As China moves towards membership in the WTO, and therefore it becomes subject to the Agreement of Agriculture, the Chinese economy in general and the agricultural sector in particular would face with significant adjustment.

This paper aims to assess the social economic and environmental impacts of China's potential trade liberalisation in agriculture especially in view of China's expected imminent entry into the WTO. This study will analyse the impact of China’s accession to the WTO on agriculture, through economic modelling, scenario analysis and integrated assessment, to find the social economic and environmental impacts of large agricultural imports.

1 Methodology

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 1. (For detail see Zhou, 1999).

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 elasticities of major consumer goods. This LA/AIDS model and other regression models also provide many coefficients for partial equilibrium model.

The AIDS model is usually specified as:

\[ W_i = \alpha_i + \sum \gamma_{ij} \ln p_j + \beta_i \ln \left( \frac{X}{P} \right) \] (1.1)

with the theoretical restrictions imposed

\[ \sum \alpha_i = 1, \sum \beta_i = 0, \sum \gamma_{ij} = 0 \text{ (homogeneity)}, \gamma_{ij} = \gamma_{ji} \text{ (symmetry)} \]

**Figure 1. The structure of JAPA model**

The model that uses Stone’s index is called the “Linear Approximate AIDS”. The Stone index is specified as:

\[ \ln P = \sum W_k \ln p_k \] (1.2)

where

- \( W_k \) : share of total expenditure allocated to good \( k \)
- \( p_k \) : price of good \( k \)
- \( P \) : price index
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 the 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 behaviour. 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.

The price demand elasticity $E$ is specified as:

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

(1.3)

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

1.2 Partial equilibrium model

The second sub-model is a partial equilibrium model. The objective function of this model is maximising 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 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 2. Structure of partial equilibrium model**

The objective function of the partial equilibrium model is maximizing producer surplus and consumer surplus. 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).

**Figure 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, at the equilibrium solution \( (P, Q) \), the value of the objective function can be expressed as follows:

\[
\text{Obj} = \text{CS} + \text{PS} \quad (1.4)
\]

In the equation, \( \text{CS} \) is consumer surplus and \( \text{PS} \) is 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:

\[
\text{Obj} = \text{Area under demand curve} - \text{Physical input costs} - \text{Transport costs} - \text{Labour costs} - \text{Non-linear costs for risk} - \text{Non-linear costs for regional transport}
\]

This leads to the following mathematical formulation:

\[
\text{Obj} = \sum_{r, O} \left[ \alpha \cdot \text{XDC} + 0.5 \cdot \beta \cdot (\text{XDC})^2 \right] - \sum_{r, \text{aa}} \left( \text{INANPR} \cdot \text{INANQU} \right) \cdot \text{Xaa} - \sum_{r, \text{ac}} \left( \text{INCRPR} \cdot \text{INCRQU} \right) \cdot \text{Xac}
\]

\[\text{[ Area under demand curve ] (1.5)}
\]

\[\text{[ Animal physical cost ] (1.6)}
\]

\[\text{[ Crop physical cost ] (1.7)}
\]
\[ -fa \cdot \sum_{rr,OA} (d \cdot XTC_r) \quad \text{--- [ Animal transport cost ] (1.8)} \]
\[ -fc \cdot \sum_{rr,OC} (d \cdot XTC_r) \quad \text{--- [ Crop transport cost ] (1.9)} \]
\[ \sum_r \text{clab} \cdot \text{lab}^2 \quad \text{--- [ Non-linear labor cost ] (1.10)} \]
\[ \sum_{r,a} 0.5 X^{'} \cdot \text{diag (nlcoc)} \cdot X \quad \text{--- [ Non-linear cost for risk ] (1.11)} \]
\[ \sum_{r,O} 0.5 \delta^{'} \cdot \text{diag (nlcot)} \cdot \delta \quad \text{--- [ Non-linear cost for transport ] (1.12)} \]

where

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

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

\text{Acreage constraint for irrigated land} \\
\text{Acreage constraint for dry land} \\
\text{Labor force constraint}
Quota constraint
Market balance constraint for products
Feed balance constraint
Calorie balance constraint
Draft balance constraint

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.

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 and fee are important methods to transfer a part of farmers’ profit to government revenue. The government can get more revenue by increasing agricultural tax and fee, 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.

2 The Impact of China’s Accession to the WTO

China is one of 30 governments currently seeking accession to the World Trade Organisation. 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.
2.1 The impact of China’s access to the 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 the WTO includes:

It will promote China’s economic reform. In order to get accession to the 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 non-state 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 accession could improve Chinese foreign trade environment. After the accession to the WTO, China can enjoy multilateral Permanent Normal Trade Relations (PNTR) with the 130 members of WTO. This could be favourable for increasing 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-favoured-
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.

2.2 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 
aricultural products exported with subsidies, and prohibit the introduction of new
export subsidies for agricultural products. Domestic support reductions were realised 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 (SPS 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.

2.2.1 Agricultural market access

The agricultural market access commitments include measures to address the following problems: trading rights, distribution, high tariffs; quotas; application of unscientific SPS 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 non-tariff 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 has committed to follow WTO standards in eliminating all quantitative restrictions. In particularly sensitive sectors, China will adopt tariff-rate quotas 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 (usually 1-3%), 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. The 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).

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)

### 2.2.2 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.

2.2.3 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:

2.2.3.1 '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.
2.2.3.2 '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 subsidise 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.

2.2.3.3 '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.
2.2.3.4 '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 non-specific 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.

2.2.4 Export subsidy

The subsidised 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.

2.2.5 Sanitary and Phytosanitary Measures (SPS)

The Uruguay Round’s SPS 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’ SPS regulations and providing improved means for settling SPS-related trade disputes. China agrees that sanitary and phytosanitary disputes should be settled scientifically.

3 Policy simulation

3.1 Baseline Projection

In order to provide a fair comparison basis for the scenario analysis on the impact of trade liberalisation, 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. These and also other simulation results will be used as the baseline projection.
Table 3.1 Projected sown area and output in Jiangsu province 2001

<table>
<thead>
<tr>
<th></th>
<th>Sown area</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>3,076.86</td>
<td>9,521,156.17</td>
</tr>
<tr>
<td>Barley</td>
<td>285.63</td>
<td>951,131.49</td>
</tr>
<tr>
<td>Rice</td>
<td>3,462.23</td>
<td>19,062,733.00</td>
</tr>
<tr>
<td>Corn</td>
<td>631.70</td>
<td>2,295,009.55</td>
</tr>
<tr>
<td>Soybean</td>
<td>343.19</td>
<td>784,444.79</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>711.86</td>
<td>961,661.43</td>
</tr>
<tr>
<td>Cotton</td>
<td>830.18</td>
<td>583,617.26</td>
</tr>
<tr>
<td>Fruit</td>
<td>297.69</td>
<td>4,974,912.48</td>
</tr>
</tbody>
</table>

Source: Model projection results.

3.2 Scenario Analysis

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 China’s 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 that 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 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.

4 Integrated Assessment of Trade Liberalisation

In this part integrated assessment of trade liberalisation will be made. After China joins the 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.

Therefore the current challenge is that trade liberalisation will cause a large agricultural import, mainly in wheat, corn, cotton, soybean oil and etc. 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 liberalisation.

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 analysed.

4.1 Economic Impacts

The model scenario analysis results indicate that the large imports of wheat, corn and cotton will bring following enormous economic impacts:
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 have the shortage in wheat. Therefore the import of cotton and corn can help Jiangsu to solve the shortage.

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.

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 83,596.49 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.
Table 4.1: Simulated sown area, output and price changes

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

Source: Model simulation results.

**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 4.1 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 favourable to consumers, and is also favourable to animal production because some main products and by-products can be used as feed, but it is unfavourable to producers of agricultural commodities.

**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:

**Promote agricultural production structure adjustment**

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

**Utilisation rate of cultivated land decrease, valuable land lies waste**

Jiangsu province is in south-eastern 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.

**Reduction in the self-sufficiency rates of the agricultural commodities**

Owing 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 %.

**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.
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.

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:

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).

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.

Agricultural production capacity decrease and large import may fall in a vicious circle

Owing to the low land productivity and labour 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 capacity decrease and large import 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.

4.4 Cost- Benefit Analysis
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 it is very 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 are listed in Table 4.2.

Table 4.2 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. There the total costs is 3,813.04 million RMB in Jiangsu province.
Table 4.2: Cost-Benefit Analysis on the impacts in Jiangsu (million RMB)

<table>
<thead>
<tr>
<th>Costs of the import TRQ’s of the three agricultural commodities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural output value changes</td>
<td>-583.39</td>
</tr>
<tr>
<td>Prices of agricultural products decrease (for producer)</td>
<td>-1,359.72</td>
</tr>
<tr>
<td>Agricultural employment decrease</td>
<td>-651.31</td>
</tr>
<tr>
<td>Tariff lose</td>
<td>-190.82</td>
</tr>
<tr>
<td>Cultivated land lies waste</td>
<td>-23.51</td>
</tr>
<tr>
<td>Payment for the import</td>
<td>-1,004.29</td>
</tr>
<tr>
<td>Total costs</td>
<td>-3,813.04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits of the import TRQ’s of the three agricultural commodities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve the shortage of the two commodities (corn and cotton)</td>
<td>632.01</td>
</tr>
<tr>
<td>Prices of agricultural products decrease (for consumer)</td>
<td>1,359.72</td>
</tr>
<tr>
<td>Reduction of pesticide application</td>
<td>0.38</td>
</tr>
<tr>
<td>Reduction of chemical fertilizer application</td>
<td>0.29</td>
</tr>
<tr>
<td>Total benefits</td>
<td>1,992.40</td>
</tr>
</tbody>
</table>

Net benefits: -1,820.64 million RMB

Source: Author’s calculation according to simulation results.

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 Summary

The positive impacts identified

The trade liberalization could cause enormous social economic and environmental impacts. 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 agricultural import could reduce the acreage of agricultural products, therefore reduces the applied quantities of chemical fertilizer...
and pesticide.

**The negative impacts identified**

The agricultural import increase (Tariff Rate Quota) could bring enormous shock to domestic agricultural production and marketing. The sown areas and output of wheat, corn and cotton will decrease; the price of agricultural products in domestic market will decrease; the agricultural employment will decrease; and influence the benefit of 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 wheat, corn and 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 labour 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 capacity decrease and large import 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.