Country Report on

Environmental Impacts of Trade Liberalization in the Chinese Cotton Sector

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Foreword

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1 Introduction

1.1 Chinese Cotton Production

1.1.1 Cotton acreage

Chinese total cotton acreage in the 1950s stayed around 5.5 million hectares. From the early 1960s to the early 1980s, the total cotton acreage on average fell below the 5 million hectares. It rose sharply in 1982 by over 12 % from the 1981 level. Thereafter the acreage increased until it reached over 6.9 million hectares in 1984. It then fell to 4.3 million in 1986 before it again rose to over 6.8 million in 1992.

The last five yeas have seen a continuous decline in China's cotton acreage. A sharp fall occurred in 1996, of 12.91 %, from 5.4 million ha in 1995 to 4.7million. In 1999 the cotton acreage declined by 15 %, only about 3.7 million ha.

1.1.2 Cotton yield

China's cotton yield has shown a sharply rising trend from 1949 to 1999. Before 1966, it was below the world's average. Since 1966, its has been well above it. The early 1980s saw China's greatest leap in its cotton yield. During this period, new high yield cotton varieties were developed and adopted. The high yield varieties and better field management jointly contributed to a significant improvement in cotton yields, which doubled over the 1978-1984 period, from 0.45 ton/ha to 0.9 ton/ha. Afterwards the yield fluctuated in the range from 0.66-0.89 ton/ha. After 1997 China achieved enormous success in raising cotton yield to 1.02 ton/ha on average.

1.1.3 Cotton output

China's cotton output has increased rapidly since 1949, the founding of the People's Republic. In 1949, output was 444 thousand metric tons. It rose more than tenfold to reach 4.5 million metric tons in 1998. The average annual growth rate in cotton output was 4.84 %, which is 1.94 percentage points higher than the world's average of 2.9 % for this period. Since 1982, China's cotton output has ranked the world's first, accounting for more than 20 % of the world's total production. This output growth, however, has not always been smooth. Sharp ups and downs reflected the complex relationship between natural conditions, state policies and the general economic environment.

In the period 1950-1960, cotton output rose sharply as China got out of the shadow of civil war, especially after the cotton industry was brought under the orbit of state planning and state contract purchase was made part of China's cotton purchasing policy in the early part of the decade. 1958 saw the peak of cotton output in the decade, reaching a record of 1.96 million tons. In the following three years, 1960-1962, China's cotton production was devastated by a combination of bad planning and nationwide natural calamity. The three largest cotton-producing provinces, Hebei, Shandong and Henan, were the most severely affected areas. Cotton

output fell from 1.7 million tons in 1959 to 0.75 million tons in 1962. Subsequent recovery, however, was rapid. Cotton output was increased by 60 % in 1963. A new record was reached in 1967 at 2.35 million tons. From 1966 to 1978, a ten-year long stagnation followed. The turning point came in 1978, the start of the rural reform. The establishment of the family production responsibility system and the adoption of various favorable pricing and incentive policies boosted cotton production. [1]

From 1978 to1984, China's cotton output increased steadily, and reached a historic high of 6.26 million metric tons in 1984, afterwards the cotton output fluctuated between 4.1-5.7 million metric tons. Finally the cotton output dropped to 3.8 million metric tons in 1999.

1.1.4 Main cotton producing areas

Broadly speaking, China has three major cotton growing regions, and they are the Xinjiang Automous Region, the Yangtse River basin region (which includes principally Jiangsu and Hubei), and the Huang-Huai production region (Principally, Hebei, Henan, and Shandong). Among these three regions, the Huang-Huai region has been the largest.

The Huang-Hui Region: The three major cotton growing provinces, Heibei, Shandong and Henan, once accounted for 50 % of China's total cotton output. In 1996, the ratio of cotton sown area to total cultivated land in these provinces was 21.0%, 26.5%, and 32.7%, respectively, and the number of cotton growing counties in these three province totaled 136, 124, and 99 respectively. Cotton has been a very important sector in the economies of these provinces. However, cotton production in this region has fluctuated widely over the past ten years, with output, acreage and also yield declining in most of the marketing years. There were two important factors that made production declines in this region more pronounced than in other regions.

Firstly, since1992, cotton growth in places along the Yellow River has suffered from the bollworm and other cotton diseases. Take Hebei for example. From 1991 to 1992, its cotton output was decreased by 52 % as a result of bollworm attacks, and in 1993 cotton output was further reduced by 47 % from the 1992's level, due to a bollworm calamity compounded by severe verticillium wilt and drought attacks.

Secondly, the central government adopted a "withdrawing cotton fields and return them to grain" policy, which was aimed to ensure the fulfillment of high grain output target set for the year 2000. Grain is the major alternative crop in cotton growing areas. According to the plan of the State, the target grain output level for 2000 was 500 billion kg, and the target cotton output was 5 million tons. However, with limited arable land, it proved to be very unlikely that these two targets could be achieved simultaneously. As a result, the government decided to sacrifice cotton output for grain's sake. The policy was implemented in Hebei, Shandong, and Henan provinces. As planned, in these three provinces, area under cotton was to be reduced by 20 million mu (1.2 million ha) by 2000, which measured in terms of output equals to 1 million tons.

[1] Policies include increases in procurement price and rewards of fertilizers and grain on the basis of cotton sale to the state.

The Yangtse river Region: The Yangtse river basin region is the second largest cotton producing area in China. With cotton acreage of 2 million ha, it accounts for close to 30 % of China's cotton production. The annual average cotton output in this area is around 1.5 million tons. Generally speaking, cotton production in this area is more efficient and the cotton produced has a better quality. The middle and lower reaches of the Yangtse River, especially Jiangsu, Zhejiang and Shanghai, constitute the most prosperous economic zone in China at present, and industrialization has been taking place at a very fast pace in this area. As a result, opportunity costs of cotton production are much higher in this area than in other areas. Land that was traditionally sown to cotton has been increasingly bid away by rural industries and other agricultural sectors and, therefore, the acreage has been gradually shrinking. The cotton sector has to depend on increased multiple cropping for its output growth. The prevalent multiple cropping indexes are 3 and 4 in this area.

The Xinjiang Region: With an average annual cotton acreage of 1 million ha, it has become increasingly important as a result of its great potential in cotton production. Average cotton yield in Xinjiang is as high as 1,176 kg per ha, and the annual cotton output is set to approach 1.5 million tons. In 1998, Xinjiang accounted for over 30 % of China's cotton output and its share in national output is still set to rise.

Compared to other regions, Xinjiang has several advantages in cotton production. It has favorable natural conditions, less incidence of bollworm attacks, good irrigation systems and low labor opportunity cost. Adequate light supply, high degree-days, stable water resources and abundant land are unrivalled conditions that Xinjinag is endowed with. A satisfactory range of cotton varieties has made Xinjinag a cotton base that cannot be replaced by others. It is the only producing area that has the capability to produce the Sea-Island cotton and long staple cotton. Furthermore, Xinjiang has a very long history of cotton growing. As a result, technology has been well developed and farming mechanization as well as market-oriented technology service systems are beginning to take shape. According to 1994's statistics, 85 per cent of Xinjiang's total area under cotton is ploughed mechanically, and 78 per cent of it is sowed mechanically (Mao 1998). Considering the comparative advantage Xinjiang has in growing cotton, the central government has decided to shift China's cotton-milling capacity to Xinjiang, accompanied by a whole set of favorable policies. This has brought new opportunities to Xinjiang's cotton industry.

1.1.5 Cotton varieties

At present, most the popular planted cotton varieties in China are domestically bred. Many cotton varieties are planted throughout the whole China. Different region has different domain varieties. Their common features include:

High yield. High yield is the main target for cotton breeding in China. Varieties bred by China Cotton Research Institution already have obtained a yield potential above 3,000 kg per ha.

Medium quality level. The main yardsticks to grade (classify) cotton are length, length uniformity index, strength, fineness and fiber maturity.[2] The prevalent cotton

[2] Length is a measure of the average length of the longer one-half of the fibers, reported in both hundredths and thirty-seconds of an inch. Length uniformity index is the ratio between the mean length

varieties have an average length of 29-31mm and an average fineness of 5500-6500m per gram, which are well above the world's average level. However, as far as strength and maturity is concerned, China's cotton performance is just mediocre. The average strength is 3.6-3.8g and the average maturity is about 1.6. This has to do with the ecological conditions and the field management system prevalent in China.

Low resistance. China has few varieties that are resistant to blight, cotton wilt and pests.

Lack of early maturing varieties. This has led to the high risk of the crop being exposed to adverse conditions, such as an early frost, thus adversely affecting output and quality.

1.1.6 Chinese position on world cotton markets

Cotton is grown or used in virtually country in the world. The largest producers, consumers, and exporters are China, the United States, the former Soviet Union, India, and Pakistan. These countries have accounted for 77 % of world production, 62 % of consumption, and 66 % of exports in recent years. Other important exporting countries include Turkey, Australia, Paraguay, Argentina, and the French-speaking countries of West Africa. These countries export virtually all their production. The European Union (EU), Russia, Japan, Taiwan, South Korea, Hong Kong, and Eastern Europe traditionally have been the largest cotton importers.

Table 1.1: Cotton output (in 0 000 metric tons)

Year	China	U.S.	India	Pakistan	Uzbekstan	Turkey	Australia
1990	451.0	338.0	199.0	164.0	165.4	65.0	31.0
1991	567.5	383.5	167.3	219.3	149.8	53.9	41.0
1992	450.8	353.1	198.2	200.7	154.0	57.4	46.9
1993	373.9	370.3	221.0	219.9	189.4	52.5	37.3
1994	434.1	423.5	226.4	158.4	130.6	59.0	32.9
1995	476.8	46.8	226.4	169.8	130.6	76.2	31.6
1996	420.0	375.0	238.0	187.0	131.0	76.0	63.1
1997	460.0	401.0	272.0	176.0	106.0	76.0	58.0
1998	450.0	300.0	272.0	156.0	97.0	80.0	67.0
Average	453.8	332.4	224.5	183.5	139.3	66.2	45.4

Source: *IISD/WWF 1997:8-9; Banuri (1998).*

China is one of the largest cotton producing and consuming countries. It accounts for more than 20 % of world production and nearly 20 % of world consumption. Any development in China will have a significant impact on the world cotton market. In 1997 China imported 783 thousand metric tons cotton, which was about 13.6 % of the world's total import, but in 1999 it became a net exporter of 235 thousand metric tons. While the increase in China's exports was not extraordinarily large by historical

and the upper half mean length expressed as a percentage. Micronaire is a measure of fiber fineness represented by the air permeability of a mass of cotton fibers compressed to a fixed volume. Measurement is performed on an instrument known as a micronaire. Fiber strength is reported in grams per tex and represents the force in grams required to break a bundle of fibers one tex unit in size. (Source: Cotton Council International, U.S.A.)

standards, and its decrease in imports was not its largest ever, on a net basis, the impact of these two changes was extraordinary.

1.2 Cotton Production and Environment

Environment is the basis for all agricultural activities: resources base including land, water, energy are essential inputs for agriculture; land fertility and local eco-conditions have large impacts on agricultural productivity and more fundamentally, environmental conditions affect the working conditions and the health well-being of farmers who are main actors in agricultural production. Destruction of eco-balance can put an end to all the agricultural activities. Poor land use planning and unsustainable agricultural practices has led to desertification and declining soil fertility in that region. Cotton production uses pesticides, chemical fertilizer, irrigation water and plastic film, which may influence the environment.

1.2.1 Pesticides and the environment

The term pesticides covers herbicides, fungicides, and insecticides. Insecticides are the most commonly used in cotton production. Environmental consequences of applied pesticides in cotton production can be divided into three major categories: the impacts on human health; on wildlife; on water, soil and air contamination.

According to Schuman(1993), human health effects due to overexposure to pesticides are divided into six major categories: acute toxicity, which damages organ systems or metabolic consequences; delayed toxicity, which causes renal, hepatic, hematologic, or neurologic effects; chronic cumulative toxicity, which includes carcinogetic effects; reproductive effects, which result in sterity and birth defects; hypersensitivity, which possibly causes cardiovascular anaphylactc shock and psycholegical or psychiatric conditioning, which is difficult to diagnose (Shaw et al.,1997).

Pesticide enters into the human body in several ways: through the skin(dermal), by swallowing(oral) and by breathing(inhalation). Cotton growers are the most direct victims of pesticide use. Lack of awareness and safety measure, farmers get poisoned easily when exposed to pesticides. Workers may be exposed to residual pesticides in ginning and spinning mills. People who drink the water that is contaminated by pesticides either get poisoned immediately or suffer from the long term harmful effects of the pesticides. To make things worse, pesticides can also affect human health indirectly by contaminating food for human consumption or accumulating in the food chain (Shaw et al.,1997). Various ginning by -products often find their way untreated into the feed of dairy and beef cattle, the spray drift of pesticides are “swallowed” by wildlife and livestock, and cotton seed oil is a major edible oil in some regions, notably in some parts of Shandong province.

The damaging effects that agrochemical have on wildlife and domestic animals can be either direct, such as acute toxic poisoning though eating pesticide-covered seeds and animals or indirect, such a the loss of habitat caused by herbicide. (Shaw et al.,1997)
Some of the insecticides and herbicides can be long-lived in the soil. There may be an insidious loss of vital soil organisms which play important roles in decay, nitrogen fixation, the sulphur cycles and/or are of significance in symbiotic relationship with

crops. (e.g. mycorrhizal fungi, soil arthropods). It is likely that the microclimate of the fields be altered, which lead to serious soil degradation. (Barrow, 1991)

Pesticides enters surface water sources as run-off. Valorized pesticides may also pollute the air and dissolve in precipitation. These chemicals are likely to build up in cotton sediments and will eventually be concentrated in living organisms through the food chain. (Wagner, 1994).

Pesticides find ways into groundwater through leaching and draining. The degree of ground water contamination is largely determined by soil characteristics and the location of the field (Shaw et al.,1997).

1.2.2 Fertilizers and the environment

Fertilizers are used to replenish the nutrients that the crop takes up from the soil or to insert lacking nutrient types in the soil (Harry de Vries, 1995). The main environmental impacts of fertilizer application arise when it is not properly used, or when (climatic) conditions are not as predicted. The composition of applied fertilizers may not always coincide with the extracted nutrients. This means the some nutrients are still depleted and others are overcompensated. This may lead to soil degradation.(Harry de Vries, 1995) In some regions of China, Urea is overused to such an extent that the it has caused major imbalance between N and P, with the highest ratio of N and P being 1:0.8-1.0 (Zhang Jusong 2000). The direct consequence of this is high input accompanied by low yield increase. Fertilizers contribute to soil degradation in several other ways. Examples are soil acidification caused by super phosphate fertilizers, accumulation of phosphates and heavy metals in soils and soil firmness induced by over application of chemical fertilizers. Soil degradation means the lose of fertility and therefore increasingly larger input of fertilizers, thus leading to a fertilizer dependency cycle.

Also, when climatic conditions (esp. rainfall , but the same effect occurs with over-irrigation) differ from expected values. When rain is short, the crop might be harmed more than gains from fertilizer application. When rain is more abundant than expected, some of the applied fertilizer may leak away from top soil to lower (and for the crop unreachable) layers. In this later case, the fertilizer can pose a risk for water resources (Harry de vries, 1995)

One of the well-known causes of ground water contamination is the massive use of fertilizers containing nitrogen. Nitrogenous fertilizers, phosphate fertilizers and ammonium-rich fertilizers can be converted in the soil by Nitrosomonas bacteria to nitrate compounds. These fertilizers , if not entirely absorbed by the crop, will cause serious problems. Some of the nitrates leach out to contaminate waterbodies and may also be converted by soil micro-organisms into nitrogenous gases which escape to add to the “greenhouse effect”. (Soil degradation) Nitrates, composed of one atom of nitrogen and three atoms of oxygen, pose health risks to infants when found in drinking water. Although nitrate itself is not usually considered harmful to human health , the immature digestive systems of infants changes nitrate to nitrite, which can cause a disease called methemoglobinema (McCasland et al., 1997). Hemoglobin of babies with methemoglobinema will be converted to methemoglobin, which cannot carry oxygen. In severe cases, the infants may have digestive or respiratory problems

an anoxia (McCasland et al.,1997). Also nitrous oxide emissions from the use of nitrogen fertilizer affect air quality.

Another problem environmentalists have with fertilizers is that agricultural run-off can be disastrous to water ecosystems. If an overabundance of nutrients is located within a water source, eutrophication can set in. The water's oxygen content is used up by microbial organisms and fish die off. Since fertilizers are highly necessary, improvements in its application are necessary to reduce collateral ecological damage. The damages caused by agrochemical run-off can be reduced by implementing proper irrigation scheduling, paying close attention to weather forecasts and using strip crops to minimize the amount of fertilizers and pesticides washed away into water bodies by rainfall.(Shaw et al., 1997)

1.2.3 Irrigation and the environment

Cotton is a high water user. Therefore, water is a very important input in cotton cultivation. Irrigation waters make it possible to grow cotton in some regions that otherwise are not suitable for cotton growing. They help to increase cotton yield and ensure regular harvest and they are very effective in shorten cotton's ripening periods. (Roche, 1994). However, unchecked water use, compounded by some of the inefficient irrigation practices, makes the cotton production system in most of the cotton producing countries largely unsustainable. Water resource is, obviously, not inexhaustible. The intensive water use makes a huge dent in this limited water base, let alone various other side-effects it has caused, mostly in collaboration with other production practices.

The large volume of water use and low rate of utilization shows that water is often regarded as an everlasting resource. As new irrigation practices have enabled farmers to draw water from deep underground aquifers, as well as from surface water stored in dams and levees. Water shortages are typically viewed as a supply problem rather than as a demand issue. (Shaw et al.,1997) however, irrigation waters, either pumped from aquifers or diverted from surface sources, cause environmental damages and threatened to undermine future production.

Over irrigation and lack of drainage causes leakage and runoffs of agrochemicals, which have disastrous impacts on the environment. Irrigation run-off from surrounding cotton fields has created wasteland and birds living in the surrounding areas are experiencing birth defects in record numbers. The toxic runoffs and leakage into ground and surface water are harmful to humans and wildlife, and wipe out natural biological systems available to the farmers.

Excessive pumping of groundwater for cotton growing is common in many producing regions. Often, the speed of pumping is much faster than the that of natural replenishment. As groundwater is drawn out of the aquifers, porous and permeable soils that once harbored water are prone to compression and sinkage, which may well disappear the aquifers . Serious subsidence problem and intrusion of salt water may also arise as a consequence of excessive groundwater mining. (Shaw et al., 1997)

Another important consequence that surface water irrigation has is the soil salinization. In general, irrigation and the subsequent evaporation of water leaves salt on the soil. If

the salt content is high, plants have a more difficult time sucking up water. They wilt and are more vulnerable top pests. If the soils are shallow and/or the water table is near the root zone of crops, even water of relatively low salt content used will cause salinity. A good way to slow the salting of soils is to irrigate at night. This reduces the evaporation. Drip watering is also beneficial and uses less water. The problem with drip irrigation system is they are more expensive to construct. A good drainage system also lessens the salinization problem. However, the disposal of saline irrigation water into rivers, lakes and the sea also pose a formidable environmental problems. In addition to high salt concentration, it contains arsenic, boron and mercury. (Shaw et al., 1997) The agrochemical contamination of water can be reduced using many of the practices discussed in relevant sections. Other mediation methods include low-volume irrigation, the restoration of wildlife habitat or the use of agroforestry to minimize the impacts of salinity and high water tables. However, in the long run, some regions may have to be removed from production of cotton.

1.2.4 Plastic film and environment

The application of plastic film is very popular in China. The plastic films mentioned here refers to polythene film which is as thick as 0.008mm and is used to cover the cotton nursery surface (and therefore in China is called ground surface film). It is mainly used to raise ground temperature and retain moisture for cotton growth (Mao 1998). After germination, holes are made for the cotton plants to come out.

The plastic film was first introduced in the 1970s and it is already applied to 50 % of China's cotton acreage during recent years. It is the most intensively used in Xinjiang, where it represents 40 % of the total cost of cotton production (labor cost not included). It has been proven that this newly popularized technology is very effective for its designed purpose. However, plastic film fragments that remain in the soil may stay for as long as 20 years without being degraded by microbial. If the plastic film fragments are not removed, they may hamper cotton root growth, and cause decrease in yield.

1.2.5 Monoculture and its side effects

In some cotton producing areas of China, cotton is produced as a monoculture. Take south Xinjiang for example. All the Cotton varieties planted there are midseason varieties. As a result, not all the cotton plants ripe by September. Therefore, it is impossible to plant winter wheat. Farmers has to wait until next year to grow cotton as their main crop. This has created dependency on off-farm inputs. Continuous mono-cropping causes fertility deficiency that must be replaced by fertilizers inputs. It also creates favorable environments for pests , which require pesticides to control weeds and insects. Furthermore, the balance of soil pH may be disrupted as a result of monoculture.

1.2.6 The concept of sustainability

However, the issue of why and to what extent these alternatives contribute to sustainable cotton growing need to be surveyed in order to get a clearer picture of them. Sustainable production is defined as production that meets the needs of the present and does not hamper the ability of future generations to satisfy their needs. A

weak interpretation of the sustainability criterion is that there are no irreversible effect from pollution or from depletion of natural resources. A “strong” interpretation would be that current production is undertaken in such manner that even reversible negative environmental impacts are avoided or neutralized. An operational of the latter interpretation is the one by Kox and Stellinga (1992:17-19). They propose an agricultural production system to be considered sustainable if seven ecological constraints are met:

- The nutrient status of the soil is left intact (or is restored);
- pollution emission (by fuel gases, agrochemical) is absent or neutralized in the agricultural sector itself;
- on balance no encroachment into natural landscapes, like wetlands, natural forests, and mountainous regions, take place. Agricultural expansion in one area may be compensated by new reservations (wild areas) where wild animals can reproduce and live undisturbed;
- no contribution is made to endangering biodiversity;
- no contribution is made to depletion of fossil energy or other nonreproducible (mineral)stocks;
- no land erosion takes place due to agricultural activity;
- the resilience of the local ecosystem is left intact.

Although the government also have to consider other policy objectives such as income, equality and technology and financial constraint and the priorities choices under such constraint, these objectives should be a part of policy making instead of the definition of sustainable agriculture.(Harry de Vries, 1995). Or else, there will never be a concrete judgment as to whether a certain production method is sustainable or not. Taking the environment seriously is a necessary but not sufficient step towards an environmental policy. To provide coherence, the policy requires clear objectives and targets that derive from them. It also requires an appropriate set of instruments and a set of institutions capable of implementing it.(Dieter Helm,1996)

1.3 Chinese Textiles and Clothing Industry

The textile industry holds a very important position in China. Before the 1980s , the gross value of industrial output of this industry accounted for more than 15 % of the country’s total. Since the 1990s, the under-restructuring textile industry has sustained faster growth. In 1998, the gross value of industrial output of the textile industry covered 10.8 % of the country’s total. (the State Textile Industry Bureau of China, 2000)

1.3.1 Textiles and clothing as a main foreign trade earner

China is traditionally a textile exporter. Textile export accounted for a very large share of total export revenues since the early fifties. The growth rate of textile export is much higher than the total export growth rate. The revenue from textile exports was US$ 42.9 billion in 1998, which was about 17 times greater than the US$ 2.4 billion earned in 1978. The export revenue from textile accounted for around 25 % of the total during 1978-98. After reaching nearly 30 % during 1992-94, its importance in national export revenue has declined in more recent years. Specifically, as the export revenue from textiles decreased by 6 % in 1998, its share in total export revenue fell

to 23.3 %. The fall in textile exports in 1998 was largely attributed to Asian financial crisis.

The world ranking of China as a textiles and clothing exporter has moved steadily up over the past 20 years, rising from tenth in 1980 to the number one position in 1995. According to WTO figures, the value of China's textiles and clothing exports accounted for 4.6% of the world total in 1980 and 12% in 1995. It reached US$ 45.6 billion, 13.7% of the world total, in 1997. In terms of volume, China has been the world's top exporter of textiles and clothing since 1997.

The Chinese T&C exports destinations are undergoing a diversifying process. In 1992, T&C exports destined for Hong Kong, Japan, EU and the U.S. represented 82 % of the total T&C export. However, in 1998, the percentage declined to 76 %. Hong Kong was the largest importer of Mainland China's T&C products and Japan was the second largest, followed by the U.S. and EU.

1.3.2 The ownership structure of the textile industry

The major part of the T&C exports suppliers are State Owned Enterprises (SOEs). Foreign funded enterprise are having an increasingly larger share of the export market, representing 32 % of the total in 1998. Collective enterprises and private enterprises domestically owned account for only 3.9 % and 0.1 % of the total export respectively. However as China's market-oriented reform is further carried out, the market shares of the non-state enterprises will be continuing to grow.

1.3.3 Comparative advantage of China's textile industry

China's comparative advantage in textile and clothing production is based on its large labor force. According to an estimate by the World Bank, China's working population (age 15-64) was 723 million in 1995, which was 29 % of the global total, and half the working population of low-income countries. Compared to other large textile and clothing exporters of the world, the labor cost is very low in China. China beat all the other countries for its low labor cost of textile production and ranked the second lowest in labor costs of apparel production. However, what is different between textile and clothing is that textile is more technology -intensive compared to apparel and therefore the labor comparative advantage of China is partly offset by its disadvantage in technology. (Handbook of Textile quota Management and Usage)

1.4 The Impact of China's Accession to the WTO

China was one of the 23 original signatories of the General Agreement on Tariffs and Trade (GATT) in 1948. After China's revolution in 1949, the government in Taiwan announced that China would leave the GATT system. Although the government in Beijing never recognized this withdrawal decision, nearly 40 years later in 1986, China notified the GATT of its wish to resume its status as a GATT Contracting Party. A working party to examine China's status was established in March 1987 and met for the first time in October 1987. At that time, China's Deputy Minister for International Economic Relations and Trade, Mr. Shen Juren, said China's reform programme, which began in the early 1980s, was having a profound effect on the country's

economy. He said during the previous 10 years, or since 1978, the value of China's trade increased from more than US$20 billion in 1978 to over US$80 billion in 1987.

China is one of 30 governments currently seeking accession to the World Trade Organization. Like many of the countries now applying for WTO membership, China is in the process of implementing economic reforms and transforming its economy to one which is more market-based. China's accession process to the WTO is guided by a Working Party whose membership consists of all interested WTO member governments. Initially, the Working Party on China's status was established under GATT in 1987 and concerned only China's trade regime for goods. In 1995, it was converted to a WTO Working Party and its scope was broadened to include trade in services, new rules on non-tariff measures and rules for intellectual property rights.

A substantial part of China's accession process involves bilateral negotiations between China and WTO Members. These are usually conducted privately, either at the WTO in Geneva or in capitals. Other meetings concern either informal or formal sessions of the Working Party. While several areas of China's trade policies, i.e. schedules of market access commitments in goods and specific commitments in services, have been and will continue to be the focus of bilateral and multilateral negotiations, it is the responsibility of the Working Party to maintain an overview of how the negotiations are progressing and to ensure that all aspects of China's trade policies are addressed.

In 1999 and early 2000 China intensified its bilateral negotiations with WTO member governments. China had concluded negotiations with most WTO members, including the United States and European Union. China was the 2nd largest receiver of foreign direct investment in 1998 and that China made tremendous concessions during the 12 years of its accession negotiations to the WTO. Examples included the following:

- Average tariffs (not including agricultural products) reduced from 42.7 % in 1992 to 17 % in 1998. Further reduction to 10 % foreseen by 2005.

- NTMs (non-tariff measures) reduced from 1247 in 1992 to less than 400 in 1998. A timetable existed to eliminate all WTO inconsistent NTMs.

- China agreed to sign the Information Technology Agreement. This calls for lowering to zero duties on a variety of information technology products.

- China said it had no regime for export subsidies for agricultural products.

- China said it made good progress in its negotiations on trade in services. There were already 150 foreign banks operating in China.

- Finally China would continue to make a sound contribution to the world's trading system and the stability of the world's economy. China has been flexible and pragmatic in its dealings with its trading partners and asked them to be flexible in their own attitudes toward China's accession.

1.4.1 The impact of China’s access to WTO in general

China, like all other countries, can best manage its growing economic relations with the world on the basis of rights and obligations agreed by consensus and reflected in enforceable rules and disciplines. The benefits of China’s access to WTO includes:

It will promote China’s economic reform. In order to get the access to WTO, China has speeded it’s step in opening. Chinese market access included industrial and agricultural products, telecommunication, insurance, banking, professional service, travel and tourism will opened not only to foreign companies, but also to Chinese nonstate entities. China has to give up monopoly policy step by step. The law and regulation system will be improved, the market oriented economic system will be established.

China’s access could improve Chinese foreign trade environment. After getting the access to WTO, China can enjoy multilateral Permanent Normal Trade Relations (PNTR) with the 130 members of WTO. This could be favorable for increase China’s export capacity.

This is the only way to resist bilateral pressures or threats of unilateral actions. It is also the only way to sustain and promote domestic economic reform knowing that China's efforts in this direction are being matched by its trading partners, members of the WTO, who share the same obligations under the WTO Agreements.

Joining the WTO means assuming binding obligations in respect of import policies - obligations which will necessitate an adjustment in China's trade policies and, in most cases, economic restructuring. But, in turn, China will benefit from the extension to it of all the advantages that have been negotiated among the 130 members of the WTO. It will be entitled to export its products and services to the markets of other WTO members at the rates of duty and levels of commitment negotiated in the Uruguay Round - this includes tariff bindings benefiting nearly 100 per cent of China's exports of industrial products to developed countries, with almost one-half of these products being subject to duty-free treatment. These tremendous market access opportunities will be underpinned and reinforced by the two cardinal principles of most-favored-nation and non-discrimination.

Equally importantly, China will have recourse to a multilateral forum for discussing trade problems with its WTO partners and, if necessary, to a binding dispute settlement procedure if its rights are impaired. This greater level of security will benefit China immensely - encouraging even greater business confidence, and attracting even greater levels of investment.

There is another major reason for China's participation in the multilateral system. Only inside the system can China take part in writing the trade rules of the 21st century. This will be an unprecedented set of rights and obligations negotiated internationally by consensus.

1.4.2 The impact of China's access to WTO on agriculture

Until the Uruguay Round, agriculture received special treatment under GATT trade rules through loopholes, exceptions, and exemptions from most of the disciplines applying to manufactured goods. As a result, the GATT allowed countries to use measures disallowed for other sectors (e.g., export subsidies), and enabled countries to maintain a multitude of non-tariff barriers that restricted trade in agricultural products. Participants in the Uruguay Round continued the GATT's special treatment of agricultural trade by agreeing to separate disciplines on agriculture in the Agreement on Agriculture (URAA), but initiated a process aimed at reducing or limiting the exemptions and bringing agriculture more fully under GATT disciplines.

Under the Agreement, countries agreed to substantially reduce agricultural support and protection by establishing disciplines in the areas of market access, domestic support, and export subsidies. Under market access, countries agreed to open markets by prohibiting non-tariff barriers (including quantitative import restrictions, variable import levies, discretionary import licensing, and voluntary export restraints), converting existing non-tariff barriers to tariffs, and reducing tariffs. URAA signatory countries also agreed to reduce expenditures on export subsidies and the quantity of agricultural products exported with subsidies, and prohibit the introduction of new export subsidies for agricultural products. Domestic support reductions were realized through commitments to reduce an aggregate measure of support (AMS), a numerical measure of the value of most trade distorting domestic policies. The agreement is implemented over a 6-year period, 1995-2000.

In addition, the Agreement on the Application of Sanitary and Phytosanitary Measures (SPM Agreement) established rules to prevent countries from using arbitrary and unjustifiable health and environmental regulations as disguised barriers to trade.

The provisions and commitments defined by the Agreement of Agriculture with regard to Market Access include a number of important elements. These can be roughly divided into the following four areas: Tariffication, Tariff reduction, Market access provisions and Special treatment and special safeguard provisions.

1.4.2.1 Agriculture market access

The agricultural market access commitments include measures to address the following problems: trading rights, distribution, high tariffs; quotas; application of unscientific SPM standards; the reliance on state trading companies; and export subsidies.

Tariffication, or the replacement of NTBs by tariffs, is an important part of agriculture's inclusion within the framework of the GATT, in that it brings agricultural trade policy into line with the GATT principle of transparency, and potentially eliminates some of the distortionary effects that NTBs have on trade. It requires countries to convert their existing NTBs into tariff equivalents. These tariff equivalents are established for the base period and are entered in the Country Schedules as the base rate of tariff.

China has committed to eliminate nontariff barriers on agricultural imports upon its accession to the WTO and to implement a series of tariff cuts between 2000 and 2004. In addition, China committed to establish tariff-rate-quotas (TRQ's) for wheat, rice, corn, cotton, and soybean oil with gradually increase quota levels, mostly over the same period.

For goods subject to a TRQ, a specified quantity of imports—i.e., quota—may enter at a low tariff rate, and additional imports are assessed a higher tariff. The negotiated TRQ's are not "minimum purchase" commitments—i.e., they do not require China to actually import at the full TRQ amount. Rather, by cutting tariffs, they provide the opportunity for trade to the extent that domestic demand exceeds supply.

WTO accession is expected to expand China's imports of farm products, particularly for major agricultural commodities which have TRQ's. An important element in China's increased imports will be the growing shares of TRQ imports reserved for private traders.

A system of TRQ's will expand market opportunities for major agricultural commodities. The quantities of these commodities allowed in at the low "within-quota" tariff rate will increase annually from 2000 through 2004 (except soybean oil which will be fully liberalized with nothing but a bound duty by 2006).

China has committed to follow WTO standards in eliminating all quantitative restrictions. In particularly sensitive sectors, China will adopt tariff-rate quotas (i.e. a system in which imports up to the quota level are charged a minimal tariff – usually 1-3 % -- and imports above that level a high tariff). This system provides a very strong incentive for state enterprises to purchase bulk commodities at world market rates.

Specific examples include:
Soybean oil – TRQ eliminated by 2006. The TRQ will start at 1.7 million metric tons, rising to 3.3 million tons by 2005.

Wheat – Quota on accession is 7.3 million metric tons, rising to 9.3 million metric tons. (Compares to present Chinese import level of less than 2 million metric tons.)

Corn – Quota on accession is 4.5 million metric tons, rising to 7.2 million metric tons. (Compares to present Chinese import level of 250,000 metric tons.)

Rice – Quota on accession is 2.6 million metric tons, rising to 5.3 million metric tons. Half of this will cover short and medium grain rice. (Compares to present import level of 250,000 metric tons.)

Cotton – Quota on accession is 743,000 metric tons, rising to 894,000 metric tons by 2004. (Compares to present import level of 200,000 metric tons.)

Barley – No TRQ.

TRQs will be also applied on other products such as wool, sugar, palm oil and rapeseed oil. (US-China Agricultural Agreement 1999)

1.4.2.2 Tariff reductions

China will reduce tariffs immediately on accession, and when fully phased in will result in tariff levels comparable with or better than those of many developed country trading partners.

China will reduce its overall average tariff for agricultural products from an average of 22 % to 17 %. All tariff cuts will be implemented by 2004, the date when all other WTO members will have implemented their Uruguay Round tariff cuts. All agricultural tariffs will be bound (cannot be increased). For certain agricultural exports such as animal products, fruits, and dairy products, the average tariff will fall from 31 % to 14 %. Specific examples include:

Soybeans – a 3 % tariff will be bound on accession.

Barley – reduction of tariffs to 9 %.

Meats – Tariff reductions include:
Beef from present 45 % to 12 % by 2004, pork from present 20 % to 12 % by 2004, and poultry from present 20 % to 10 % by 2004.

Fruits –Tariff reductions include:
Citrus from present 40 % to 12 % by 2004, Grapes from present 40 % to 13 % by 2004, apples from present 30 % to 10 % by 2004, and almonds from present 30 % to 10 % by 2004.

Wine – Tariffs on wine will be reduced by 70 %, from present 65 % to 20 % by 2004.

Dairy –Tariff reductions include:
Cheese from present 50 % to 12 % by 2004, and ice cream from present 45% to 19% by 2004.

1.4.2.3 Domestic support

In order to limit the trade distortions caused by domestic agricultural support policies the Agreement of Agriculture introduces commitments intended to curb these policies. These commitments require countries to quantify all domestic support deemed by the Agreement to have a distortionary effect on trade, i.e. the creation of what is know as the Aggregate Measure of Support (AMS), and then progressively reduce these quantitative measures. The AMS calculation includes all domestic support policies that are considered to have a significant effect on the volume of production, both at the product level, and at the level of the agricultural sector as a whole. Market price support, except that which is achieved through border controls alone, is a major component of the AMS calculation.

The AMS is calculated by first deriving the levels of support for each commodity, plus a similar calculation for non commodity-specific support. Each of these is then summed to provide the aggregate measure. Apart from those polices which are included in the calculation, there are a large number which are excluded. Whether or

not these have, in reality, a significant effect on production is, in some cases open to interpretation. Policies are categorised as follows:

1.4.2.3.1 'Amber box' policies

Those policies which do have a substantial impact on the patterns and flow of trade, and therefore are included in the AMS calculation, are classified in what is called the 'amber box'; these policy are to be disciplined by requiring limitations or gradual reductions in related support levels.

1.4.2.3.2 'Green box' policies

Policies that are not deemed to have a major effect on production and trade are placed in the 'green box'. 'Green box' policies include a variety of direct payment schemes, that subsidize farmers incomes in a manner that is deemed not to influence production decisions. They also include assistance provided through:

- producer retirement programmes;
- resource (e.g. land) retirement programmes;
- environmental protection programmes;
- regional assistance programmes;
- certain types of investment aid;
- general services that provide for example:
  -- research, training and extension;
  -- marketing information;
  -- certain types of rural infrastructure.

1.4.2.3.3 'Blue box' policies

Policies that fall into neither of these categories, but are somewhere in between, are known as 'blue box' policies; these are also exempted from the AMS calculation. Most of the exemptions to AMS commitments are policies placed in the 'green box'. Some additional polices also gain exemption, however, as a result of the accord reached at Blair House. These are the so-called 'blue-box' polices. The most notable of these are the compensatory payments and land set-aside programme of the EU's Common Agricultural Policy, and the United States' deficiency payments scheme. Such direct payments under production-limiting programmes are exempted from AMS reduction if:

- such payments are based on fixed area and yields; or
- such payments are made on 85 % or less of the base level of production; or
- livestock payments are made on a fixed number of head.

1.4.2.3.4 'De minimis' exemptions

As noted above, AMS calculations are carried out for each commodity and for no-specific support. The 'de minimis' exemption allows any support for a particular commodity (or nonspecific support) to be excluded from the total AMS calculation if that support is not greater than a given threshold level. Thus, an additional exemption is contained in the provisions of the Agreement, in the following circumstances:

- Where the value of total domestic support for a particular commodity is not greater than 5 % (10 % for developing countries) of the total value of production

of that product, then that support need not be included in the calculation of the Current Total AMS, which means that it will not have to be reduced.

- The same arrangement applies for non-product specific support. That is, provided that its value does not exceed 5 % (10 % for developing countries) of the value of total agricultural production, then, it too may be excluded from the AMS commitments.

1.4.2.4 Export subsidy

The subsidized export of agricultural surpluses has been a major source of international trade disputes, and the distortions that it has created on world markets, in terms of price and general market instability have been substantial. It is partly for this reason that the Agreement reached on export subsidies is seen by many to be the most important element of the Agreement, and likely to have the most immediate and direct impact on world markets. Export subsidies, measured in terms of both the volume of subsidized exports, and in terms of the budgetary expenditure on subsidies, have been capped at base period levels. China has committed to remove export subsidies for farm products.

1.4.2.5 Sanitary and Phytosanitary Measures (SPM)

The Uruguay Round's SPM Agreement imposed disciplines on the use of measures to protect human, animal, and plant life and health from foreign pests, diseases, and contaminants. Three years into its implementation, the Agreement can be credited with increasing transparency of countries' SPM regulations and providing improved means for settling SPM-related trade disputes. China agrees that sanitary and phytosanitary disputes should be settled scientifically.

1.4.3 The impact of China's access to WTO specially on textile

Under the Uruguay Round Agreement, the developed-country import quotas for textiles and apparel, created through the Multifiber Arrangement (MFA), are scheduled for elimination by 2005 for all WTO Members (although the U.S. would have recourse to two new product-specific safeguards to protect against any surge of imports). Without WTO membership, China would continue to face bilaterally negotiated quotas in its major export markets.

WTO membership will have important consequences for the position of china in the world market. If China is excluded from the WTO, its textile products will be discriminated against in the US and EU markets. China's textiles industry, especially its synthetic fiber production, has been subject to both tariff and non-tariff barriers imposed by the West all these years. Unlike other developing country exporters, China was excluded from the Uruguay Round Agreement on Textile and Clothing. This means that China has not benefited from acceleration in quota a growth, and the progressive movement of textile and clothing products under GATT rules provided for under this agreement. Under the latest available version of the agreement, China's textile and clothing quotas on the day before China joins WTO will become the base to which ATC rules. China will benefit from the integration of textile and

clothing products that has occurred since 1994, and from accelerating in the growth rate applying to China's quotas. This process paves the way for expansion of China's exports of textiles and clothing, with all existing quotas to be phased out by 2005, and any special textile safeguards introduced under the agreement phased out by 2008. This aspect of the agreement is the only important case where China will benefit in terms of improved market access-all of the other benefits will arise from China's own reform commitments. Chinese textile export accounted for a very large share of total export revenues since the early fifties. The growth rate of textile export is much higher than the total export growth rate. The revenue from textile exports was US$ 42.9 billion in 1998, the export revenue from textile accounted for around 25 % of the total during 1978-98.

The textiles and clothing sectors will benefit greatly from the liberalization of the textile trade after China joins the WTO. In Particular, following the removal of quotas, exports can be further increased. Upon accession, certain Chinese textiles and clothing exports will benefit immediately from the liberalization process. These include 24 categories of products destined for the US, such as baby clothing (except diapers), down feather products, certain footwear, handkerchiefs, hosiery and carpets; and eight categories destined for the EU, such as handkerchiefs, combed wool, narrow fabrics, clothing accessories, swimwear and tents.

2 Background to the Project

2.1 Relevance of the Sector to the National Economy

China is one of the largest cotton producing and consuming countries and cotton sector occupies an important position in China's national economy. The total cotton output is 3,828 thousand metric tons in 1999 with the sown area 3,749 hectare. The number of farmers, either directly or indirectly involved in cotton production, has been around 300 million in recent years, and the annual income the farmers earn from cotton production has been around 30 billion RMB in an average year (Mao, 1998). Cotton has become one of the backbone crops of the cotton producing areas and one of the main sources of their fiscal revenue. (Wang and Wei, 1997)

Cotton sector has close linkages to the textile and apparel sectors. The textile industry holds a very important position in China. Before the 1980s , the gross value of industrial output of this industry accounted for more than 10.8 % of the country's total in 1998 (the State Textile Industry Bureau of China, 2000).

As China moves towards membership in the WTO, and therefore becomes subject to the Agreement of Agriculture and Agreement on Textiles and Clothing, the Chinese economy in general and the cotton sector in particular would be faced with significant adjustment. Under the bilateral agreement reached with the US in November 1999, for example, upon accession China will significantly relax the import quota on US cotton and, in turn, the US will gradually relax its quota restrictions on China's cotton and other textile and apparel products. China accounted, in 1992, for more than one fourth of total global cotton production (ICAC 1993c: 6-7), and continues to rank as the world's single largest producer. The cotton and cotton products industry is the single most significant sector--in terms of value added as well as employment--in the Chinese economy. Finally, this sector has also long been the subject of multilateral trade negotiations, and is a prominent feature of current negotiations over trade and the environment. It is an area where the market and non-market environmental measures introduced by industrialized countries will affect the prospects for stability and sustainability in the South.

While the cotton sector (including the production and marketing of cotton) and the textile and apparel sectors are closely linked, this project will be concerned with the cotton sector only. It will study the institutions and policies governing cotton production and marketing in China, the slow progress towards a market system (the sector remains one of the most controlled sectors in China), the distribution of gains, and the environment impact of current cotton production methods. The information to be collected through this project will equip policy-makers to begin the reconfiguration of policies to maximize the benefits and avoid major dislocations from global trade agreements.

Cotton production has also had severe environmental impacts on the local eco-systems and, ultimately, on the local population. One of the principal goals of this project is to study and measure such environmental impacts, and to find

technologically feasible and economically rational ways to reduce such impacts to socially acceptable limits, e.g. by using "greener" technologies and methods of cultivation.

2.2 Project Objectives and Outputs

2.2.1 Project objectives

This project aims to provide policy recommendations for a transition to sustainable development of the cotton sector in view of China's expected imminent entry into the WTO, and to strengthen China's negotiating capacity in subsequent rounds of trade talks relating to cotton. Specific objectives are:

2.2.1.1 Enhance the country's understanding of the implications of the WTO membership, promote cotton trade liberalization in China in a sustainable manner, and enhance its negotiation capacity in future rounds of trade talks.

2.2.1.2 Assess the environmental as well as social and economic impacts of China's potential trade liberalization in cotton.

2.2.1.3 Use a sector-specific methodology to assess these impacts. The established Jiangsu Agricultural Policy Analysis Model (JAPA) will be used to assess the impacts of trade liberalization on cotton production, and to identify optimal resource allocation adjustments after trade liberalization.

2.2.1.4 Formulate a policy package to correct the identified negative impacts of liberalized trade, and to maximize the positive ones. We will consider both economic and regulatory instruments, as well as the possibility of applying voluntary private sector initiatives.

2.2.1.5 Perform a cost-benefit analysis of implementing this policy package.

2.2.1.6 Contribute to establish a long-term policy development process in the cotton sector in China to address future trade-related environmental and social impacts of the sector’s activity.

2.2.1.7 Contribute to enhancing coordination between related national entitles and to increasing national expertise in using integrated assessment tools to identify and quantify both negative and positive environmental, social and economic impacts of trade liberalization.

2.2.1.8 Enhance and support national capacity in international trade policy-making and research.

2.2.2 Project outputs

This project will provide with following outputs:

- An inception report, outlining the focus of the study, the methodologies to be used and the availability of data.

- A work-plan outlining the activities to be undertaken during the 18-month study with a schedule for all project activities with a listing of project milestones.

- Proceedings of all national workshops and planning meetings undertaken as part of the study .

- Country and cotton sector specific methodologies for integrated assessments of trade liberalization in the cotton sector.

- An assessment of the impact of different trade liberalization policies and multilateral trade rules on the cotton sector, and a proposal of clear and practical policy options to reduce negative environmental and social impacts.

- A draft country study report for peer review.

- Information on consultations with government representatives on possibilities for implementation.

- Publication of the peer reviewed country study, including a recommended policy package, designed for implementation in the cotton sector.

- Analysis and evaluation of the recommended policy package and its implementation.

- An action plan for implementation.

- A final brief report providing an assessment and evaluation of the outcome of the project.

2.3 Project Approach and Process

2.3.1 UNEP

The United Nations Environment Programme organized this country study project, provides financial support for the project. It offers technical input and manual use, holds country project review meetings, invites experts and consultants to give comments and suggestion for the project. Mr.Abaza, Chief of ETU came to China to participate our Stakeholder Meeting on July 2000.

2.3.2 National institution

The National Institution is Agricultural Economic Research Institute of Nanjing Agricultural University, the project leader is Prof. Shudong Zhou, the research team includes Dr. Minquan Liu, Providence Professor of Economics with the

Hopkins-Nanjing Center, at the University of Nanjing and Dr. Tariq Banuri, Senior Research Director at Stockholm Environment Institute – Boston.

The local institution has made following activities for the project:

- Assemble a multidisciplinary team to carryout the study and the project.(May 2000)
- Review of comprehensive global and national literature and methodologies, and existing policies, particularly economic reform and trade policies. They include analysis of data sources and the impact of trade liberalization policy for the cotton sector. The output was an Inception Report. (May/June 2000)
- Convene a national stakeholder workshop to launch the project. The workshop defines the project's objectives, approach, process, partners, and result in a detailed work program. The output was a National Stakeholder Workshop Report. (July 2000)
- Establish a national steering committee to guide the study with local input. (July 2000)
- Undertake a detailed field study that includes mainly:
  - an analysis of the effects of trade liberalization policies on the sector
  - an assessment of the positive and negative environmental, social and economic impacts of trade liberalization on the cotton sector (including a cost-benefit analysis to provide to the extent possible the cost and benefits associated with trade liberalization)
  - a package of recommended measures & policies to promote the sustainable production of cotton in China

  The output was the First draft of Country Study on Environmental Effects of Trade Liberalization on the Cotton Sector. (June/October 2000)
- Submit study to UNEP to be presented and reviewed at an international expert workshop.(November 2000)
- Prepare final country study incorporating comments of the international group of experts and submission to UNEP for review and comments. (February 2001)

2.3.3 Stakeholders approach – Project Steering Committee

A national steering committee has been held to guide the project. The steering committee is composed by members of the Ministry of Agriculture, Ministry of Foreign Trade and Economic Cooperation, Environmental Protection Administration, Jiangsu Agriculture and Forestry Department, Nanjing Agricultural University, the Chinese Academy of Agricultural Sciences, Delegate of Cotton Farmer and Jiangsu Tongyu Fabric Group Company, and etc.

2.4 National Institution, Team Members and UNEP

2.4.1 National institution

The Nanjing Agriculture University was formerly part of the Nanjing University and Jinling University, and has more than 85 years of history. The Agriculture Economic Research Institute (AERI) of the Nanjing Agriculture University was established in December 1986 with the approval of the Ministry of Agriculture. AERI consists of six research groups undertaking research in various areas. It has 66 faculty members (17 professors and 27 associate professors). Senior faculty has won international and domestic recognition in their fields of study, while the middle-career and young scholars have achieved great success with their solid theoretical training and standards of rigor in pursuing academic work. AERI has many young talents who are full of initiative and vigor, and have a strong commitment to applicability and excellence in research.

AERI has carried out many research projects financed by local and national governments and international foundations. Recent projects include: the Supply and Demand of Animal Products in Big and Medium Cities, financed by the local government of Jiangsu Province; A Comparative Study between the Chinese and Foreign Agricultural Economies, also financed by the local government of Jiangsu Province; Agricultural Sustainable Development of Red and Yellow Soil Region in South China, financed by the Science Committee of China; Exploitation of Seabeach in Jiangsu Province and its Sustainable Development, financed by the Winrock Foundation of the US; Optimization of Grain Reserve Systems in China, financed by the Natural Science Foundation of China, and so on. In total, 162 research projects have been completed by AERI since 1979. Eighty-eight books and more than 700 journal articles have been published based on them.

2.4.2 Team members

2.4.2.1 Relevant experience and previous relevant work of the project leader

Shudong Zhou, Ph.D., Professor and deputy director of the Agricultural Economic Research Institute (AERI) of Nanjing Agriculture University. Prof. Zhou has 15 years of research experience in agricultural economics. He studied at the University of Oxford, England during 1988-1989,and studied at the University of Giessen, Germany during 1995-1999. He got his Ph.D. degree with the dissertation "Regional Model for Agricultural Policy Analysis in Jiangsu/China". The model combined econometrics methods and partial equilibrium model; it can be used for baseline projection, for agriculture policy evaluation and for policy simulation. This model includes 48 important agriculture products such as cotton, rice, wheat, rapeseeds. Much research on the impact of China's WTO accession has been undertaken using this model. His recent research also includes finding effects of China's WTO accession on Chinese agricultural and the policy strategy

2.4.2.2 Relevant experience and previous relevant work of the collaboration partner

Minquan Liu, Ph.D., Providence Professor of Economics at the Hopkins-Nanjing Center of the University of Nanjing. Dr. Liu's work has concentrated on the economics of development and reform in China and East Asia. Recent publications and work have focused on China's agricultural sector, financial reform and foreign direct investment. He has completed collaborative projects on China's agriculture funded by the Department for International Development, UK, and another of EU foreign direct investment in the province of Guangdong, China.

2.4.2.3 Relevant experience and previous relevant work of the international consultant

Tariq Banuri, Ph.D., Senior Research Director at SEI-B, whose work focuses on sustainable development policy, with special emphasis on the impact of such global trends as trade liberalization and the changing nature of governance. He is a leading member of two of the largest professional networks in the area of conservation and sustainable development: the Inter-governmental Panel on Climate Change (IPCC), in which he is a Convening Lead Author; and the IUCN-the World Conservation Union, where he is the elected chair of the Commission on Environmental, Economic, and Social Policy (CEESP).

2.4.3 UNEP as project organizer and supporter

This project is organized and financially supported by the Economics and Trade Unit (ETU), Division of Technology, Industry and Economics (DTIE), United Nations Environment Programme (UNEP).

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3 Development of In-country Methodology

3.1 Overview of Methodology Selection

In order to find the social economic and environmental impacts of trade liberalization on China's cotton sector, we will carry out the research step by step.

First, the possible impacts of trade liberalization on cotton production in China after joining the WTO will be studied. Specifically, a suitably adapted version of our existing JAPA model will be used to make a baseline projection on the situation in 2001, which provides a comparative basis, then a scenario analysis on the impact of agricultural import increase will be made with the JAPA model.

Secondly, the model scenario analysis results of agricultural import increase will then be used to assess the social, economic and environmental impacts of trade liberalization. For this, the relationship between the level of cotton production and the use of inputs such as chemical fertilizers and pesticides under existing methods of production will be estimated.

Thirdly, Integrated assessment is applied for the study. For this purpose it is necessary to make economic valuation for social and environmental impacts.

Fourthly, a cost-benefit analysis will then be applied to assess the social, economic and environmental impacts of the trade liberalization.

Fifthly, based on the above cost-benefit analyses and scopes of implementation, a specific policy package will be recommended.

3.2 Methodology

3.2.1 The methodological approach of the JAPA Model

Econometric model and programming model are widely used for economic forecasting and for policy simulation. The JAPA model is a combination model consisting of different sub-models. It includes a data bank, a series of econometric models, a Partial equilibrium model and an interactive display system. This display system allows user to operate the model and to control the sub-models with ease because it can transfer information to sub-models within the JAPA Model. The model structure is described in Figure 3.1. (For detail see Zhou, 1999).

3.2.1.1 Econometric model

In the first sub-model, a Linear Approximation/Almost Ideal Demand System (LA/AIDS) is established to estimate human consumption level of various commodities and the price elasticity of major consumer goods, This LA/AIDS model

and other regression models also provide many coefficients for partial equilibrium model.

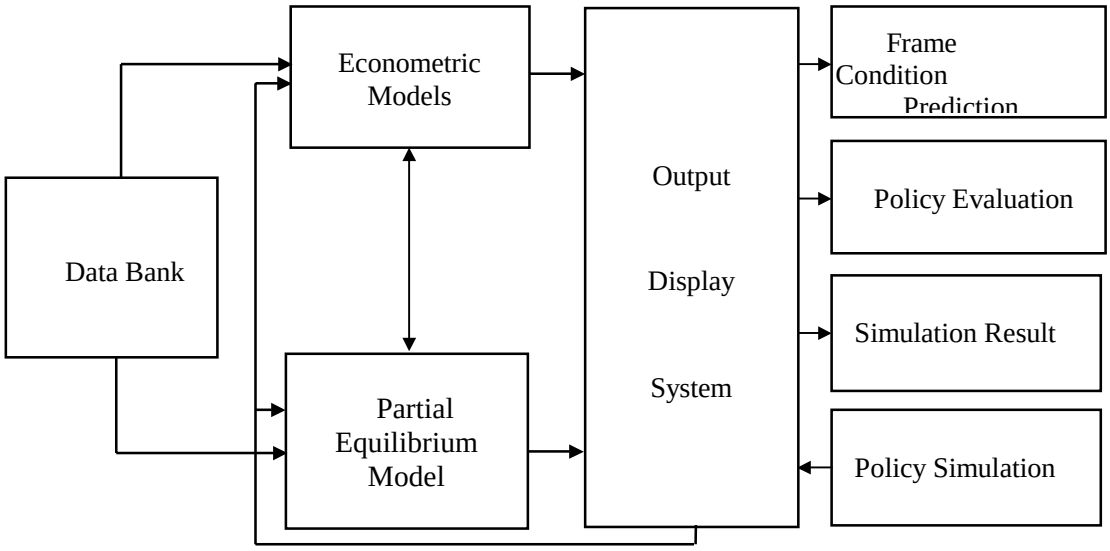

Figure 3.1. The structure of JAPA model

The AIDS model is usually specified as :

$$W_i = \alpha_i + \Sigma \gamma_{ij} \quad \ln P_j \quad + \beta_i \ln \left(\frac{X}{P}\right) \qquad (3.1)$$

with the theoretical restrictions imposed

$\Sigma \alpha_i = 1, \quad \Sigma\beta_i = 0, \Sigma \gamma_{ij} = 0$ (homogeneity), $\gamma_{ij} = \gamma_{ji}$ (symmetry)

The model that uses Stone's index is called the "Linear Approximate AIDS". The Stone index is specified as :

$$\ln P = \Sigma w_k \ln P_k \qquad (3.2)$$

where

W_k : share of total expenditure allocated to good k

P_k : price of good k

P : price index

X : expenditure level

A two-stage budgeting model is used to estimate expenditure share for Food 1 (crop products), Food 2 (animal products), Clothing, Daily household goods and others in first stage; and afterwards to estimate the expenditure share within the Food 1 group for wheat, rice, vegetables, fruits, tea, rapeseed and other crop products; and the expenditure share within the Food 2 group for pork, beef, poultry, egg, fish and other animal products in the second stage.

This LA/AIDS model will enter the partial equilibrium model to define the human consumption behavior. The price elasticity is widely used to show supply or demand responsiveness to price change. The price demand elasticity is used to show how the peoples' consumption level responds to price changes. Normally the price demand

elasticity is negative, implying that if the price of a commodity increases, the consumer decreases their consumption level of this commodity.

The price elasticity E is specified as:

$$E_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{W_i} - \frac{\beta_i}{W_i}\left[W_j + \sum_k W_k \ln P_k (E_{kj} + \delta_{kj}) \right] \quad (3.3)$$

where δ_{ij} is Kronecker delta ($\delta_{ij}=1$ when $i = j$; $\delta_{ij} = 0$ when $i \neq j$).

3.2.1.2 Partial equilibrium model

In the second sub-model, a partial equilibrium model is established. The objective function of this model is maximizing producer surplus and consumer surplus. The model includes crop sector and animal sector for five regions in Jiangsu province. It considers all input items and output products on the supply side, and human consumption, industrial demand, feed, storage, loss, regional transport, international import and export on the demand side. Figure 3.2. shows the structure of the partial equilibrium model. The characteristics of the partial equilibrium model are :

- multi-cropping system, JAPA model included 41 cropping and animal activities, 31 agricultural products ;
- interregional transport as endogenous variable;
- international trade as exogenous variable ;
- non-linear labor cost;
- calibration for non-linear cost for risk, disturbance and etc. ;
- calibration for non-linear cost for regional transport.

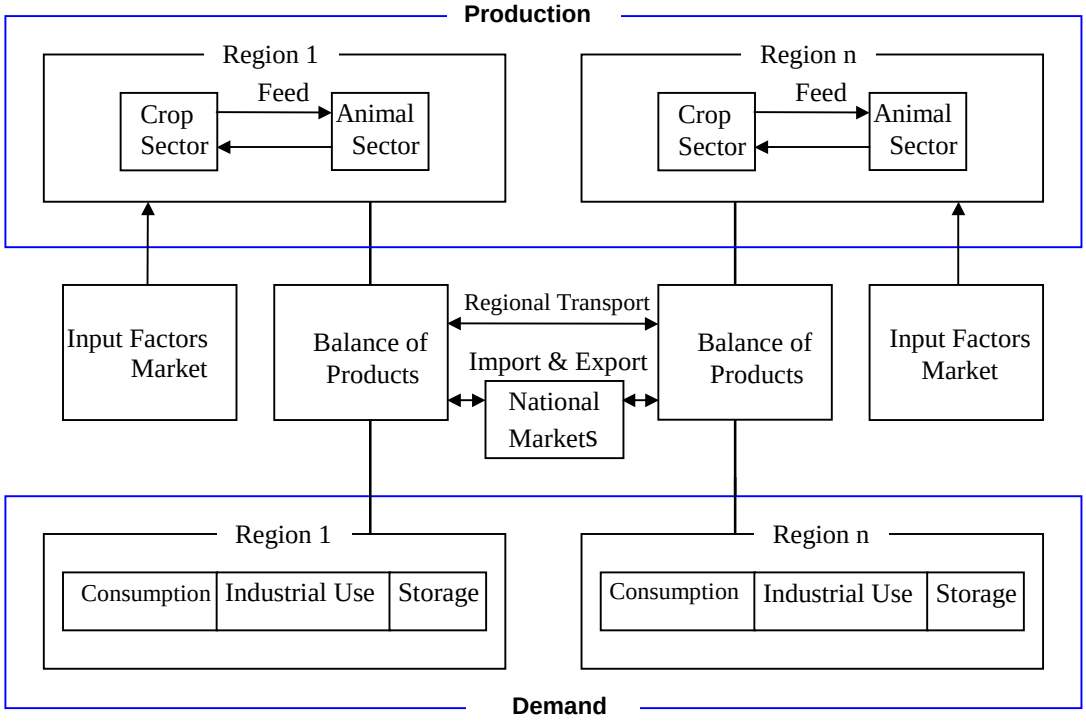

Figure 3.2. Structure of partial equilibrium model

Because this model is relative complex, an interactive display system has been established which makes it easier to go through the tables and change policy variables and then make simulations. This display system can transfer information from one program to another program and it can also control the partial equilibrium model. After the partial equilibrium model has run the simulation, the simulation results will be sent back to the display system.

The objective function of the partial equilibrium model is maximizing producer plus consumer surpluses. The Samuelsonian objective function has two components: the total area under the demand function and the area under the supply function. The first component enters the objective function with a positive sign and the second with a negative sign so that their algebraic sum is the sum of producer and consumer surpluses (see Figure 3.3).

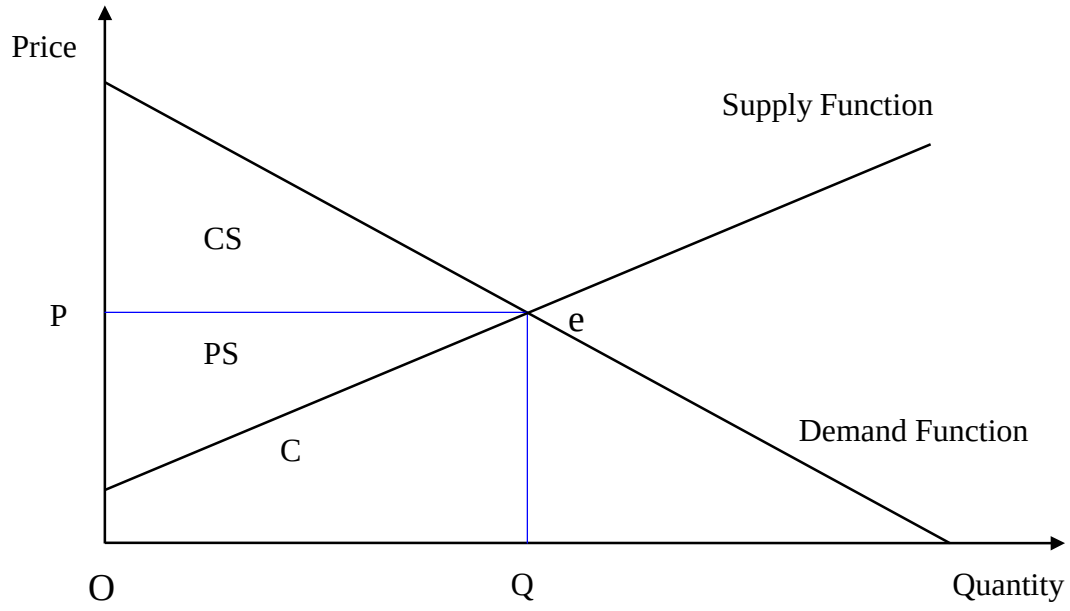

Figure 3.3 : The geometry of the objective function in a competitive market

Source:
Modified representation from HAZELL and NORTON 1986.

On the assumption of a competitive market without export and import, according to Figure 3.3, at the equilibrium solution e (P, Q), the value of the objective function can be expressed as follows:

Obj = CS + PS (3.4)

where

CS : consumer surplus
PS : producer surplus

Consumer surplus can be described as the difference between willingness to pay and actual payment. Producer surplus can be described as the difference between actual payment and variable costs.

The area between demand curve and supply curve is the sum of producer and consumer surplus. Therefore the objective function of the partial equilibrium model is expressed as follows:

Obj = Area under demand curve - Physical input costs - Transport costs - Labor costs
- Non-linear costs for risk - Non-linear costs for regional transport

This leads to the following mathematical formulation:

$$\text{Obj} = \sum_{r,O}\left[\text{alpha}\cdot XDC + 0.5\ \text{beta}\cdot(XDC)^2\right] \quad \text{----[Area under demand curve]} \quad (3.5)$$

$$- \sum_{r,aa}(INANPR \cdot INANQU)\cdot X_{aa} \quad \text{----[Animal physical cost]} \quad (3.6)$$

$$- \sum_{r,ac}(INCRPR \cdot INCRQU)\cdot X_{ac} \quad \text{----[Crop physical cost]} \quad (3.7)$$

$$- fa \cdot \sum_{r\,r,OA}(d \cdot XTC) \quad \text{----[Animal transport cost]} \quad (3.8)$$

$$- fc \cdot \sum_{r\,r,OC}(d \cdot XTC) \quad \text{----[Crop transport cost]} \quad (3.9)$$

$$- \sum_{r} clab\cdot lab^2 \quad \text{----[Non-linear labor cost]} \quad (3.10)$$

$$- \sum_{r,a} 0.5\ X'\cdot diag(nlcoc)\cdot X \quad \text{----[Non-linear cost for risk]} \quad (3.11)$$

$$- \sum_{r,O} 0.5\ delta'\cdot diag(nlcot)\cdot delta \quad \text{----[Non-linear cost for transport]} \quad (3.12)$$

where

XDC	: total demand
INANPR	: input price of animal production
INANQU	: input quantity of animal production
INCRPR	: input price of crop production
INCRQU	: input quantity of crop production
X	: activity level
fa	: transport fee for animal products
fc	: transport fee for crop products
d	: distance between regions
XTC	: regional transport quantity
wage	: wage rate
clab	: coefficient of labor function
lab	: labor use
nlcoc	: non-linear coefficient for risk
nlcot	: non-linear coefficient for transport
delta	: derivation from observed net transport stream

Besides the objective function, there are many constraints should be considered in the partial equilibrium model. The following constraints are included in the model.

- Acreage constraint for irrigated land
- Acreage constraint for dry land
- Labor force constraint
- Quota constraint
- Market balance constraint for products
- Feed balance constraint
- Calorie balance constraint
- Draft balance constraint

3.2.1.3 Scenario Analysis

As a decision making support system, the JAPA model allows policy makers to make scenario analysis in order to understand the positive and negative impacts of changing policies on agricultural production and consumption. JAPA model therefore serves as a simulation tool for changing agricultural policies, some other policies which may affect the agricultural sector and some important social and economic frame conditions. Stated below are some examples for scenario analysis:

- Population increase causes more demand for agricultural products which poses additional demand for agricultural production and may influence the prices.

- The decline of cultivated land causes a decrease in agricultural production which may lead to change of agricultural production structure and may eventually influence the prices of agricultural products.

- Inflation can also influence agricultural production, any change of the agricultural input prices will directly affect production costs, the profit of some agricultural production may decrease, therefore it could affect agricultural production.

- Increase of peoples' living standard may change the consumption patterns, i.e. change the consumption levels of different agricultural products, which will influence the demand levels. This causes a change of the agricultural production structure in order to meet the new demand pattern.

- Yield increase of agricultural production as a result of technology improvement plays a very important role in China. It is the most effective way to solve the shortage caused by population increase and cultivated land decrease.

- Agricultural tax is an important method to transfer a part of farmers' profit to government revenue. The government can get more revenue by increasing agricultural tax, but it may decrease farmers' enthusiasm for agricultural production.

- International trade of agricultural products can affect domestic market. The government can use import and export policies to adjust the production structure and the prices of agricultural products in the domestic market.

3.2.2 Baseline Projection

In order to provide a fair comparison basis for the scenario analysis on the impact of trade liberalization, it is necessary to make a baseline projection. The baseline projection takes following assumptions in future:

- Simulation year 2001;
- Population increases according to the current growth rate, the cultivated land decreases as the current trend;
- The average production yields in 1999 are used for the simulation, which means the yield increase in future caused by technical improvement is not considered in the simulation;
- Natural disasters are not considered.

After simulation JAPA model provides following results as listed in Table 3.1.

Table 3.1 Projected sown area and output in Jiangsu province 2001

	Sown area 1000 ha	Output Metric ton
Wheat	3,076.86	9,521,156.17
Barley	285.63	951,131.49
Rice	3,462.23	19,062,733.00
Corn	631.70	2,295,009.55
Soybean	343.19	784,444.79
Rapeseed	711.86	961,661.43
Cotton	830.18	583,617.26
Fruit	297.69	4,974,912.48

Source: Model projection results.

These and also other simulation results will be used as the baseline projection.

3.2.3 Scenario Analysis: Policy simulation

This model scenario analysis tries to find what kind of impacts could large agricultural import bring to China. According to US-China Agricultural Agreement 1999, China will adopt tariff-rate quotas (i.e. a system in which imports up to the quota level are charged a minimal tariff – usually 1-3 % -- and imports above that level a high tariff). Three examples are chosen for simulation:

Wheat – Quota on accession is 7.3 million metric tons, rising to 9.3 million metric tons by 2004. (Compares to present Chinese import level of less than 2 million metric tons.)

Corn – Quota on accession is 4.5 million metric tons, rising to 7.2 million metric tons. (Compares to present Chinese import level of 250,000 metric tons.)
Cotton – Quota on accession is 743,000 metric tons, rising to 894,000 metric tons by 2004. (Compares to present import level of 200,000 metric tons.)

The scenario analysis tries to find if the import TRQ's for the above three commodities can fully enter Chinese markets, what could be the consequence. For the simulation year, it is assumed that in year 2001 China can join the WTO, therefore the simulation assumption is the import TRQ's are wheat 7.3 million metric tons, corn 4.5 million metric tons and cotton 743,000 metric tons in 2001.

Actually the JAPA model is only for Jiangsu province, so it is necessary to divide the total TRQ's into the different provinces in China, Jiangsu province get its shares of TRQ's according to its production share, because the simulation tries to find the impacts on agricultural production. Therefore the import TRQ's shares of Jiangsu for simulation are wheat 365,700 metric tons, corn 91,357 metric tons and cotton 55,710 metric tons. Other external condition assumptions remain unchanged as the baseline projection.

The simulation results will be discussed in next chapter.

3.2.4 Economic valuation

To make Cost-Benefit Analysis, it is important to evaluate the impacts. It is easy to evaluate economic impacts (such as output and prices change), so this section discusses the technique of economic evaluation on social and environmental impacts.

3.2.4.1 Economic valuation of social impacts

The model scenario analysis results show a decrease of agricultural employment, the agricultural employment reduction is expressed as agricultural labor working days. The current wage rate of agricultural labor force per working day can be considered as the opportunity cost, therefore the decrease of agricultural employment can be evaluated as the total opportunity cost of the agricultural employment reduction (working days).

The model scenario analysis results also show a decrease in utilization rate of cultivated land, valuable land lies waste. The average shadow price of the cultivated land estimated by the partial equilibrium model can be considered as the land rent. The model baseline projection shows the average shadow price of the cultivated land is 892.8 RMB/ha. Therefore this shadow price multiply the unused cultivated land is the opportunity cost of valuable land which lies waste.

But some other social impacts such as social stability problem can not be evaluate here.

3.2.4.2 Economic valuation of environmental impacts

It is relative hard to make economic valuation of environmental impacts, because the consequence of some environmental problem is very hard to estimate.

3.2.4.2.1 Pesticide pollution

Cotton is one of the most susceptible crops to insect damage, and the production of cotton consumers 25 % of all insecticides used in the world (Patagonia, INC, 1996, cited in Shaw et al., 1997).

Among the three cotton producing regions in China, Xinjiang has the least insect problems and therefore the least pesticides input for cotton production. The Huang-Huai region and Yangtse river regions, however, are frequently troubled by insects infestations. On average, insecticides costs per hectare in these two regions are 13.4 % higher than that in the U.S. **(**Mao, 2000).

Insects that cause the most problems are the cotton bollworms. In some parts of China, the second and even third generations of cotton bollworms often occur. Cotton bollworms have detrimental effects on cotton yield. Since 1992, cotton production in places along the yellow river has been suffering from the cotton bollworm infestations. Take Hebei for example, from 1991 to 1992, its cotton output was decreased by 52 % as a result of bollworm attacks and in 1993 cotton output was further reduced by 47 % from the 1992's level, due to a bollworm calamity, compounded by severe verticillium wilt and drought attacks. (Yu et al., 1996)

In face of the serious insects problem, it is very hard to persuade farmers not to use insecticide, if alternatives are not readily available for them. What makes it even harder for the farmers to reduce insecticide use is the relative profitability of cotton compared to other crops and the sudden outbreak diseases and insects which may cause enormous damage on yield. Farmers feel compelled to apply large dose of insecticides to reduce the risks of immediate loss. Sometimes, this eagerness to cure the yield may lead to overuse of insecticides. More insecticides are sprayed in higher frequencies than needed. The excessive insecticides serves only to poison the environment instead of the insects. According to the estimation, the utilization rate of pesticides is about only 30 %, the rest 70 % of the pesticides is remained in the soil, or drained with rainwater into river and lake. According to our survey, the average pesticide input quantity is about 1,500 g/ha in cotton production, so only 450 g pesticide is effective, the rest 1,050 g pesticide will pollute environment.

The environmental pollution is converted in following way:

$$PE_i = \frac{QC_i}{D_i} \qquad (3.13)$$

where

PE_i : converted quantity

Q : quantity of waste in gram

C_i : concentration of pollution object

D_i : convert rate

According to the standard issued by the Environmental Protection Administration, the convert rate D_i for pesticides is 50. The average concentration of pesticide is assumed as 20 %.

It is also important to assign the economic values to the converted pollution quantity. Because it is difficult to estimate the direct and indirect damages of the pollution on human health; on wildlife; on water, soil and air contamination, an effective way is to find the shadow price to treat for the environmental pollution. For the shadow price we use the charge standard for pollution made by Chinese Environmental Protection Administration – 1.4 RMB per PE.

According to the equation (3.13) the converted quantity (PE) of pesticides is 4.2 per hectare, multiply by 1.4 to get the shadow price to treat for the environmental pollution 5.88 RMB/ha in cotton production. This can be considered as the cost of the environmental pollution for cost-Benefit Analysis.

The applied quantity of pesticide varies in crops, the converted quantities and the shadow prices of pesticide pollution of main crop production per hectare are calculated and listed in table 3.2.

Table 3.2 Converted quantities and shadow prices of pesticide pollution per hectare

	Converted quantity	Shadows price
Wheat	0.8	1.13
Barley	0.5	0.73
Rice	1.9	2.62
Corn	0.4	0.50
Soybean	0.4	0.59
Rapeseed	0.5	0.65
Cotton	4.2	5.88
Fruit	11.8	16.48

Source: Author's calculation.

3.2.4.2.2 Chemical fertilizer pollution

The main environmental impacts of fertilizer application arise when it is not properly used, or when (climatic) conditions are not as predicted. In China, fertilizer used for cotton account for 50 % of all physical inputs for the country as a whole (Mao 1999). According to the estimation, the utilization rate of chemical fertilizer is about only 35%, the rest 65 % of the chemical fertilizer is remained in the soil, or drained with rainwater into river and lake. A research project on agricultural pollution carried out by Nanjing Soil Research Institute of China Science Academy showed that the drained fertilizer to river and lake varied according to the soil types, fertilizer applied method, fertilizer applied time and the rainwater time and quantity, an experiment showed the on the dry land for cotton production the drained fertilizer to river and lake is 8.7 kg/ha (calculated in pure N) in 1988, about 2.6 % of the applied chemical

fertilizer. Calculating according to the average chemical fertilizer input quantity 365.4 kg/ha (calculated in pure N) by our survey, in each cotton growth season 9.5 kg chemical fertilizer (calculated in pure N) per hectare are drained with rainwater into river and lake, which is harmful to human and fishery.

Although 65 % of the applied chemical fertilizer can not be used for current crop growth, it may be useful for the crop growth in next season. The caused soil degradation can be solved by the application of organic manure, or compound fertilizer to adjust the balance of N, P, K and other elements. Therefore we focus the chemical fertilizer pollution on these chemical fertilizer which are drained into river and lake. According to the study by Nanjing Soil Research Institute of China Science Academy, about 6.9 % of applied chemical fertilizer in paddy is drained into river and lake. The percentage of applied chemical fertilizer drained into river and lake is assumed as 2.6 % for dry land crops (as in cotton production).

The applied quantity of chemical fertilizer varies in crops as well. According to the standard issued by the Environmental Protection Administration, the convert rate D_i for chemical fertilizer (N) is 800. With the equation (3.13), the converted quantities and the shadow prices of chemical fertilizer of main crop production per hectare are calculated and listed in table 3.3.

Table 3.3 Converted quantities and shadow prices of chemical fertilizer pollution per hectare

	Converted quantity	Shadow price
Wheat	11.89	16.65
Rice	39.55	55.37
Corn	11.22	15.71
Soybean	2.51	3.51
Rapeseed	10.71	14.99
Cotton	12.98	18.17
Fruit	19.91	27.88

Source: Author's calculation.

3.2.4.2.3 Plastic film pollution

Plastic film is widely used in cotton production. After harvest a large amount of broken films will remain in the field, the remaining films may hamper the crop growth in next season. This problem becomes very serious where the farm mechanization is carried out. In Xinjiang the problem of remaining films in cotton field is called as "white pollution", which is the biggest environment problem there. According to a survey made by the Agriculture Department of Xinjiang in 1999, the remaining films in the cotton fields have amounted to 52.8 kg/ha on average in Xinjiang (Mao, 2000), which causes about 15 million RMB direct economic lose in cotton production each year. On average about 60 % of cotton field is covered by the plastic film, calculating according to remaining broken films rate 20 %-30 %, the average remaining broken films in cotton field is 15 kg/ha, within 3 years it can reach 45 kg, about 360 thousand broken pieces. The normal broken films can remain in field for 100 year without degrade, it could bring enormous damage for agricultural

production. When the remaining broken films reach 37-45 kg in field per hectare, it can decrease wheat yield by 7 %, vegetable yield by 10 % or cotton yield by 10-15 %, the damage value is about 818.3 RMB/ha for three years remaining broken films accumulation. Therefore the average damage of plastic film pollution is estimated about 272.8 RMB/ha per year.

In other province where farm mechanization is not carried out in cotton production, the problem of remaining films is not so serious, because farmer can find the remaining broken films and remove them in ploughing. So the impact of broken films is not considered in the Cost-Benefit Analysis in Jiangsu province.

3.2.4.2.4 Irrigation problem

Cotton is a high water user. Therefore, water is a very important input in cotton cultivation. In China, annual water use for cotton amounts to 1,500-9,000 m^3 per hectare. (Mao,1998) China's cotton producing regions are mostly arid and semi-arid regions. Cotton production in these regions has been an important contributor to severe water shortage. In south Xinjiang, water diversion for cotton irrigation is drying up the lower reaches of the rivers in its domain.

To make the large volume of water use even more unsustainable is the inefficient irrigation practices. In China's cotton producing regions, the utilization ratio of irrigation waters is only 30-40 %, which is 20-30 % lower than those of the industrialized cotton producing countries. According to the research made by the Agriculture Department of Xinjiang, cotton yield has obvious relationship with irrigation. When irrigation water is below 6000-8250 mm/ha, the unginned cotton yield will be below 2250 kg/ha; when irrigation water reaches 8250-9000 mm/ha, the unginned cotton yield can reach 2250-3375 kg/ha; when irrigation water is above 9000 mm/ha, the unginned cotton yield can reach 3375-4125 kg/ha. (Mao, 2000)

Southeast China is wet or semi wet region, where rainfall is abundant, so irrigation is not a problem for agricultural production. Therefore the irrigation problem is not considered in the Cost-Benefit Analysis in Jiangsu province.

3.2.4.2.5 Monoculture and its side effects

In many cotton producing areas of China, cotton is produced as a monoculture. Take south Xinjiang for example. Continuous mono-cropping causes fertility deficiency that must be replaced by fertilizers inputs. It also creates favorable environments for pests , which require pesticides to control weeds and insects. Furthermore, the balance of soil pH may be disrupted as a result of monoculture.

In southeast China multi-cropping system is carried out, one field will be plant two or three times, so monoculture does not exist in Jiangsu, and this problem is not considered in the Cost-Benefit Analysis.

4 Integrated Assessment of Trade Liberalization

In this part integrated assessment of trade liberalization will be made. After China joins WTO, opportunity and challenge both exist in agricultural sector. The opportunity of agricultural export could be a potential possibility in the future, but the challenge of a large agricultural import is the fact right now. The basic situation in cotton sector is that China will import large quantity of cotton, promote textile industry development and increase the export of textiles and clothing.

Therefore the current challenge is that trade liberalization will cause a large agricultural import, mainly in wheat, corn, cotton, soybean oil and etc. This country study will mainly focus the cotton sector, but only one product (cotton) import could not bring big impacts on Chinese agriculture, many import commodities come into Chinese domestic market at the same time will bring enormous impacts. As appeared in US-China Agricultural Agreement, China will adopt tariff-rate quotas for bulk commodities, for technique reason the TRQ imports of three bulk agricultural commodities (wheat, corn and cotton) are chosen for the integrated assessment of trade liberalization.

JAPA model will be used to simulate the consequence of agricultural import. Comparing with the baseline projection, the consequences of large import of the three commodities can be found. On this basis the social economic and environmental impacts will be analyzed.

4.1 Economic Impacts

In chapter 3 the methodology of JAPA model and scenario analysis is discussed. The model scenario analysis results indicate that the large imports of wheat, corn and cotton will bring following enormous economic impacts:

4.1.1 Help to solve the shortage of two commodities

The baseline projection shows in 2001 Jiangsu has shortages in cotton and corn, but it does not has the shortage in wheat. Therefore the import of cotton and corn can help Jiangsu to solve the shortage.

4.1.2 Sown area and output decrease

The wheat, corn and cotton imports bring a big pressure on agricultural production, therefore the production structure should be adjusted to adapt the big change. According to the optimal solution of the partial equilibrium model, the sown area of wheat will decrease by 2.93 %, that of corn by 3.18 % and that of cotton by 8.83 %, as the result of structure adjustment, the sown areas of other crop products may increase (see Table 4.1). Anyway total sown area will decrease by 1.2 %, about 88,427 hectares.

Table 4.1: Simulated sown area, output and price changes

	Sown area change %	Output change Metric ton	Price change %
Wheat	- 2.93	-296,592.45	- 1.96
Barley	0.07	627.09	- 0.86
Rice	1.37	256,171.46	- 3.22
Corn	- 3.18	-83,596.49	- 5.41
Soybean	1.93	14,877.19	- 4.28
Rapeseed	0.42	3,227.86	- 1.64
Cotton	- 8.83	-56,517.00	- 3.40
Fruit	0.25	12,355.67	- 2.70

Source: Model simulation results.

The production structure adjustment will also cause the output change. Table 4.1 shows that the wheat output will decrease by 296,592.45 tons, corn decreases by 83,596.46 tons and cotton by 56,517 tons, at the same time rice output will increase by 256,171.46 tons, soybean increases by 14,877.19 tons, rapeseed by 3,227.86 tons and fruit by 12,355.67 tons.

4.1.3 Prices of agricultural products decrease

The wheat, corn and cotton imports will cause the decrease of prices, not only the prices of the three commodities, but also the prices of all other crop commodities, because the production structure adjustment increases the sown area and output of other crop production. The model scenario analysis results in Table 7.2 shows the price of wheat will decrease by 1.96 %, corn by 5.41 %, cotton by 3.40 % and the price of rice also decreases by 3.22 %, soybean by 4.28 %, rapeseed by 1.64 % and fruit by 2.70 %.

The price decrease of agricultural commodities is favorable to consumers, and is also favorable to animal production because some main products and byproducts can be used as feed, but it is unfavorable to producers of agricultural commodities.

4.1.4 Producer surplus and farmers income decrease

After agricultural production structure adjustment, the producer surplus for crop products will decrease by 2.2 %. Owing to the price decrease, farmers income for crop production will decrease by 1,359 million RMB.

4.2 Social Impacts

Besides the above economic impact, large import of wheat, corn and cotton will also bring enormous social impacts:

4.2.1 Promote agricultural production structure adjustment

The trade liberalization could promote the agricultural production structure adjustment according to the comparative advantage. China need to find its position in the global market, and reallocate the resource to the products which have comparative advantage.

4.2.2 Utilization rate of cultivated land decrease, valuable land lies waste

Jiangsu province is in southeastern China, multi-cropping system is carried out in Jiangsu, so there may be two or three harvests in one field. There are many combinations of cropping patterns, so sown area and cultivated land usage are differentiated. Planting packages for multi-cropping system are used in the JAPA model. After agricultural production structure adjustment according to the import increase, the model scenario analysis results indicated that the valuable cultivated land can not be sufficiently used, about 26,331 hectare cultivated land will lie waste.

4.2.3 Reduction in the self-sufficiency rates of the agricultural Commodities

Owning to the three commodity imports, after the production structure adjustment, the self-sufficiency rate of the three agricultural commodities will decrease, i.e. the self-sufficiency rate of wheat decreases from 95.87 % to 92.97 %, that of corn decreases from 39.55 % to 38.16 %, and cotton from 104.45 % to 95.23 %• meanwhile the self-sufficiency rate of rice increases from 109.90 % to 111.40 %, that of soybean from 42.46 % to 43.28 %, rapeseed from 70.24 % to 70.48 % and fruit from 163.40 % to 163.81 %.

4.2.4 Agricultural employment decrease

The model scenario analysis result also shows that after the production structure adjustment, the agricultural employment decreases by 50.1 million working days, farmers do not have enough farm work to do.

4.2.5 Poverty problem

Poverty is still a big problem in China. Until now about 60 million rural residents are still under the poverty line, they are mostly located at less developed area, where the agricultural production constitute their main income source. The decrease of farmer's income could worse the poverty in rural area.

4.2.6 Social stability problem

The decrease of farmer's income and the increase of unemployment could be social unstable factors. If a large quantity farmers move to urban area to find job, it could worse unemployment in urban area.

4.3 Environmental Impacts

The model scenario analysis results show that large imports of wheat, corn and cotton may have following environmental impacts:

4.3.1 Reduction in application of chemical fertilizer and pesticides

The wheat, corn and cotton imports will cause an agricultural production structure adjustment. According to the optimal solution of the partial equilibrium model, the sown area of crop products will decrease. It could result a decrease in chemical fertilizer and pesticide application. The reduction in applied chemical fertilizer and pesticides may include two parts. Firstly, the production structure change causes the sown area decrease, which will reduce the inputs, which include chemical fertilizer, pesticides, water and etc. The model scenario analysis shows that the usage of chemical fertilizer will decrease by 1.01 % and pesticide by 1.39 % comparing with the baseline projection. Secondly owing to the prices of agricultural products decrease, farmers could reduce the quantities of applied chemical fertilizer and pesticides. For example, as the cotton purchase price decreased from 12,350 RMB/ton in 1998 to 7,660 RMB/ton in 1999, farmers reduced the applied quantities of chemical fertilizer by 6.42 % and pesticide by 29.82 % (the applied pesticides change was also related to the disease and pest condition).

4.3.2 Cultivated land may be lost

Cultivated land is a very important revival agricultural resource. China is a cultivated land scared country, the cultivated land per capita is 0.11 hectare. In Jiangsu the cultivated land is even less, only 0.07 hectare per capita and 0.185 hectare per agricultural labor force in 1999. In such a condition, the waste of cultivated land could be a very serious problem for the sustainable agricultural development.

After agricultural production structure adjustment owning to the import increase, the model scenario analysis results indicated that the valuable cultivated land can not be sufficiently used, about 26,331 hectare cultivated land will lie waste.

If cultivated land lies waste, this part of valuable cultivated land could be occupied for non-agricultural purpose, such as city extension, industry and building, which will lose sustainability in agricultural production capacity of China. In northwestern China, if the cultivated land is not used and irrigated, it will turn to wasteland. The decrease of cultivated land has been a serious phenomenon in China. The average cultivated land decrease rate was 0.3 % for last 15 years, it means China lost 282 thousand hectare valuable cultivated land each year on average.

4.3.3 Agricultural production and trade may fall in a vicious circle

Owning to the low land productivity and labor productivity, some developing countries do not have competitive advantage in agricultural products. After the trade liberalization, they will find that their products can not contend with imported high quality, low price products. The agricultural imports will decrease the prices of domestic products, farmers have no interest in investing in agricultural production to improve technique and product quality, so agricultural production come to decline. This will cause the shortage in agricultural products and need to increase agricultural import in turn. More valuable cultivated land will lie in waste and more agricultural commodities need to be imported to solve the shortage of agricultural commodities. So agricultural production and trade may fall in a vicious circle, finally the countries will meet the problem of imbalance of foreign trade, the domestic currency may devaluated and it may cause inflation, which is not sustainable.

5 Valuation of Trade Liberalization

Based on the above integrated assessment, the impacts of trade liberalization will be evaluated in order to make the Cost-Benefit Analysis.

5.1 Economic impact

The model scenario analysis results show that agricultural import can help China to solve the shortage of agricultural commodities. Jiangsu will meet shortages in corn and cotton in 2001, therefore the import of corn by 91,357 metric tons and cotton 55,710 metric tons will bring positive impact for solving the shortage, this is evaluated as benefit about 632.01 million RMB.

To adapt the situation of agricultural import, the agricultural production structure should be adjusted. The sown areas and outputs of some agricultural products will decrease, so farmers will get loss from the output decrease. For example after the production structure adjustment, the output of wheat will decrease by 296,592.45 metric tons, evaluated as -301.93 million RMB; that of corn decreases by 83,596.49 metric tons, evaluated as -83.43 million RMB; that of cotton decreases by 56,517.00 metric tons, evaluated as -548.67 million RMB; on the other side the output of rice increases by 256,171.46 metric tons, evaluated as 270.52 million RMB; that of fruit increases by 12,355.67 metric tons, evaluated as 8.23 million RMB. The aggregated impact of the outputs change for all agricultural products is evaluated as -583.39 million RMB.

The large agricultural import will cause price decreases of all agricultural commodities. Table 4.1 shows that the price of wheat will decrease by 1.96 %, the of rice decreases by 3.22 %, corn by 5.41 %, soybean by 4.28 %, rapeseed by 1.64 %, cotton by 3.4 % and fruit by 2.7 %. The price decreases are negative to the producer of agricultural products, because farmer will get loss from the price decrease; but the price decreases are positive to consumers. The impact of price decrease is evaluated as 1,359.72 million RMB.

The above two impacts constitute most part of farmers' income decrease, another factor affecting farmers' income could be the decrease of agricultural employment which will be discussed as social impact.

After China's access to WTO, China will reduce the tariff to 3 % within TRQ's, so the government tariff income will decrease. The tariff decrease for import the three commodities is evaluated as 190.82 million RMB.

China should pay foreign currency to import agricultural commodities, the cost for import the three commodities is evaluated as 1,004.29 million RMB.

5.2 Social impact

The model scenario analysis results also indicate that agricultural import could bring social impacts. After agricultural production structure adjustment, the utilization rate of cultivated land will decrease, about 26,331 hectare cultivated land will lie waste. The average shadow price of the cultivated land estimated by the partial equilibrium model is 892.8 RMB/ha. Therefore the opportunity cost of cultivated land which lies waste is 23.51 million RMB.

As the side effect of sown area decrease, the agricultural employment will decrease by 50.1 million working days. Calculated according to the current agricultural labour force wage rate, the opportunity cost of the increased unemployment is 651.31 million RMB.

The trade liberalization could promote the agricultural production structure adjustment according to the comparative advantage, but the impact is not possible to evaluate until now.

5.2 Environmental impact

The agricultural commodity import could reduce the sown area, so it also reduce the quantities of applied chemical fertilizer and pesticides. Table 4.1 shows the simulated sown area changes of crop products, and Table 3.2 shows the shadow prices of pesticide pollution per hectare for each crop products, Table 3.3 shows the shadow prices of chemical fertilizer pollution per hectare, these can be used to estimated the impact on environmental.

If we only consider the reduced quantities caused by the decrease of sown area, the reduction of pesticide application can be evaluated as 0.38 million RMB, and the reduction of chemical fertilizer application can be evaluated as 0.29 million RMB.

Owing to irrigation, soil degradation and monoculture are not the problem to Jiangsu province, and the plastic film pollution is not serious here because farm mechanization is not carried out in cotton production, these factors are not considered in the CBA.

5.3 Net Impacts (benefits/costs)

In this part the Cost-Benefit Analysis (CBA) will be applied to assess the impact of the import TRQ’s of the three agricultural commodities. Because there is difficulty to assign economic values to some social and environmental impacts, therefore the CBA only includes impacts which can be evaluated. The results of CBA is listed in Table 5.1.

Table 5.1: Cost-Benefit Analysis on the impacts in Jiangsu

million RMB	
Costs of the import TRQ's of the three agricultural commodities	
Agricultural output value changes	- 583.39
Prices of agricultural products decrease (for producer)	- 1,359.72
Agricultural employment decrease	- 651.31
Tariff lose	- 190.82
Cultivated land lies waste	- 23.51
Payment for the import	- 1,004.29
Total costs:	- 3,813.04
Benefits of the import TRQ's of the three agricultural commodities	
Solve the shortage of the two commodities (corn and cotton)	632.01
Prices of agricultural products decrease (for consumer)	1,359.72
Reduction of pesticide application	0.38
Reduction of chemical fertilizer application	0.29
Total benefits:	1,992.40
Net benefits:	- 1,820.64

Source: Author's calculation according to simulation results.

Table 5.1 shows after the import of the three agricultural commodities, the agricultural production structure change could cause the agricultural output value decrease by 583.39 million RMB; the price decrease will reduce farmer's income by 1,359.72 million RMB; the agricultural employment will decrease by 50.1 million working days, the shadow price is evaluated as 651.31 million RMB; after China decrease the tariff rate to 3 %, the tariff lose for the TRQ's import of the three commodities is about 190.82 million RMB; the shadow price of the cultivated land which lies waste is evaluated as 23.51 million RMB, and the payment for the import the three commodities is about 1,004.29 million RMB. So the total costs is 3,813.04 million RMB in Jiangsu province.

On the other side, the imports can solve the shortage of corn and cotton in Jiangsu (Jiangsu does not have wheat shortage), so the benefit for this is 632.01 million RMB; and the price decrease of agricultural commodities is a positive impact to consumers, so it brings 1,359.72 million RMB benefit to consumers as well. The agricultural imports can reduce the application of pesticides and chemical fertilizer, so it reduce the environment pollution and get its benefit about 0.38 million RMB and 0.29 million RMB respectively. Therefore the total benefits is 1,992.40 million RMB in Jiangsu.

Comparing the total costs and total benefits, it can be found that the net benefits for the import of the three commodities is -1,820.64 million RMB in Jiangsu.

6 Policy Package

Based on the above analysis, this chapter aims to propose policies to mitigate negative and enhance positive impacts, provide strategy for sustainable development in cotton production, and submit suggestion for establishing market oriented cotton marketing system.

6.1 Main Impacts Identified (positive and negative)

6.1.1 The impact of China's access to WTO specially on cotton sector

Under the US-China Agricultural Agreement, China will permit imports of 743 thousand metric tons of cotton at a duty of 3 % (1998 imports equaled 200 thousand metric tons). This volume will grow to 894 thousand metric tons by 2004. Imports above these levels will face a higher duty of 76 %, which will be reduced to 40 % by the year 2004. China made specific commitments to administer these TRQs so as to maximize the potential that they will be filled. Specifically, if TRQs are not utilized they will be redistributed to other end users who have an interest in importing. Moreover, 33 % of the TRQ will be reserved for importation through state trading enterprises and 67 % will be reserved for non-state trading entities. Finally, if a TRQ share that was reserved to be imported by a state trader is not contracted for by October for any given year, it will be reallocated to non-state trading entities.

The TRQ for cotton is enormous in relation to Chinese cotton consumption. According to the statistics, the cotton consumption level of textile industry is 3.8 million metric tons in 1999. If China import 743 thousand metric tons to 894 thousand metric tons of cotton annually, the cotton import could take the share of 20 % to 23.5% of the Chinese total cotton consumption.

The tariff rate for cotton is settled very low. According to the US-China Agricultural Agreement, Chinese overall tariff will reduce from present 21.1 % to 17 % on average, the tariff for agricultural products will decrease from 15 % to 14.5 %. But the tariff within TRQ is only 1 – 3 %, this level is much lower than the average tariff of agricultural products. So it is very favorable for foreign cotton exporter.

According to the US-China Agricultural Agreement, Chinese will give up export subsidy, but US can continue to use subsidy for cotton export, therefore China will lose cotton export advantage in the world market.

China's textile exports to developed countries would be greater with accession to the WTO, therefore cause an increase in cotton consumption. This brings a pressure to cotton production, China has to produce more cotton in the limited cultivated land. If China's cotton production can not meet the demand of cotton consumption, relaxation of import barriers would increase cotton imports.

6.1.2 The positive impacts identified

The trade liberalization could boost Chinese textiles and clothing export, which will bring high demand for cotton. The agricultural import could solve the shortage of some agricultural commodities in China; it also promotes Chinese agricultural production structure adjustment. On the environment, the cotton import could reduce the acreage of cotton, therefore reduces the applied quantities of chemical fertilizer and pesticide.

6.1.3 The negative impacts identified

China's WTO accession may also increase uncertainty for Chinese textile and clothing export. The Sanitary and Phytosanitary Measures (SPM) could be used by some countries to hinder imports, which could cause enormous fluctuation on the production and price of textiles.

As Cotton sector is closely linked to the textiles industry, so the fluctuation on the production and price of textiles may cause uncertainty for cotton production and its price. The cotton import increase (Tariff Rate Quota) could bring enormous shock to domestic cotton production and marketing. The sown areas and output of cotton will decrease; the price of cotton in domestic market will decrease; the agricultural employment will decrease; and influence the benefit of cotton farmers. The decrease of farmer's income could worse the poverty in rural area, and it could cause social unstable problem.

After agricultural production structure adjustment owing to the import, the utilization rate of cultivated land will decrease; the self-sufficiency rate of cotton will decrease; valuable cultivated land will lie waste, they could be occupied for non-agricultural purpose, such as city extension, industry and building, which will lose sustainability in agricultural production capacity of China.

There is also a possibility for developing country that the agricultural production and trade may fall in a vicious circle after trade liberalization. Owning to the low land productivity and labor productivity, some developing countries do not have competitive advantage in agricultural products. After the trade liberalization, they will find that their products can not contend with imported high quality, low price products. The agricultural imports will decrease the prices of domestic products, farmers have no interest in investing in agricultural production to improve technique and product quality, so agricultural production come to decline. This will cause the shortage in agricultural products and need to increase agricultural import in turn. More valuable cultivated land will lie in waste and more agricultural import will be needed to solve the shortage of agricultural commodities. So agricultural production and trade may fall in a vicious circle, finally the countries will meet the problem of imbalance of foreign trade, the domestic currency may devaluated and cause inflation.

6.2 Proposed Policies to Mitigate Negative and Enhance Positive Impacts

6.2.1 Increasing the competitive advantage of Chinese cotton

After China's access to WTO, Chinese domestic markets become a part of the global market. It is important to increase the competitive advantage of cotton.

6.2.1.1 Supporting agriculture with 'Green box' policies

The agricultural basis in China is weak, agricultural input is very low comparing with other countries. The agricultural production has low resistance to natural disaster such as drought, flood, typhoon, plague of pest and disease. For example, the main cotton production regions are located at the dry or semi-dry areas on the north side of Yangtse river, water shortage is a restrictive factor for cotton sustainable development. It is important to use 'Green box' policies to build water conservancy projects and improve irrigation system, to protect agricultural environment, to improve rural infrastructure, to establish marketing information service and to invest in research, training and extension in agriculture.

6.2.1.2 Promoting new cotton variety breeding

For long time Chinese cotton variety breeding was aimed at increasing yield, did not pay enough attention on quality improvement. An obvious fact is that Lumian -1 was taken by Shandong Province as a good cotton variety for extension because of its high yield, but afterwards the textile mills found that this variety had very low quality.

The Chinese prevalent cotton varieties have an average length of 29-31mm and an average fineness of 5500-6500m per gram, which are well above the world average level. There is a big demand for long-staple variety (length above 35), medium long-staple variety (length 33-35), the variety with fiber strength 23-28 gf/tex, micronaire 3.7-4.2, and varieties which are resistant to blight, cotton wilt and pest.

6.2.1.3 Promoting the production of special purpose cotton

Because textile industries are required to produce high quality products, they pose increasing demand for special purpose cotton, such as long-staple cotton, medium long-staple cotton, color cotton and organic cotton. Owing to the climate condition, Xinjiang has the advantage to produce long-staple cotton and organic cotton. The Huang-Hui region and Yangtse river region may try to produce medium long-staple cotton and color cotton.

6.2.1.4 Adjusting cotton regional distribution

The mainland of China has 31 provinces, among them 24 provinces produce cotton. Some province have strong comparative advantage, while other do not. It is necessary to analyzing the production capacity and future demand, adjust cotton regional distribution in order to shift cotton production to regions which have comparative

advantage. There are top 10 cotton produce provinces, which can be considered as the cotton production zone. The local government should invest in the capital construction on farmland and in variety, technique extension to stabilize cotton production.

6.2.1.5 Establishing cotton production cooperative

China is a cultivated land scared country, the cultivated land per capita is 0.11 hectare. In Jiangsu the cultivated land is even less, only 0.07 hectare per capita and 0.185 hectare per agricultural labor force in 1999. This small cultivated land is normally divided to separate plots, this situation results in the low land productivity and also low labor productivity, it hinders the application of new technology. Farmer do not have enough interest in increasing agricultural input, the small production can not suit the big market.

Establishing cotton production cooperative is a possible solution. The cooperative is organized by farmers on the principle of voluntary participation. It should be a corporate organization, and can take legal responsibility. The cooperative has the advantage to purchase qualified cotton seed, increase agricultural input, collect marketing information and sign contracts with other organizations.

6.2.2 Maintaining the basic balance between supply and demand of cotton

The final object of government intervention in cotton is to maintain the basic balance between supply and demand, and avoid fluctuation. This balance includes regional balance and variety balance.

Although Xinjiang province has the comparative advantage for cotton production, but China can not move most cotton production to Xinjiang, the limitation factors of cotton production in Xinjiang lie in irrigation water, uncertainty of natural disaster, transport capacity, and regional cotton process capacity. Cotton regional balance means that regional cotton production quantity should be decided according to the regional cotton process capacity, transport capacity and cost, natural resource limitation and it should try to minimize the risk of possible natural disasters.

Different textile industries need different kinds of cotton (grade and variety). Some textile industries need long-staple cotton to produce high quality textiles, some need short-staple cotton to produce jeans, some need organic cotton and color cotton. Cotton variety balance means that China should not only to pursue the supply-demand balance of aggregate cotton quantity, but also the balance of main cotton grades and varieties.

6.2.2.1 Completing the multi-channel cotton marketing system, promoting lateral cooperation among different cotton marketing entities

After the old monopoly cotton marketing system is abolished, a chaos in cotton market occurs as expected. The current “cotton war” characterized that different cotton marketing entities re-divide the cotton market share. China is in the process to establish a new, open cotton marketing system. It is important to coordinate

relationship among different cotton marketing entities in order to avoid vicious competition.

Under current situation, different cotton marketing entities have their advantages and disadvantages. It is necessary to promote lateral cooperation among different cotton marketing entities. For example, the textiles mills may cooperate with cotton gin factories of Supply and Marketing Cooperatives (SMC) in cotton purchasing and processing. The textile mills provide cotton purchase fund, the cotton gin factories of SMC purchase cotton and process it. Both of them can benefit from this way.

6.2.2.2 Promoting Order Cotton Production

One of the approach for pursuing the balance of cotton grades and varieties is to promote Order Cotton Production. The textile industries and cotton production cooperative (or farmers) can write contract for cotton production and purchase. The contract should indicate the purchase quantity of cotton, the variety and grade and price, the purchase price will be decided according to the cotton price of wholesale market at the harvest season (for example 5 % higher than the price of National Cotton Exchange). The textile industries pay earnest money to the cotton production cooperative, both sides of contract should take legal responsibility for the contract. This method can ensure textile industries to get qualified cotton when they have special requirement on cotton quality and variety, it can also stabilize the cotton production.

6.2.2.3 Improvement of cotton wholesale market

A National Cotton Exchange has been established on April 2000 in Beijing. It has 76 seats, most of them belongs to SMCs, and 17 temporary seats for other cotton marketing entities. The Exchange sells old cotton (cotton stocks and reserves) and Xinjiang cotton at auction, about 10 thousand metric tons maximal per days. Although the Exchange established 20 network stations by its network frame, it is only allowed to make deal in Beijing central station. In other stations it is only possible to observe the auction information from the network.

There are still improvements need to make for the National Cotton Exchange. The Exchange only sells old cotton (cotton stocks and reserves) and Xinjiang cotton at auction, very large quantity of new cotton is excluded at the auction. Therefore the Exchange do not provide price signal for new cotton. So it is urgent to include new cotton at the auction in the National Cotton Exchange.

There are only 93 seats in the National Cotton Exchange, which is too fewer for cotton marketing dealer in whole China. The future target of the Exchange should be that every cotton marketing dealer with license can have seat in the Exchange, in any network station of the Exchange he can make deal for any kinds of cotton.

Except the National Cotton Exchange, China needs cotton spot transaction markets in the main cotton production regions. For long time Chinese government do not allow existence of cotton spot transaction markets to ensure the monopoly cotton marketing of SMC. After the monopoly cotton marketing system is removed, it is necessary to establish cotton spot transaction markets in the main cotton production regions.

6.2.2.4 Establishing textile exporter association

After China's accession to WTO, many enterprises could have the license to export textiles and clothing, it is necessary to establish a textile exporter association in order to avoid vicious competition in reducing prices and to guarantee the product quality. Chinese textile industry should change the strategy from produce low price products to produce medium price - medium quality products, and even high quality products (such as organic cotton or color cotton products).

6.2.2.5 Establishing agricultural consulting system

After the economic reform, the production plan made by the governments in agricultural sector were abolished. Farmers make their own production decision, but they often confused by different information. Most farmers eager to know is what crop and how much they should produce in order to sell a good price?

Actually marketing information should be collected and analyzed in order to guide agricultural production. An agricultural consulting system can provide such kind of service. As a Non-Government Organization (NGO) the agricultural consulting system works as an intermediary among government, processing industrial enterprises of agricultural products, wholesale markets, agricultural cooperative and farmers. After China's WTO accession, China have to adjust the structure of agricultural production, this structure adjustment program should through the consulting system to farmers.

6.2.3 Stimulate Chinese cotton sustainable development

Different regions have different natural conditions and different degree of dependence on unsustainable production methods. Therefore, in transition to sustainable cotton production, they should have different choices as to which alternative methods to choose.

6.2.3.1 Decreasing the applied quantity of chemical fertilizer

One of the environmental problem with the cotton production is that the utilization rate of chemical fertilizer is very low (about 35 %), a large part of them are wasted and caused environment pollution. So China should give support on research and extension of applying chemical fertilizer more efficiently. If the utilization rates of chemical fertilizer can be increased to 45-50 %, the applied chemical fertilizer quantity could be reduced.

Although all the fertilizers have adverse effects on the environment. Natural manure are prone to cause less problems than chemical fertilizers. Crop rotation can reduce the risk of depletion of one mineral season after season. Different crops use and replenish different minerals and thus decrease the need to apply fertilizers. Plant residues can be remained in the field after harvest so that the mineral within the crop stalks decompose back into the soil and therefore lessen the pressure to apply chemical fertilizers where insects do not pose serious problems.

6.2.3.2 Establishment of pest prevention service

The utilization rate of pesticides in China is also very low (about 30 %), there are several reasons, firstly farmers can not find the right time to kill the pests at their early stage, after the pest plague become very serious they have to use large quantity of pesticides to control the situation; secondly farmers like to over use the dose of applied pesticides to ensure the pests been killed immediately; thirdly when farmers do not apply pesticides at the same time, pests can move from one plot to another plot to avoid pesticides; fourthly farmers like to buy low price but high toxic pesticides, which is harmful to environment.

In order to increase the efficiency of applied pesticides, it is necessary to establish pest prevention service. The service will write contract with farmers and production cooperative to provide service of controlling plant diseases and elimination of pests. The advantage of the service is it can predict plant diseases and pests plague and use qualified pesticides to eliminate them efficiently, at the same time minimizes the environmental pollution.

6.2.3.3 Integrated Pest Management

Integrated Pest Management (IPM) consists of a careful integration of a number of available pest control techniques that discourage pest population development and keep pesticides and other interventions to levels that are economically justified and safe for human health and the environment. IPM emphasizes the growth of a healthy crop with the least disruption of agro-ecosystems, thereby encouraging natural pest control mechanisms. It seeks to reduce pest populations to economically manageable levels though a combination of biological control (use of pest resistance varieties), cultural control (e.g. crop rotation, inter-cropping), physical control (hand picking of pests, use of pheromones to trap pests) and less toxic chemical controls. However, it allows the use of chemical pesticides, even synthetic and toxic ones, only when there is a real need (Banuri, 1998).

A few countries in Asia have adopted national IMP policies including China, with the help of national and international agencies. Although these policies were targeted at rice production initially, their effects spread to other crop sectors subsequently. Presently, a 12 million-Euro project to enable small cotton farmers in Asia to cut their insecticide use by half and increase their production is to be implemented by FAO.

The European Union-funded project will train 90 000 small cotton producers in integrated pest management. Six Asian countries have participated in the project, China, India, Pakistan, Bangladesh, the Philippines and Viet Nam. The EU project provides for 3 800 Farmers' Field Schools. The schools use the participatory learning approach to educate farmers in IPM techniques, as have been done by Indonesia. Farmers will learn more about cotton agronomy, cotton agro-ecosystems and alternative pest control techniques. They will be trained in how to physically remove and destroy pests, build up beneficial predators, and rotate and diversify crops. The aim is to keep a balance between pests and their natural enemies and to keep the spraying of expensive and potentially damaging and dangerous insecticides to an absolute minimum. The project will also promote farm-oriented local research. Pilot projects in China financed by the Asian Development Bank has shown that cotton

farmers have reduced their use of pesticides and increased yields at the same time. (FAO, 1999)

6.2.3.4 Partial alternatives to pesticide

Partial alternatives exists that lead to more sustainable cotton production. Partial alternatives include Biological Control, Microbial Control, Control through sex pheromones and physical removal of pests and genetically modified cotton. The first two are based on the idea that every organism on earth has natural enemies. Biological control emphasize on the importance of parasites and predators as natural enemies and microbial control usually involves a spray containing a bacterium or a fungus or a baculorirus. Pheromones are the substances female insects secret to attract males for mating. It is possible to trap part of the pests population through imitating these pheromones by making synthetic substance with the same effect. (Harry de Vries, 1995)

6.2.3.5 Genetically modified cotton

Breeding new varieties that is resistant to insects through genetic engineering is a fundamentally important way of raising cotton yield without using pesticide. The most commonly used methods include modifying plant characteristics (eg. Shape and size of leaves which form the source of nutrients for insects), the speed of ripening (thus limiting the exposure tile to insects during the vulnerable stages), and the introduction of insects repellent genes into the plant (Banuri, 1998).

In China, insects, especially cotton bollworms, have caused a 15 - 20 % output loss in an average year and they are unusually rampant in the last few years. However, most of the breeds are not insects- resistant. The most commonly used genes to build cotton resistance to pests is those for the Bt (Bacillus thuringiensib) toxin. Bt cotton variety 33b of Delta & Pine Land Company shows resistance to pests and achieve high yield at same time.

Anyway GMO production may have the possibility for inducing other environment problem, such as transference of the gene to wilds and pests and inducing super wilds and pests, damage on the bio-diversity, safety of GMO food, and etc. Heated arguments have been made on this topic. It is necessary for China to issue a regulation for GMO products, it is also important to apply ecolabelling for GMO products, the ecolabel should indicate which gene has been modified in the product, which make it possible to identify the specific product when some transferred genes proven not safe. Consumer have the right to know the information about GMO products.

6.2.3.6 Pesticide degrade bacteria

The newly developed “bio-degrader”, capable of degrade 95 % of pesticide residues within 5-10 days, is very effective in mitigating the damages caused by pesticides. However, the price of “bio-degrader” is relative high, it has confronted major financial obstacles in China.

6.2.3.7 Increasing the efficiency of irrigation

In the northwest area it is very important to increase the utilization rate of irrigation water. The utilization rate of irrigation water should be increased from current 30 % to 70 % (Mao, 1999). It calls for technological, institutional and policy changes. Drought-resistant varieties need be bred to reduce water use and irrigation systems that reduce percolation and leakage are required. The various kinds of irrigation practices such as drip irrigation, furrow irrigation, subirrigation, sprinkler irrigation and irrigation at night to reduce water evaporation should be experimented to find out the best choices in different regions. Research on optimal irrigation scheduling and irrigation volume should be encouraged and flood irrigation that is typical in many producing regions must be stopped as soon as possible. More fundamentally, new laws governing the use of water should be erected and the enforcement of laws be strengthened. Policies concerning subsidies on irrigation and water use must be reformed in most producing regions. In some regions, water quotas may also have to be established.

6.2.3.8 Organic cotton

Organic cotton is the most sustainable alternative to conventional production and it comes closely to this goal (Harry de Vries, 1995).

Organic farmers use biologically-based rather than chemically dependent growing systems to raise crops. Organic cotton is produced without synthetic insecticides and fertilizers and defoliators, as well as other inputs prohibited by the certifying organization. Worldwide organizations exist which are entitled to control the production (both product and process) and certify the product as organic. (Harry de vries, 1995) . Until very recently, fields must be free of synthetically derived chemicals for three years to achieve organic certification. IFOAM (The International Federation of Organic Agricultural Movements) regulations were changed in late 1994 to a one year transition period where levels of chemical inputs are lower.

Organic cotton farming is a high yielding and environmental reserving farming methods. However, the transition to organic farming is not a easy task. Much efforts have to be made to facilitate the transition and addressing the aftermath technical and marketing difficulties. Due to varieties in natural conditions, in depth research has to be conducted to find out if local conditions allow organic farming and in the case of yes, what specific combinations should be chosen for organic farming. For some areas(for example, regions that have high pest occurrence and lack of pest predators), it may be impossible to grow organic cotton and in other regions, costs may be very high. Technical aspects such as the varieties of pests and their predators and the right time to release those predators, have to be studied. Coaching and extension to farmers is also needed in order for them to know the organic way of farming. Yield may decline sharply during the first couple of years after transition and price premium may prove hard to get for some cotton farmers with cotton qualities failing to please the market. “Farmers who have changed to organic production have encountered higher costs and/or lower yields. This is compensated for by higher prices on the market for organic textiles. However, this is a relatively small market and thus the possibilities of this form of compensation remains limited (mainly because it remains a voluntary decision of consumers to buy these products against higher price).”(Harry de vries, 1995) The government play a very important role in addressing these problems.

China has started building organic cotton bases in some cotton growing regions on a very small scale. In some other producing regions, however, organic cotton is even unheard of. For the Chinese government and cotton growers, organic farming is a new challenge after years of exclusive dependence on chemicals for higher cotton yield. At present, organic farming is still conducted as a pilot project. However, further development can be expected for China's organically grown cotton. Since organic cotton farming is a highly labor intensive process, it will be to China's advantage to grow organic cotton, given its abundant labor resource and low labor costs.

6.2.3.9 The Environmental Protection Administrations should play a more important role to improve the environment

The job of the Environmental Protection Administrations is not only to charge the enterprises for pollution, they should do more things to minimize the environmental pollution and improve the environment in following aspects:

- Research and assessment of environmental pollution;
- Research and extension of environment friendly techniques;
- Help fee payer to establish facilities to minimize environmental pollution.

6.3 Plan of Action

Although the final country study project report is finished, the project is not over. There are still many things to do. The plan of future action is listed as following:

- Prepare presentations for Berlin meeting following format proposed. (March 2001)

- Revise Country study in the light of the review meeting in Berlin. (April 2001)

- Convene a national workshop to launch the final country study to sensitize the cotton sector and relevant government officials to the problems identified, results outlined and the strategy for implementation. (May 2001)

- Initiate implementation of policy package.(June/July 2001)

- Publish country study. (July/August 2001)

- Evaluate the outcome of the project. (December 2001)

7 Project Experience: Main Conclusions

7.1 Project Experience

This country study project tries to combine government organizations with academic research institution, therefore a network is built and a national steering committee which is composed by different stakeholders is established to guild the study.

This study is carried out through four dimensions:
The 1st dimension is: economic impact – social impact – environmental impact;
The 2nd dimension is: regional (provincial) impact – national impact – international impact;
The 3rd dimension is: process – analysis – participant policy;
The 4th dimension is: production – marketing – government intervention

7.2 Main Findings

After China joins WTO, opportunity and challenge both exist in agricultural sector. The opportunity of agricultural export could be a potential possibility in the future, but the challenge of a large agricultural import is the fact right now. The basic situation in cotton sector is China will import large quantity of cotton, promote textile industry development and increase the export of textile and clothing.

Therefore the current challenge is that trade liberalization will cause a large agricultural import, mainly in wheat, corn, cotton, soybean oil and etc. This country study tries make scenario analysis with JAPA model to find social, economic and environmental impacts. Through 9 months hard work, this country study achieves following findings:

7.2.1 The positive impacts identified

The trade liberalization could boost Chinese textiles and clothing export, which will bring high demand for cotton. The agricultural import could solve the shortage of some agricultural commodities in China; it also promotes Chinese agricultural production structure adjustment. On the environment, the cotton import could reduce the acreage of cotton, therefore reduces the applied quantities of chemical fertilizer and pesticide.

7.2.2 The negative impacts identified

China's WTO accession may also increase uncertainty for Chinese textile and clothing export. The Sanitary and Phytosanitary Measures SPM could be used by some countries to hinder imports, which could cause enormous fluctuation on the production and price of textiles.

As Cotton sector is closely linked to the textiles industry, so the fluctuation on the production and price of textiles may cause uncertainty for cotton production and its

price. The cotton import increase (Tariff Rate Quota) could bring enormous shock to domestic cotton production and marketing. The sown areas and output of cotton will decrease; the price of cotton in domestic market will decrease; the agricultural employment will decrease; and cotton farmers' income will decrease. The decrease of farmer's income could worse the poverty in rural area, and it may cause social unstable problem.

After agricultural production structure adjustment owing to the import, the utilization rate of cultivated land will decrease; the self-sufficiency rate of cotton will decrease; valuable cultivated land will lie waste, which could be occupied for non-agricultural purpose, such as city extension, industry and building, this will lose sustainability in agricultural production capacity of China.

There is also a possibility for developing country that the agricultural production and trade may fall in a vicious circle after trade liberalization. Owning to the low land productivity and labor productivity, some developing countries do not have competitive advantage in agricultural products. After the trade liberalization, they will find that their products can not contend with imported high quality, low price products. The agricultural imports will decrease the prices of domestic products, farmers have no interest in investing in agricultural production to improve technique and product quality, agricultural production come to decline. This will cause the shortage in agricultural products and need to increase agricultural import in turn. More valuable cultivated land will lie in waste and more agricultural commodities need to be imported to solve the shortage of agricultural products. So agricultural production and trade may fall in a vicious circle, finally the countries will meet the problem of imbalance of foreign trade, the domestic currency may devaluated and cause inflation, which is not sustainable.

7.3 Benefits and costs

Based on the scenario analysis with the JAPA model on agricultural TRQ's import (corn, wheat and cotton), a cost-benefit analysis (CBA) is applied, the possible benefits and costs of the social, economic and environmental impacts for Jiangsu province are evaluated as following.

7.3.1 Economic impacts

Benefits:

- The agricultural import could solve the shortage of agricultural commodities, this will bring about 632.01 million RMB economic benefit.
- The agricultural import could cause the prices of agricultural commodities decrease, it will bring 1,359.72 million RMB benefit to consumers.

Costs:

- The agricultural import will cause the sown areas and outputs of some agricultural products decrease, so farmers will get loss from the output decrease by 583.39 million RMB, and from price decrease by 1,359.72 million RMB.

- The government tariff income decrease by 190.82 million RMB. (For Jiangsu's share)

- To import agricultural commodities, China should pay foreign currency, the cost for import the three commodities is evaluated as 1,004.29 million RMB. (For Jiangsu's share)

7.3.2 Social impacts

Benefits:
- The trade liberalization could promote the agricultural production structure adjustment according to the comparative advantage.

Costs:
- Owing to the agricultural import, utilization rate of cultivated land decrease, valuable land lies waste, this brings social opportunity cost for 23.51 million RMB.

- As the result of sown area decrease, agricultural employment will decrease, the opportunity cost of the increased unemployment is 651.31 million RMB.

- The poverty problem and social stability problem could worse, but there is difficulty to evaluate the impacts.

7.3.3 Environmental impacts

Benefits:
- The agricultural import could reduce sown area and decrease applied quantities of chemical fertilizer and pesticide, so it brings environmental benefit by 0.67 million RMB.

Costs:
- As the result of sown area decrease, valuable cultivated land may be lost, but this impact can not be estimated and evaluated up to now.

7.4 Constraints Faced and Steps Forward

China's access to WTO is a great event, it will bring enormous impacts not only to Chinese government, but also to all Chinese people. It is important for the government to participate the research on the impacts on every branch, and provide enough information for the research. Until now Chinese government still not opens the content of the bilateral agreements Chinese government has signed, therefore it is difficult to make complex scenario analysis without enough information.

The Jiangsu Agricultural Policy Analysis Model (JAPA) is established several year ago, it is proved to have the advantage to simulate the impacts of trade liberalization. Anyway this model is only for Jiangsu province, in order to simulate the impact for whole China it is necessary to establish a national model. Our next target it to establish China Agricultural Policy Analysis Model (CAPA).

We shall convene a national workshop to launch the final country study, we calls for the further cooperation with government organization in the implementation of the

policy package. The relevant Ministries and national authorities include: Ministry of Agriculture, Ministry of Foreign Trade and Economic Cooperation, Environmental Protection Administration, and Jiangsu Agriculture and Forestry Department.

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