrated than 10 years ago" (de Man, 2006).

The list of the main international traders is given in Box 6.2. All European traders operate in Africa (Dunavant included, which appears in the U. S. list). The biggest trading companies sell 8.9 million tonnes of cotton, or 43 per cent of world cotton production (ICAC, 2005). Only one Chinese group is listed among them, and it does not operate in Africa (Box 6.3).

Box 6.2: The biggest international trading groups according to ICAC (2005), trading more than 200,000 tonnes of cotton

Europe	United States
Paul Reinhart	Allenberg Cotton Co.
Louis Dreyfus	Cargill Cotton (Liverpool)
Plexus Cotton	Dunavant (Geneva)
Aiglon Dublin	Staple Cotton Cooperative Association
COPACO	Plains Cotton Cooperative Association Well
Brothers & Rountree	Ecom USA
	Calcot
Others	
Chinatex (China)	
Namoi Cotton (Australia)	
Olam international (Singapore)	
JSC Innovatsia (Uzbekistan)	
JSC Uzmarkazimpex (Uzbekistan)	
Uzprommaksimpex (Uzbekistan)	
Toyo Cotton (Japan)	

Box 6.3: International traders operating in Africa

Biggest traders (> 100,000 tonnes)	Big traders (between 50,000 and 100,000 tonnes)	Others
COPACO (Paris) Louis Dreyfus (Antwerpen) Paul Reinhart (Winterthur) Aiglon (Geneva) Dunavant (U.S./Geneva)	Plexus (Liverpool) CDI (Lausanne) Mambo (Paris)	Cargill (U.S./Liverpool) Weil Brothers et Stern (Merseyside) Devcot (Lille) Olam (Singapore) Baumann Hinde (Southport UK) Goenka-Impex (Geneva) OCTC Switzerland Ecom (Pully CH) Cogecot (Geneva)

International traders are the only operators capable to provide information to retailers and branders on how cotton is grown. They are effectively the ultimate actor within the chain who knows the social and environmental conditions of the cotton processed. The question, then, is: is the there any benefit for traders to play an active role in sustainable cotton trading?

Under current conditions, it appears that traders tend to answer that there is not (de Man, 2006). Their value added rests on cotton collection at the lowest cost. Also, the demand side of the cotton supply chain (if we except the cases of organic and fair trade cottons) demonstrates no widespread willingness to pay for such "transparent" (and complementary) services. Interviews with international traders for the UNEP-FAO project underline the discrepancy between rising demand for sustainable products faced by international traders, and limited willingness to pay among demanding retailers.

Governance options for the supply chains

Discussions during the above-mentioned FAO-UNEP workshop suggest that there exists a preference for promoting more sustainable cotton production through governance of the supply chain, rather than by certified labels. A key conclusion is that for the bulk market, it is more interesting to look for sector-wide solutions than to set up costly integrated chains with full traceability and transparency. International retailers confirmed that the first option was a desirable solution, should the objective be to shift large volumes of conventional cotton towards sustainable cotton.

The costs related to certification or standardization need to be assessed, with close reference to the point of view of African actors and international stakeholders already operating in Africa. The former should include the African Association for Cotton (Association Africaine du Coton [ACA]) and the French Cotton Association (Association Française Cotonnière [AFCOT]), who are key actors in this supply chain in relation to cotton production in the region.

Still, the complexity of the cotton and textile supply chain in Africa, along with the fact that African cotton tends to be blended with cotton from other sources, hampers the potential for sourcing sustainable cotton from this continent. If it is perfectly possible to imagine an integrated textile sector with fibre production in West Africa, processing in Asia and retailing in Europe and North America, the main challenge is to materialize the good intentions from cotton spinners, the textile industry and retailers to actually use African cottons in their process.

7.0 Policy Options and Recommendations

Further liberalization of the cotton/textile trade provides a possible avenue for improved sustainability at the global level, mainly because the most trade distortive countries are also countries wherein the pressure on the environment is the highest. This is particularly true in the cotton sector where a market shift from irrigated, chemical input in intensive growing areas such as U. S. and China toward rain-fed and less intensive areas in sub-Saharan Africa and parts of Brazil and India would bring significant net environmental gains. Hence, trade can be a potential lever for sustainability.

Still, negative trade-offs are likely to occur at the national level, and particularly in China, between environmental and social impacts, and between the sustainable development performance of the cotton and textile sectors respectively. At the same time, market constraints related to the externalization of social and environmental costs suggest that policy intervention may be necessary to stimulate a broad market transition toward sustainable cotton. Based on these two basic observations, it would appear that a combination of trade and non-trade policies will be required to tackle supply chain sustainability issues.

7.1 Stimulating the growth, and recognition, of China in sustainable cotton markets

Recommendation 1: Develop National Market Growth Strategy for Sustainable Cotton: Encourage the development and growth of sustainable cotton markets through improved information gathering and targeted economic policies favouring cotton from sustainable sources.

As the world's largest producer and importer of cotton, Chinese cotton policy has substantial impacts on global markets. By adjusting policy measures to reflect priorities for sustainable production and processing, China can potentially cause global markets to shift toward sustainability in a significant manner. The first step in developing a strategic approach to a market-based policy for sustainable cotton production will be through the collection of a more robust scientific basis for the sustainable development impacts of domestic and foreign cotton production. Detailed information on the pesticides and fertilizers used (N, P, K ratios), the frequency of sprayings per year, the likelihood of presenting acute hazard, Integrated Pest Management and other environmentally-friendly practices such as area ratios and irrigation efficiency could be collected and compared across supplying countries, as well as in China's own practices, to provide a

comprehensive view on the environmental pressure associated with the expected increase of China's imports of cotton.

As new sustainability initiatives are brought onto the market, China needs to undertake proactive efforts to ensure that such initiatives effectively take into account the needs and context of Chinese producers. While there are a number of initiatives already underway, a number of these initiatives are still in their early stages and represent an important opportunity for China to play an influential role. By playing a positive role in the design of such initiatives, China can help ensure its competitiveness as international markets make the transition to sustainable markets. Finally, due to the size of global reliance on China's trade with cotton producing and textile consuming countries, China has the potential and the responsibility to provide leadership in the development of the sector toward improved sustainability. Building on the context of its current strengths in the cotton sector, China should initiate a package of trade-related policy tools that can generate the clear incentives for Chinese and foreign businesses to make a verifiable transition to sustainable practices. With the above in mind, we offer the following priority sub-recommendations:

> ***Recommendation 1.1:*** Develop a National Information Strategy on Cotton Sustainability: Build an information base on the sustainability impacts of Chinese cotton production, processing and consumption. The information system should track basic science-based social and environmental indicators across foreign and national cotton production and textile manufacturing sources. Information gathering and analysis on cotton production may be made compatible with the International Cotton Advisory Committee (ICAC) data processes. The information base can be used as a starting point for determining sustainable trade policy in the cotton sector.
>
> ***Recommendation 1.2:*** Establish an International Standard for Sustainable Cotton Production: Join forces with the international community in reaching an internationally agreed upon definition of sustainable cotton production through active participation in the Better Cotton Initiative. Through its participation in the BCI, China could ensure that regionally relevant standards are developed under the initiative. China may enter such a process with the intention of using the standards developed under the initiative as the baseline for policy development in the cotton sector.
>
> ***Recommendation 1.3:*** Promote Sustainable Sourcing through Green Trade Policy: Design cotton trade policy to encourage cotton production and sourcing from sustainable supply chains. Preferential fiscal, tariff and tax treatment should be provided to sustainable cotton production (in accordance with internationally accepted standards as per organic cotton principles, the Better Cotton Initiative above or an alternate international process which China might care to initiate) both domestically and internationally.

Recommendation 1.4: Adjust Tariff Quota Policy to Promote Sustainable Production: Adjust its tariff quota allocation to state-owned enterprises in order to encourage "environmental competition," by allocating import quotas on the basis of compliance with internationally recognized sustainability criteria.

7.2 Building national capacity for sustainable cotton production

Recommendation 2: Develop a National Strategy for Environmental Sound Cotton Production: Require domestic cotton and textile producers to adopt sustainable production practices in line with internationally recognized sustainability standards. Where compliance is economically unfeasible, assistance can be provided to Chinese producers to transition out of cotton or textile production.

The most important social and environmental impacts associated with the global cotton and textile supply chains arise within China itself. As such, much of the work needed to improve the overall sustainability of the cotton supply chain needs to be done *within* China. At present, loopholes exist in current environmental regulation pertaining to cotton production and the textile industry in China. Furthermore, the domestic market signals and public incentives are still largely biased toward low-cost industries with limited incentives for countering negative environmental externalities. This general observation suggests a need for a coordinated national strategy designed to reduce the environmental impacts of cotton production, particularly through reduced water and pesticide usage. At the same time, given the social and economic importance of the cotton and textile sectors to China, it is critical that efforts toward transition be accompanied by a package of appropriate economic incentives and social protections. Cotton producers, in particular, need to be given explicit incentives to adopt more sustainable practices. Ultimately, sustainability gains are likely to be led by gains in productive efficiency, which suggests the potential for a win-win situation arising from the explicit promotion of sustainable production practices.

Beyond the potential for mere efficiency gains however, China's interest in building access to higher value-differentiated and quality-based cotton and textile markets is also served through a sectoral transition to sustainability. By making a sectoral transition, China has the potential to build a quality-based brand rather than one reliant principally on a low-wage labour force. To the extent that consumer markets are increasingly using sustainability criteria as prerequisites for market entry, China will need to ensure that its own policy framework is synchronized with such developments.

As a starting point, the Chinese government should provide direct investment into the adoption of sustainable practices, as well as the implementation of differential fiscal policies under the auspices of the WTO green box measures for producers adopting such measures. Such measures could significantly help expand Chinese-led business investments in organic and other sustainable

production systems. Since the promotion of sustainable practices will inevitably lead to changes in comparative advantage among producers within China, social sustainability demands the simultaneous implementation of complementary economic policies designed to assist those who are negatively impacted by the transition to sustainable practice. The quantities of chemicals and other inputs used in cotton and textile production need to be reduced through stricter legislation and complementary tax policy. Finally, a comprehensive program of recycling and reusing cotton by-products could reduce the overall productive need thereby reducing the overall social and environmental burden of the cotton sector on within the national context.

With the above in mind, we make the following priority sub-recommendations:

Recommendation 2.1: Invest and Promote New Environmentally Friendly Cotton Production Technologies: Invest in the development and application of new cotton technologies and varieties in order to meet the growing demands of technical and sustainability standards increasingly being applied in the cotton sector. Such support may be based on careful analysis of the long-term sustainability implications with special care being taken in the adoption or support of any GMO technologies.

Recommendation 2.2: Support Sustainable Cotton Production through Green Box Measures: In order to stimulate the growth in market-led sustainable production from the pilot project level to mainstream production, WTO green box measures can be designed to prioritize income support towards covering the cost of implementing sustainable production practices at the domestic level.

Recommendation 2.3: Ensure Regional Social Harmony through Balanced Application of Sustainable Cotton Production Policy: An intentional strategy for balancing the distribution of cotton and textile production, and benefits across different regions within China can be designed with the objective of minimizing social and environmental impact, based on regional comparative advantages and needs.

Recommendation 2.4: Strengthen Regulation on the Use of Toxic Chemicals: Toxic chemicals associated with cotton production and textile processing should be formally identified and phased out through the use of a stringent monitoring and regulation at the regional and sub-regional levels. Regulatory action can be complemented with a targeted taxation scheme at the national level.

Recommendation 2.5: Promote the Use of Cotton By-products and Recycling: Promote the comprehensive use of cotton by-products such as stalks and cotton seeds and waste cotton apparel through the provision of tax incentives for enterprises reaching specified usage levels and investing in by-product utilization technologies.

7.3 Investing in sustainable cotton production in Africa

Recommendation 3: Promote International Cooperation for Sustainable Production and Trade: Promote the development of Sino-African cotton trade by developing African capacity for sustainable production of high quality cotton and by reducing barriers to Sino-African cotton trade.

Since the local environmental impacts of cotton production vary a great deal across countries, a comprehensive effort on the part of the Chinese government to develop a sustainable cotton supply chain must also assess the relative social and environmental impacts of its various cotton suppliers on an ongoing basis (see Recommendation 1.1). However, based on our analysis of the impacts of the key sources for cotton used in Chinese textile production at present, we observed significantly reduced environmental impacts in both the U. S. and African sources. Although a degree of this difference can be traced to inefficient production practices within China, an element of the environmental burden of cotton production is related to the local climatic conditions in any given region. In particular, the availability of rain-fed cotton in many African countries provides a major means of reducing the environmental burden of cotton production globally.

Based on these broad observations, and the high level of dependence of much of rural Africa on cotton production as a sole means of livelihood, a strong argument can be made for policies aimed at transitioning Chinese cotton sourcing to African countries. At the same time, and for the same reasons, China should seek to reduce imports from Central Asian countries such as Uzbekistan, which exhibit inefficient production within the context of water scarcity. Although the shifting of production to more sustainable sources clearly only makes sense within the context of a broader economic development strategy, all other things being equal, China should seek a transition to countries with natural endowments for sustainable cotton production. Based on the above context, we make the following priority sub-recommendations:

> ***Recommendation 3.1:*** Eliminate Duties on African Cotton Imports: Eliminate duties on African cotton imports, in accordance with the commitments outlined within China's African Policy White Paper.
>
> ***Recommendation 3.2:*** Invest in Technological Development for Sustainable Cotton Production in Africa: In an effort to strengthen Sino-African Agricultural Cooperation as stipulated within China's African Policy White Paper, there is a need to intensify cooperation in agricultural technology to improve the sustainability and quality of African cotton; carry out experimental and demonstrative agricultural technology projects; and promote the adoption of best practices in cotton production and processing.

Recommendation 3.3: Improve Predictability and Transparency in Sino-African Cotton Trade: In order to enable greater price stability in Sino-African cotton commerce, one option is to encourage the use of over-the-counter forward contracts between Chinese traders and traders operating in Africa. Additional price risk management mechanisms, such as hedging or insurance "capping" schemes, may also be explored for cotton production exported to China.

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