

# Green Revolution in China: Past and Future

Zhangliang CHEN

China Agricultural University

[chen@cau.edu.cn](mailto:chen@cau.edu.cn)

# Chinese ancestors made great contributions to agriculture



Cultivar rice over 6000 years discovered in Zhejiang Province



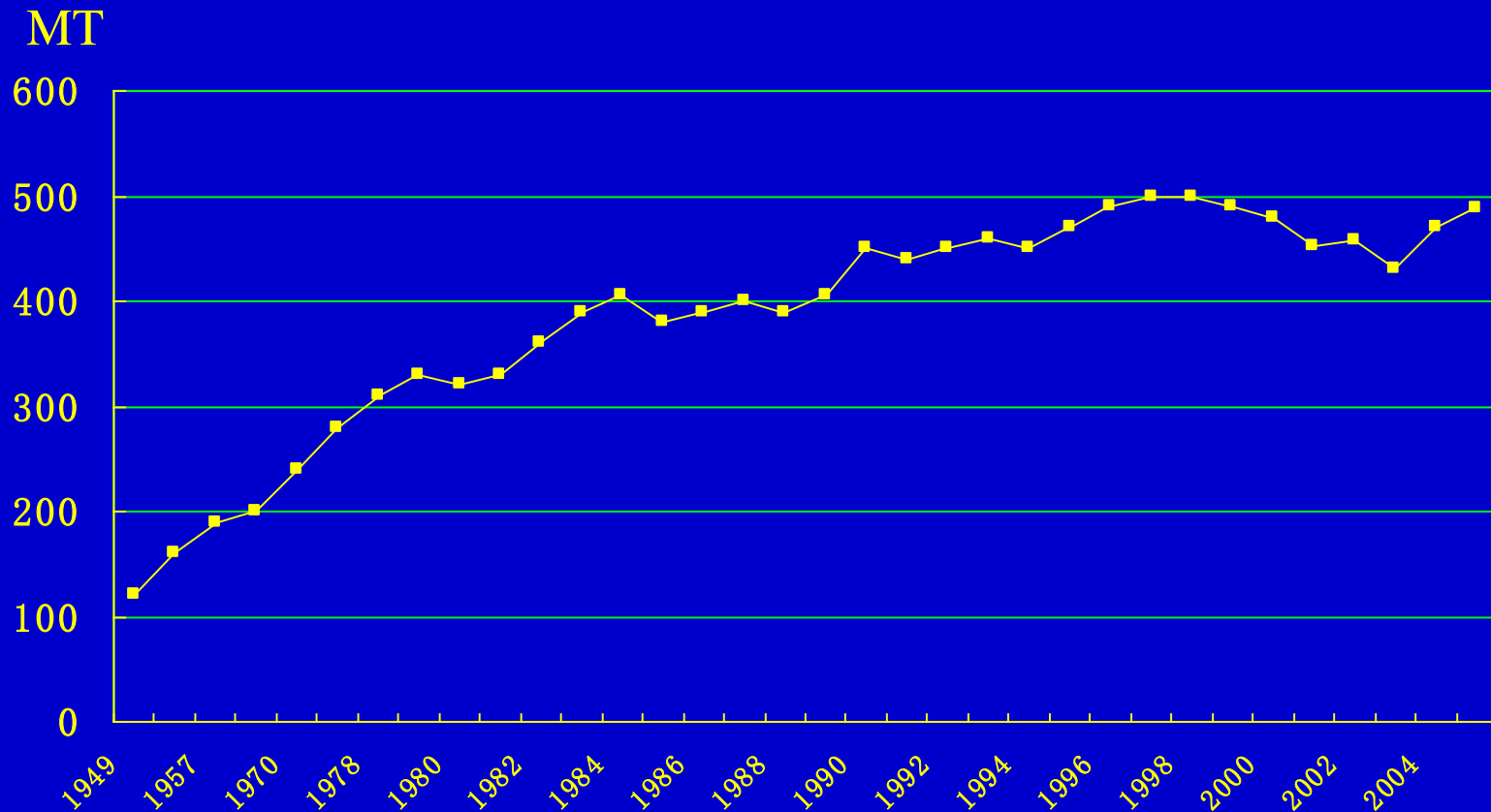
# Hani Terrace in Yunnan (constructed over 1200 years ago)



Xu GuangQi (1562-1633), Ming Dynasty



# Significant Achievements in Grain Productivity in China in Green Revolution



7% of arable land to feed 22% world population in China

# Key People to China for Green Revolution



Deng, Xiaoping



He, Kang

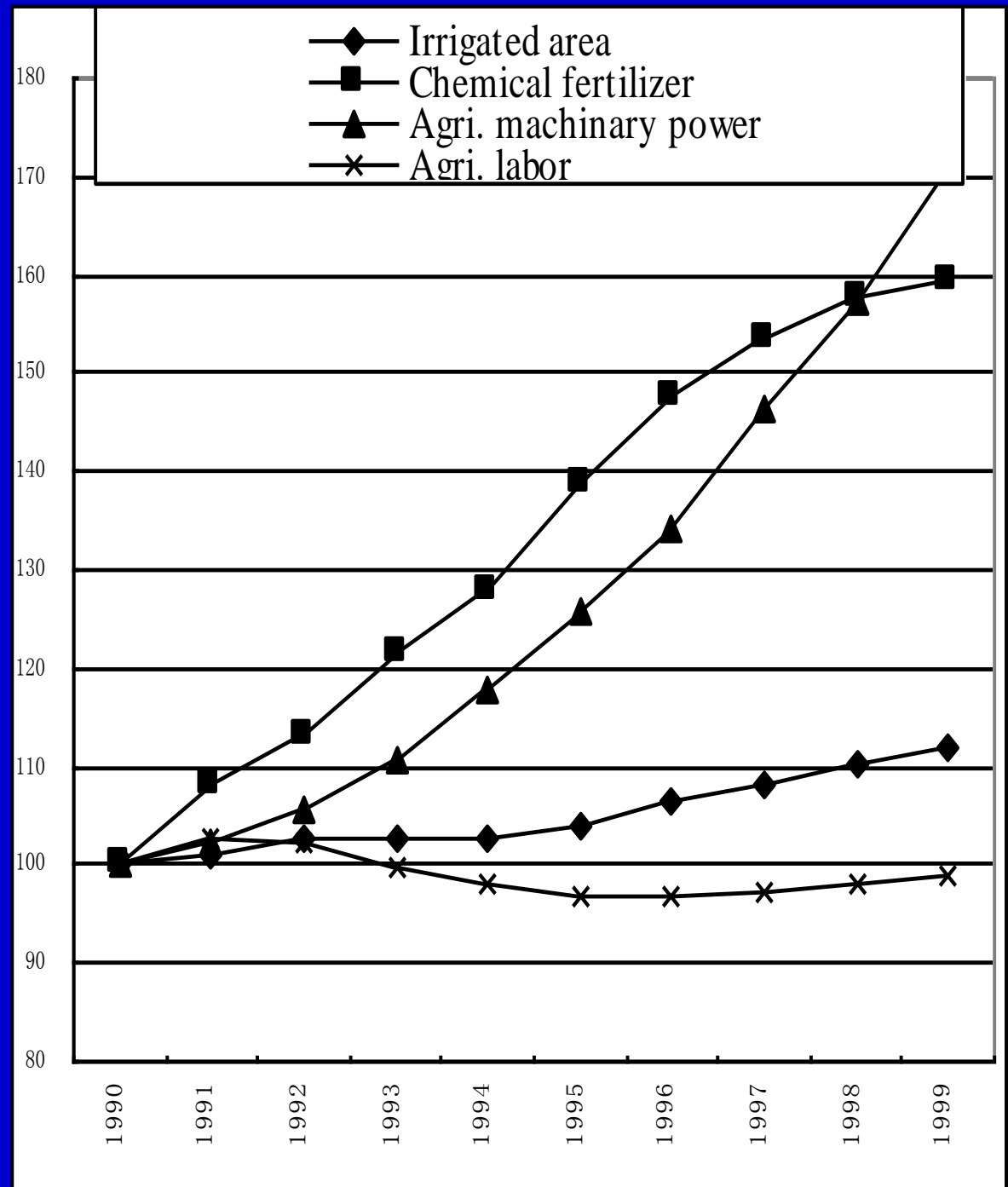


Yuan, Longping

World Food Prize Laureates

# Agricultural Production Determinants

- *Agricultural Policy*
- *Technology and Inputs*
- *Income growth and changing preference*
- *Arable Land and Water Resources*



Reform of Agriculture  
Policy in 1978  
made significant  
contribution to food  
security in China





# Small family-based farming system:

- 4.4 persons per household with 2.8 laborers working on 0.6 hectare of cultivated land
- One farmer on average produces (in a year):

grain	1362.0kg
cotton	15.4 kg
oil-bearing crops	88.9 kg
red meats	174.1 kg
aquatic products	148.8 kg
milk	55.2 kg

**High cost and low productivity hard to compete on market**

# Nitrogen Inputs

## Grain production

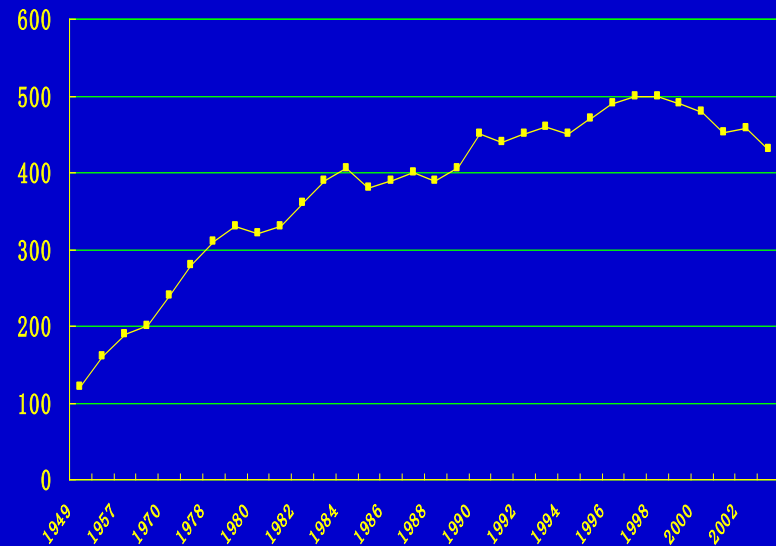
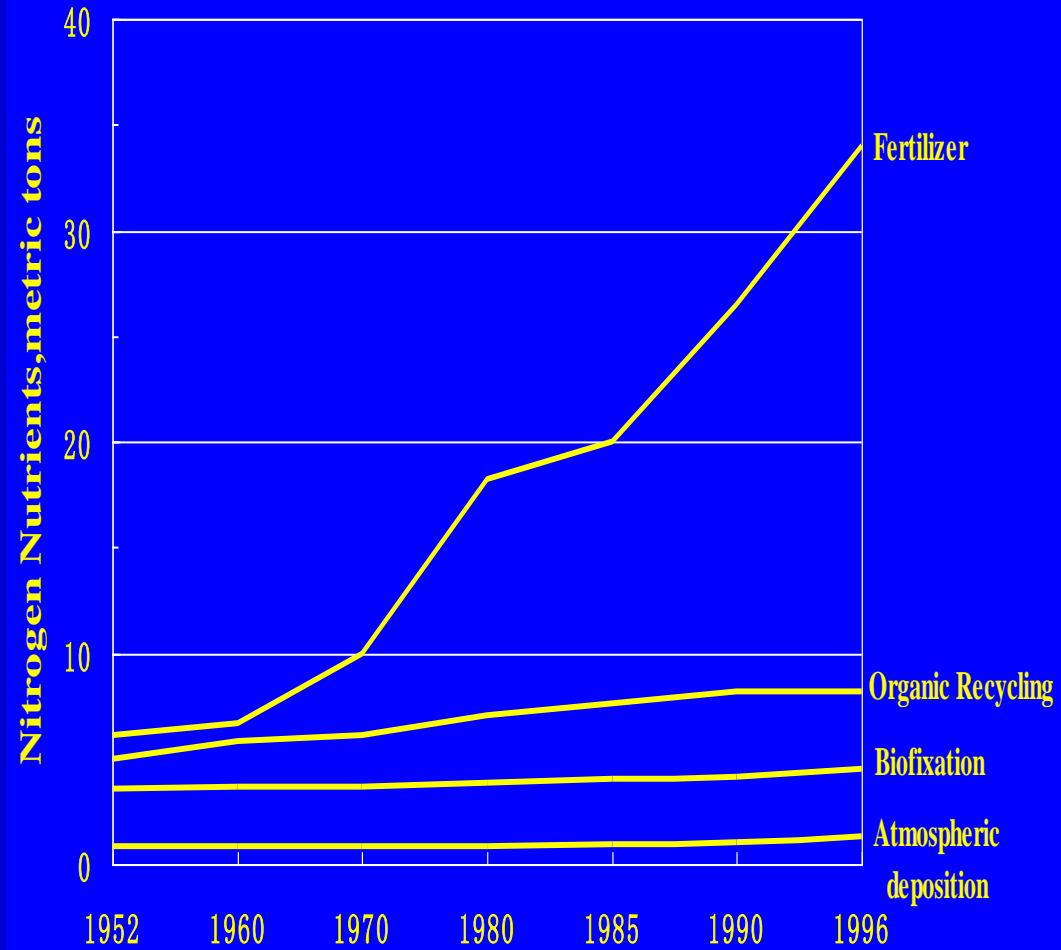


Figure 1. Nitrogen Inputs in China's Agriculture, 1952-96



Source:FAO  
2003

# Hybrid Rice:

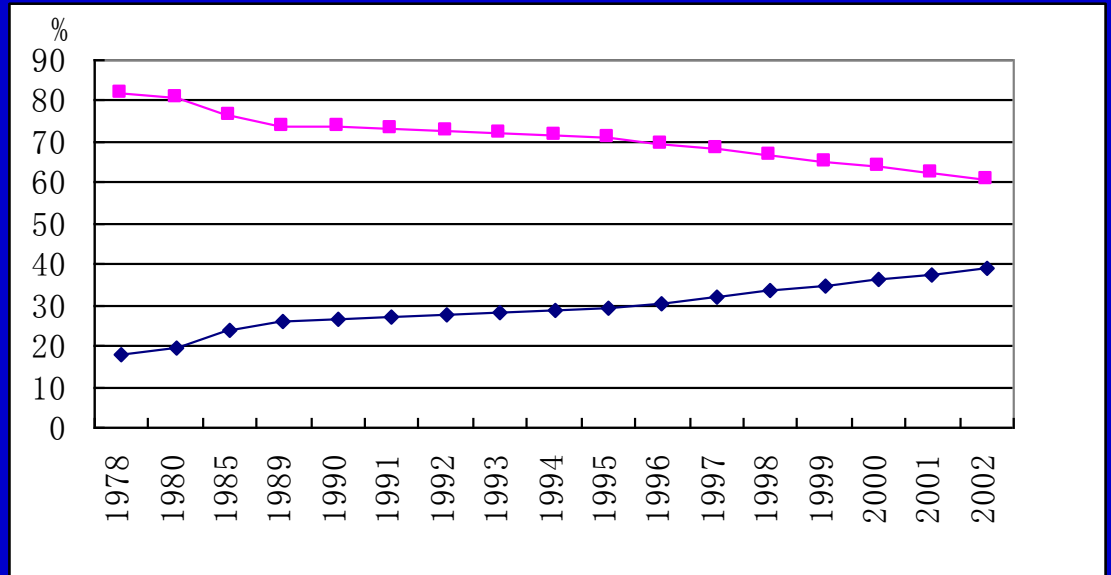
**Yield Increase: 20%**  
**15 million ha.**  
**(more than 1/2 of rice**  
**planting area in China)**



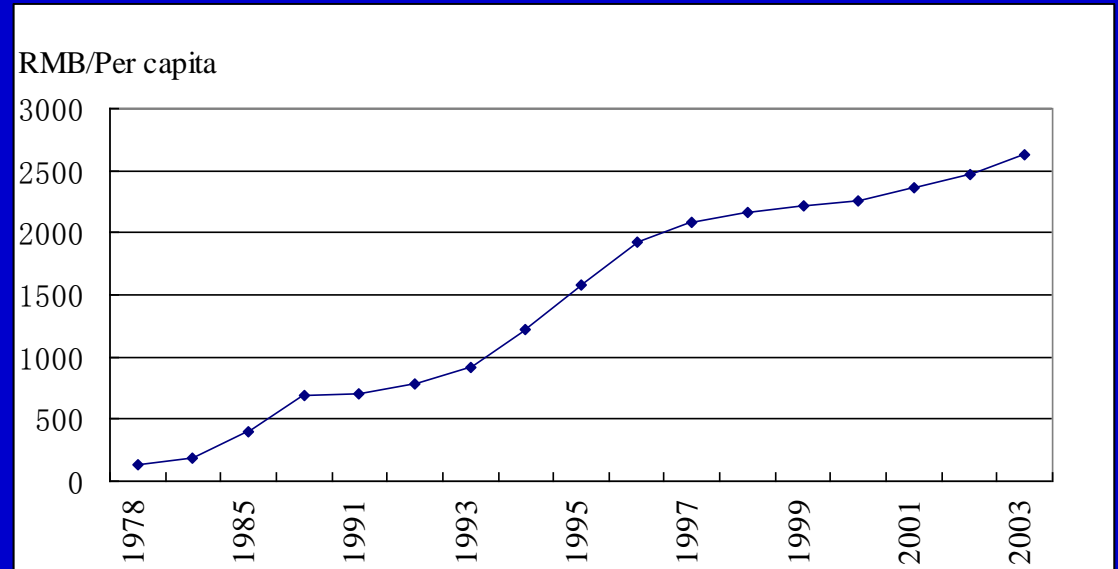
**Yuan Rongping**



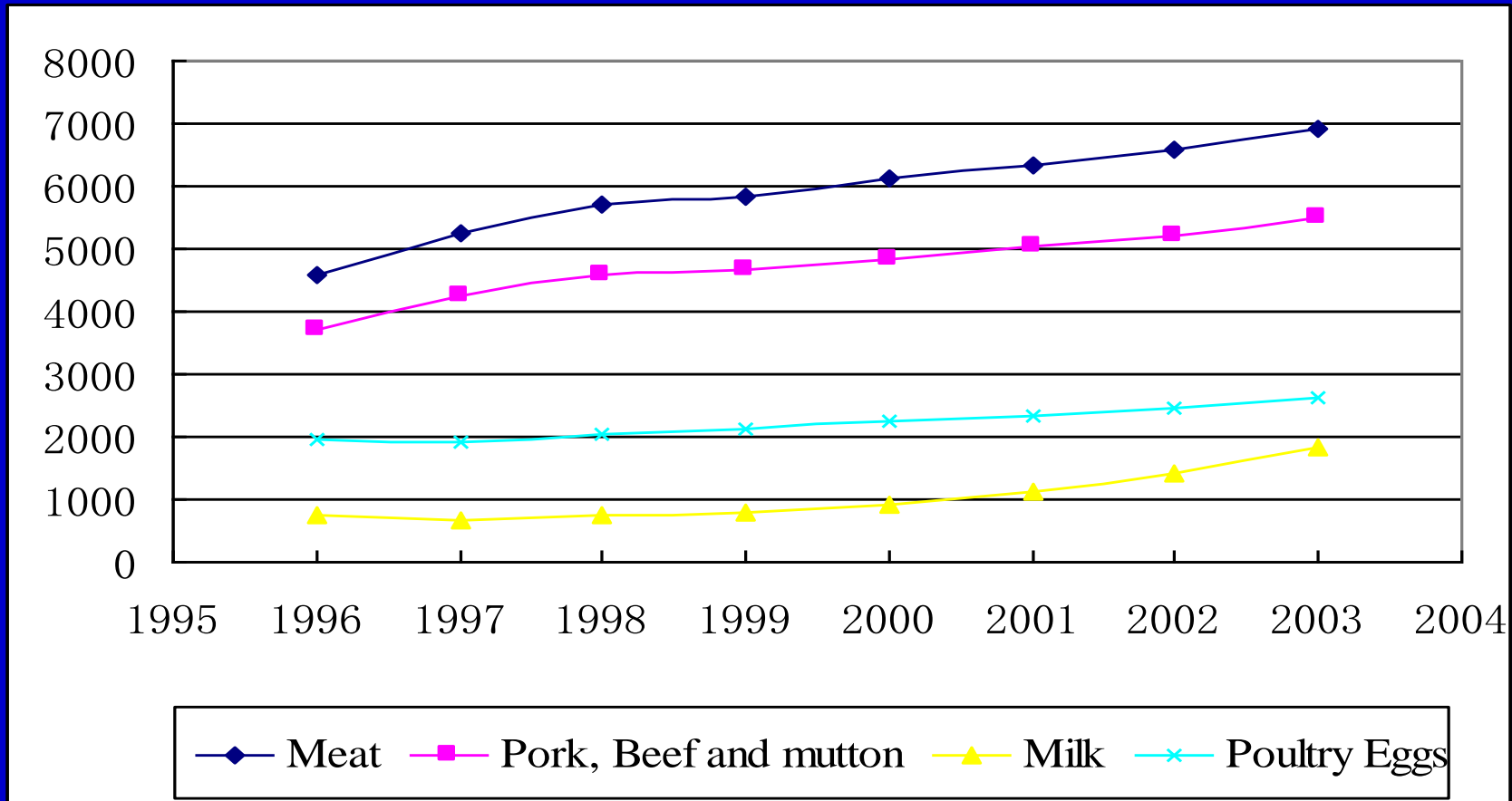
## Shares of Urban and Rural Population



## Per Capita Income of Rural Resident



# Output of Livestock Products (10,000 tons)



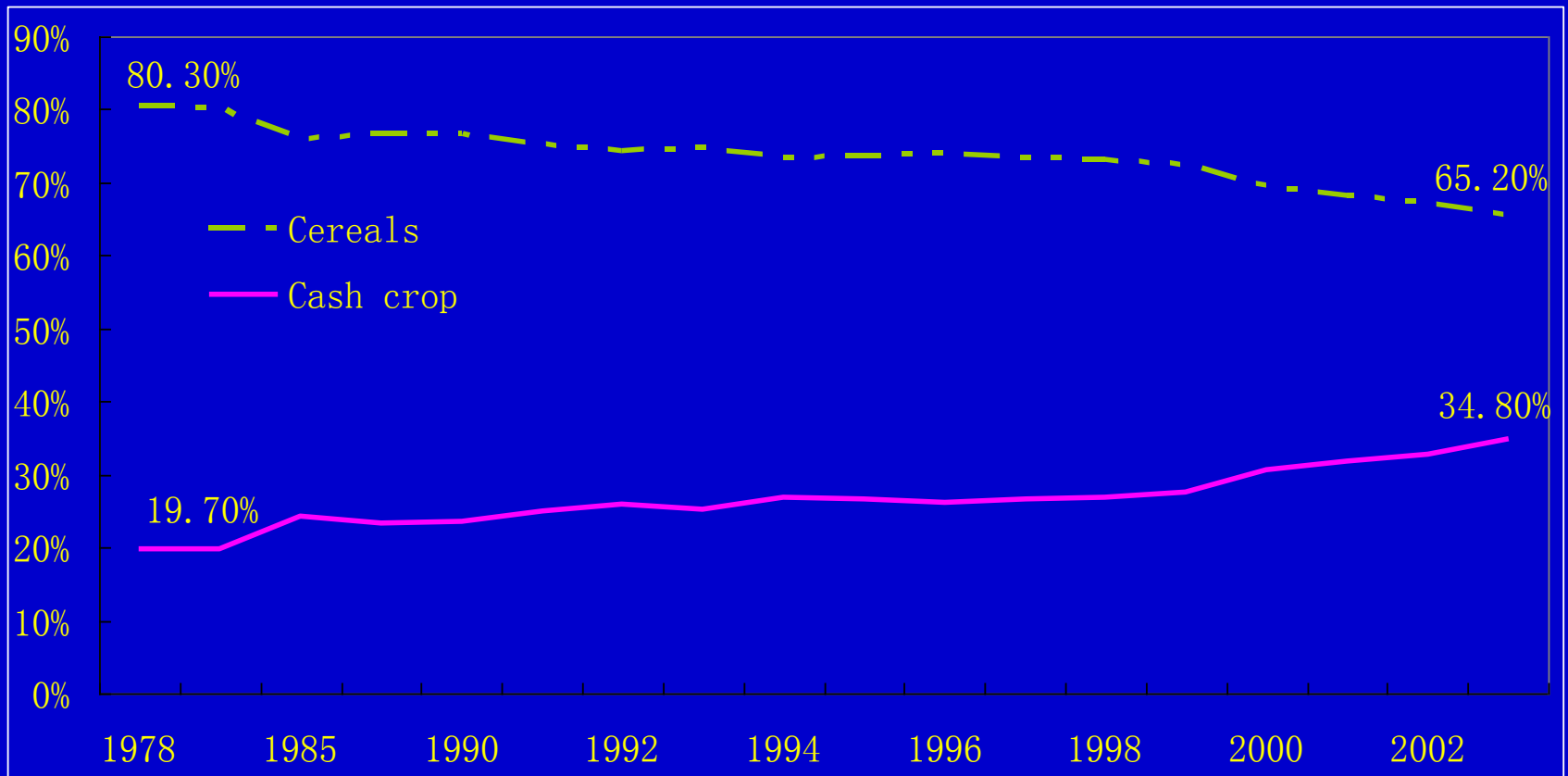
# Structure of China's Agricultural Economy, 1970-2000

## Share in Agricultural Output (%)

	1970	1980	1985	1990	1995	2000
<b>Crop</b>	<b>82</b>	<b>76</b>	<b>69</b>	<b>65</b>	<b>58</b>	<b>56</b>
<b>Livestock</b>	<b>14</b>	<b>18</b>	<b>22</b>	<b>26</b>	<b>30</b>	<b>30</b>
<b>Fisheries</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>8</b>	<b>11</b>
<b>Forestry</b>	<b>2</b>	<b>4</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>4</b>

**Sources:** CNSS, China Statistical Yearbook (various issues) and China Rural Statistics Yearbook (various issues).

# Structural changes in the crop sector



# New Stage of China Agriculture since late 1990s

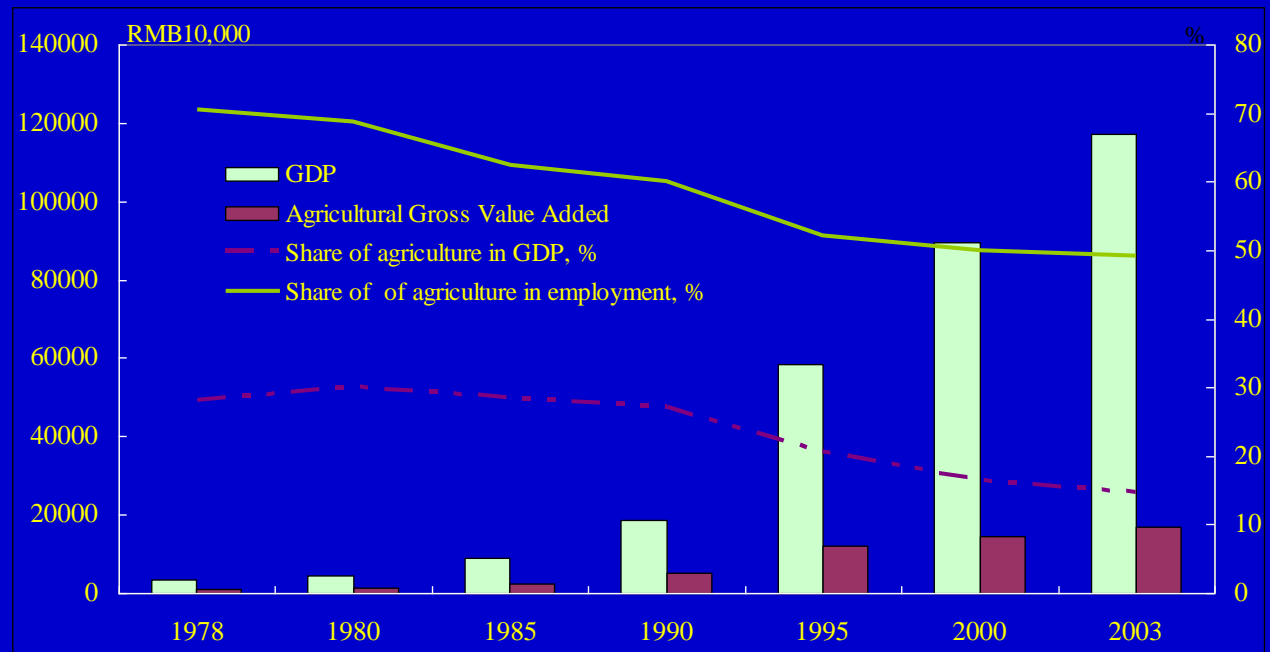
- The supply of agricultural products has undergone historical transformation from chronic shortage to basic equilibrium or supply surplus in good years.
- Income to farmers increases, consumption and demand change from quantitative to qualitative
- Contribution of agriculture to the China's economy declines.
- Both environment and conditions of agricultural development have undergone profound and significant changes, especially entered WTO.



# Contribution of agriculture to the China's economy: Rapid declining of agriculture's share in total GDP

## Economic Growth 1978-2003

- GDP: 9.4%
- Agriculture: 4.5%
- Industry: 11.6%
- Service: 10.3%



# China-USA Trade

- Trade Balance
- Chinese currency value (RMB) with US \$ exchange rate
- Intellectual property right

## Bilateral Trade in Agriculture between China and USA 2000-2004 (US\$ million)

-

<b>Year</b>	<b>China's Import</b>	<b>China 's Export</b>	<b>China 's Trade Deficit</b>
2004	7,693.69	2,395.77	5,297.92
2003	5,014.79	2,102.88	2,911.91
2002	2,722.79	1,679.72	1,043.07
2001	2,739.06	1,259.57	1,533.49
2000	2,590.96	1,184.36	1,406.60
<b>Total</b>	<b>20,815.29</b>	<b>8,622.30</b>	<b>12,192.99</b>

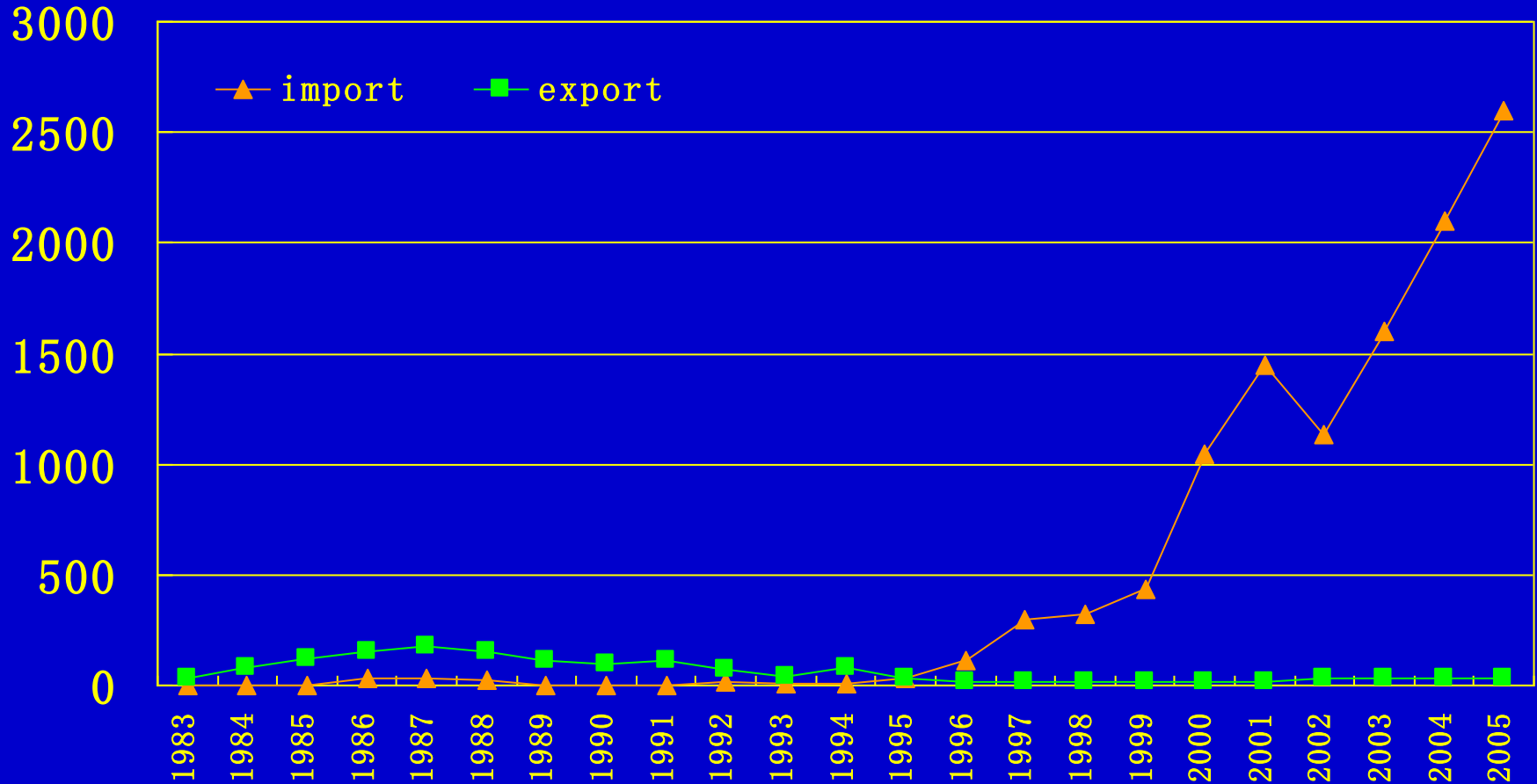
# China's agricultural trade: 1992-2003

	Unit	1992	1995	2000	2001	2002	2003
Agricultural Gross Value Added	RMB billion	580	1199.3	1462.8	1541.2	1611.7	1709.2
Agricultural Gross Value Added	USD billion	105.3	143.6	176.7	186.1	194.6	206.4
Agricultural exports	USD billion	11.3	14.4	15.6	16.1	18.1	21.2
Imports of agricultural products	USD billion	5.3	12.2	11.2	11.8	12.4	18.9
Net Export	USD billion	6.0	2.2	4.4	4.3	5.7	2.3
<b>Share of agriculture</b> , in total trade							
Share of total exports	%	13.3	9.7	6.3	6.1	5.6	4.8
Share of total imports	%	6.6	9.2	5.0	4.9	4.2	4.6
<b>Ratio to AGVA</b>							
Exports	%	10.8	10.0	8.8	8.7	9.3	10.3
Imports	%	5.0	8.5	6.3	6.4	6.4	9.2
Import and export	%	15.8	18.5	15.2	15.0	15.7	19.4
Net export	%	5.7	1.5	2.5	2.3	2.9	1.1

**Deficit in agriculture trade reached to \$5.5 billion in 2004**

# Soybean: Import and Export in China

10,000 ton



Import: 26 million ton from USA, Brazil and Argentina  
In 2005. China produced only 16 million tons

# Soybean Imports

- Total imports of soybean reach to 26 million tons in 2005. Highest in history. Will continue increase this year.
- Imports:
  - USA: 11 million tons
  - Brazil: 6 million tons
  - Argentina: 5 million tons

# Soybean Consumption and China Import (2000-2005)

	<b>World consumption</b>	<b>USA consumption</b>	<b>China consumption</b>	<b>China import</b>	<b>Percentage of China import in world import</b>
2000	25773	8305	3182	1325	24.91%
2001	27146	8548	3071	1039	19.07%
2002	29322	8080	4002	2142	34.04%
2003	28100	7178	3679	1693	31.22%
2004	31361	8821	4520	2570	39.49%
2005	33168	8781	4920	2750	40.57%

In 2005, the import of beans in China has occupied 40.57%, so it greatly influences the price of beans in the futures market in the world.

# Cotton Production and Import in China

	<b>World production</b>	<b>World consumption</b>	<b>China production</b>	<b>China consumption</b>	<b>China import</b>	<b>Percentage</b>
2000	1935	3575	442	911	5	0.88%
2001	2150	3810	531	943	10	1.52%
2002	1921	3712	492	937	68	10.38%
2003	2070	3730	486	963	192	26.05%
2004	2622	4221	631	1049	139	19.42%
2005	2432	4441	533	1112	348	38.63%

In 2005, the imported cotton has occupied 38.63%



## Projections of Grain Production, Demand and Imports in China, 2020 (million metric tons)

Projections	Rosegrant et al.	Huang et al.	USDA	World Bank
Grain Production	541	552	443	566
Grain Demand	565	594	481	600
Grain Imports	24	43	37	34

Note: 'Grain' is defined in this table as wheat, rice (milled basis see note 4), corn, sorghum, millet, barley and oats.

Source: Fan and Agcaoili-sombilla 1997.

# WTO: Demonstration in HongKong, 2005

## Agriculture is the major issue

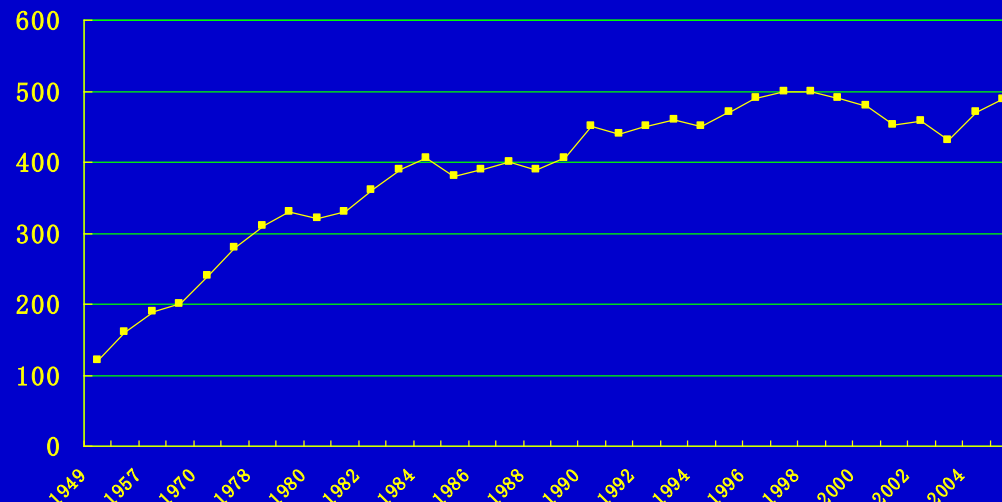


**China: Deficit in agriculture trade reached to \$5.5 billion in 2004**

# Government took strong action in enhancing the agricultural production in 2004

- Reduction the agricultural tax in the first time in history and will cut it to 0 next year in whole country
- To increase the price of grains, some of them increase about 20% or more, encourage farmers to stay in farm.
- To control the price of fertilizer and farm machines.
- To exempt education expenses for farmers children
- To encourage the investment in rural area.

Results show high increase in the production, 9% increase comparing to 2003, the highest in last 5 years. Farmers incomes Increased 6.8%

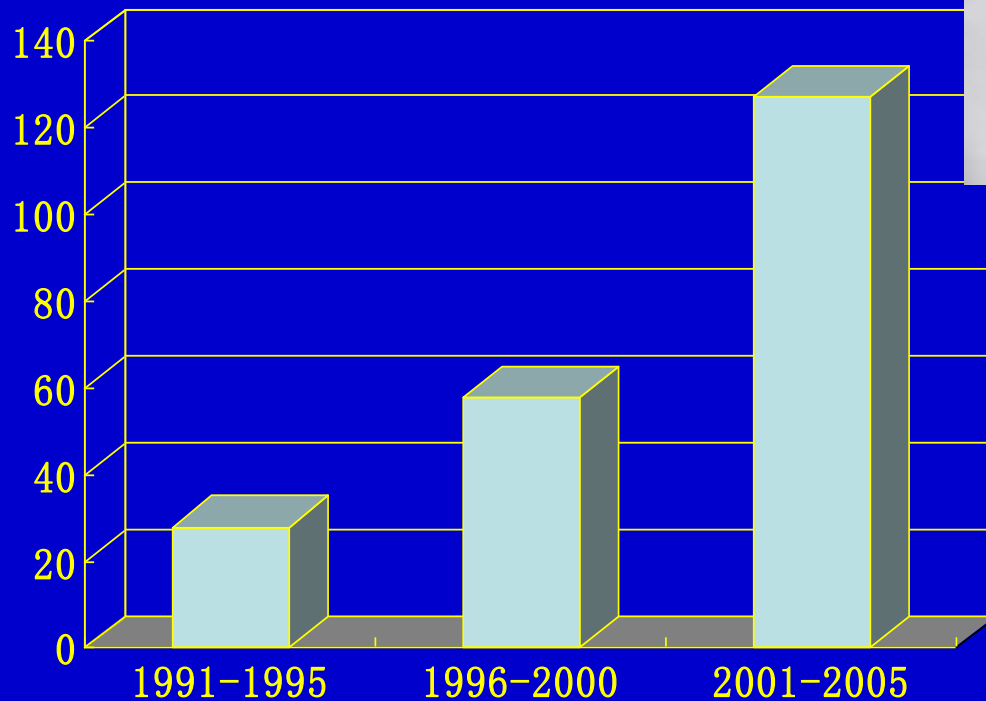


# Strategic Actions and Consideration

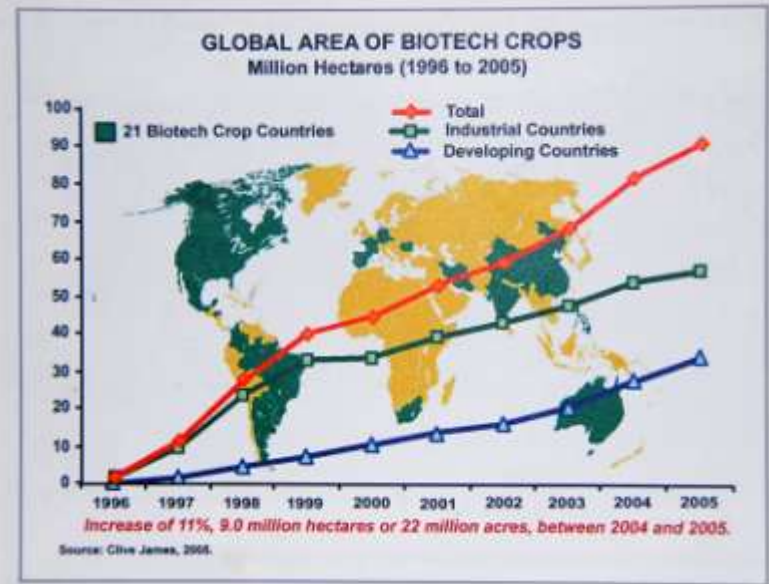
- **Future growth of agriculture and farmers' income largely depends on public policy and investment. Restructure of farming system.**
- **Reducing the number of farmers will facilitate expansion of farm size, increasing labor productivity and competitiveness**
- **Transformation of employment structure within agriculture is important**
- **New technology applications are key factors to increase the production and food quality**

# Agricultural Biotechnology

100 million RMB



**Chinese Government Inputs on Biotechnology**



**Global Area of Biotech Crops (ISAAA):**

- USA
- Argentina
- Brazil
- Canada
- China
- Paraguay
- India



**Roger Beachy, 1986, Illinois**

# Regulation of Transgenic Plants in China

- 1986 National 863 R&D Program on transgenic plants
- 1993 National Biosafety Committee established
- 1996 First National Regulation on GM plants issued. First approval on commercialization of GM cotton, tomato, and sweet pepper.
- 2001 State Council promulgated the Regulations on Safety of Agricultural GMOs
- 2002 Ministry of Agriculture issued 3 supporting documents for the Regulations, including Safety Assessment, Safety of import and Regulations on Labeling

# GMO approvals in China

(up to June,2006)

- 192 research organizations and companies both domestic and international applied for approvals. Total applications: 1525, Approved for trials:456, environment releases:211, pre-production trials: 181.
- Ministry of Agriculture has issued 424 licenses for GM crops for production
- Issued 18 licenses to imports of raw materials of GM products



# Approval of Commercialization of Transgenic Plants in China

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- Bt.Cotton                      Monsanto Company
- Bt.Cotton                      CAAS
- Anti-PG.Tomato              HuaZhong Agri.Univ.
- Virus-R Tomato              Peking Univ.
- V-R Sweet Pepper          Peking Univ.
- CHS-Petunia                 Peking Univ.
- Papaya PRV                  South China Ag. Univ.

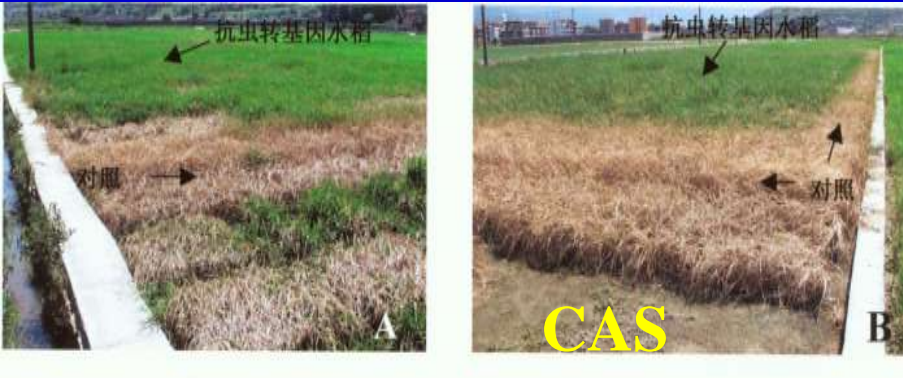
# GM Plants Tested or released in China

Cotton	peanut
Rice	cabbage
Wheat	tomato
Maize	melon
Soybean	sweet pepper
Potato	chili pepper
Oil rape	papaya
Tobacco	poplar tree
	petunia

To 2005, total GM plant species:30; application:1044,  
approval for trials:777; commercial licenses issued:73



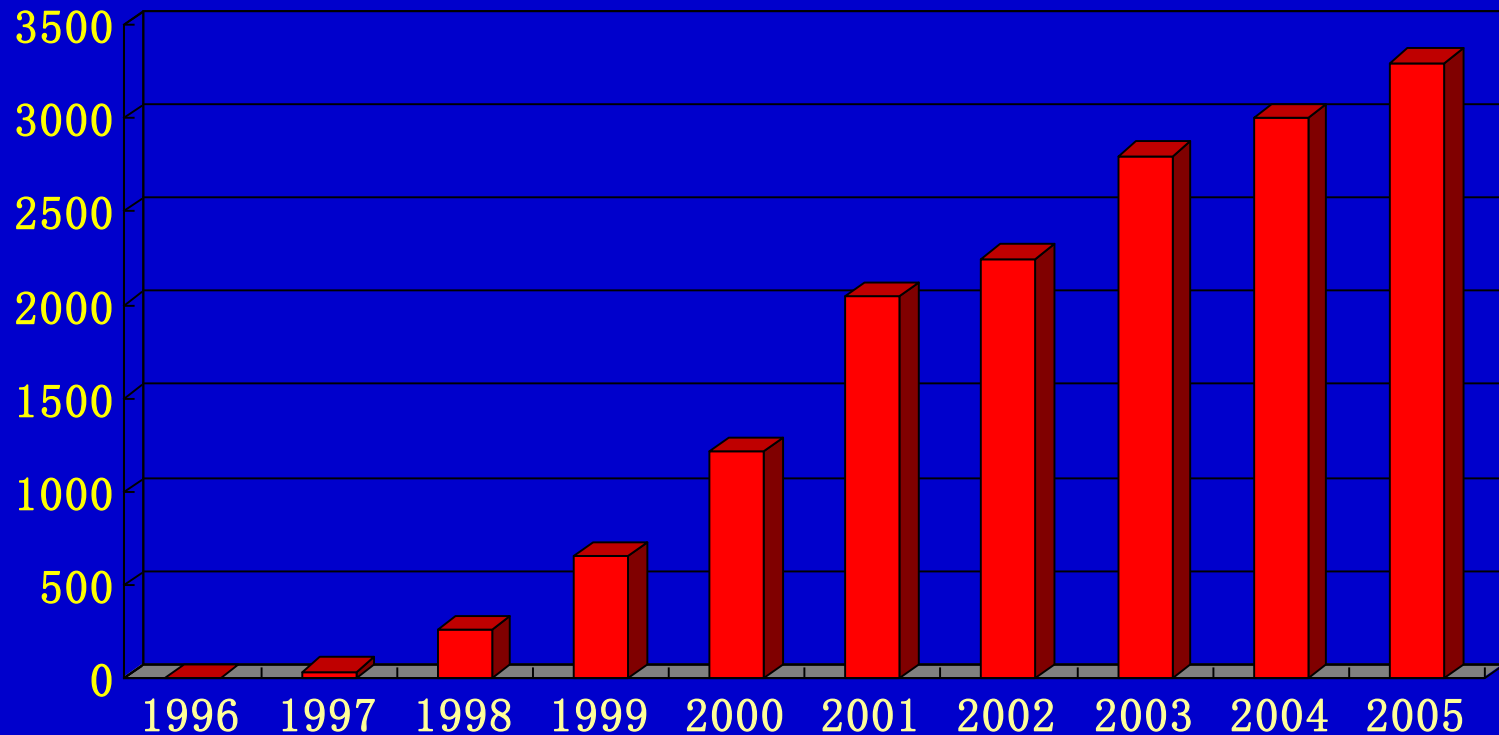
# Insect-resistant Crops



Cotton: 200 million farmers, textile exports reached to \$115.7 billion in 2005, 15% of total exports.



## Bt cotton areas in China, 1996-2005 (thousand hectares)



**Over 60% cotton fields ,about 6 million farmers  
adopted Bt cotton in 2005**

# Public Debates on GMO



**转基因生物与环境学术研讨会专辑**

主编：顾廷元、卢思靖 2002年第4期(特别) 2002年6月出版 总第4期

**转基因生物与环境学术研讨会纪要**

**最新研究综述**

**闭幕辞——卢思靖**

GREENPEACE

**转基因生物产品有五大隐忧**

信息来自国家环保权威部门

无论在国内还是在国外,关于转基因生物产品的争论从它一出现开始就没有停止过。

部分科学家称,转基因具有优越性,它使农作物增加产量、提高品质,增强抵抗有害菌的能力,因为它具备了抵抗病虫害的基因,大大减少化学杀虫剂的施用,减少对环境的污染。

然而,最近来自国家环保总局的消息表明,目前引起国际社会广泛关注的转基因生物产品,可能对全球环境产生五大危害。

首先,转基因生物可能给其他生物产生不可估量的负面影响。具有抗虫和抗病菌基因的作物,也可能通过授粉途径将其他许多有益植物产生直接、间接的影响,从而改变这些植物原有的良好基因,造成一大危害。

其次,增强害虫的抗性。具有抗害虫基因的作物虽能抵抗害虫,但抗药能力是有限的,目前已经第三代,第四代害虫已对转基因抗虫作物产生抗性,这就意味着喷更多的农药,对环境造成更大的危害。

第三,转基因植物通过授精可能抗虫、抗病,在除草剂或“土壤”中产生毒素,使之变成抗性,危害、破坏草地的植物生长,从而更广泛地掠夺地中的肥料,严重影响农作物的生长甚至生存。

第四,由于动物、植物、微生物甚至人类的基因可以相互转移,形成人为的交叉特征,这就违背了“优胜劣汰”的自然规律,将严重影响物种之间的竞争,破坏原有的自然生态平衡,导致生物多样性的凋落和生态环境多样性的退化。

第五,转基因生物产品作为食品进入市场,可能对人体产生某些毒理作用和过敏反应,如转基因的生长激素类基因可能影响人体生长发育,转基因的抗生素基因可能使人体对抗生素产生抗性,造成耐药。一旦真正生起病来,几乎所有的抗生素都不管用了,这是多么可怕的结果。

当然,迄今为止,还没有足够的证据可以有力地证明转基因食品对人体有害,这是因为转基因产品问世不过十几年,而有些转基因可能对人类的危害潜伏期尚长。因此,WHO成员国、儿童对转基因食品的生长影响和精神态度到国家,是不允许这些转基因食品入境许可的,它采取非常谨慎态度,欧盟国家尤其如此。



# Transgenic Rice in China

Transgenic rice have been tested in fields and preproduction trials:

- Insects resistant
- Bacteria blight and fungal blast resistant
- Salt tolerance
- Herbicide tolerance
- Nutritional improvement
- Rice dwarf virus resistance





Integration of Xa-21 and bt-rice

## Field-trial of Bt-rice



# Bt Transgenic Rice



# Herbicide-tolerance Transgenic Rice



# Transgenic Rice, Salt Resistant



# Commercialization of Transgenic Rice

- National Biosafety Committee approved the production of Xa-21 GM rice against leaf blight disease in Nov 2004, waiting for final approval from government.
- Green Peace involved in Chinese transgenic rice and made announcement of detection of GM rice in seeds market in HuBei Province, April, 2005
- Japan and South Korea made decisions afterwards for detection the transgene in rice before importing from China.
- Still no approvals for any transgenic rice for production commercially.
- Iran approved for commercialization in 2005.

# Green Peace Discovery: Transgenic Hybrid Bt Rice Seeds “Shan you 63”, April, 2005



Samples of rice seeds have been collected from seed companies, farmers and rice millers. Testing by the international laboratory **Genescan** has confirmed the presence of GE DNA in **19 samples** out of 25 samples.

**BEIJING, CHINA -- April 12, 2005** Greenpeace called for an urgent, international product recall after uncovering the release of a variety of genetically engineered (GE) rice in China.

# Greenpeace website Apr 13, 2005

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## Scandal: Greenpeace discovers illegal GE rice in China

13 April 2005

Print  
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Farmer selling GE contaminated rice.

[Enlarge Image](#)

only field testing. Nevertheless, it appears GE Rice is being sold, planted, consumed, and possibly exported in China, one of the

HUBEI, China — In a startling development that may have repercussions on exports of China's biggest crop, Greenpeace has uncovered genetically engineered (GE) rice, unapproved for human consumption, that appears to have been planted and sold illegally in China for the last two years.

The Chinese government has not authorised GE Rice for commercial planting, and has to date permitted

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# Recent Problems in EU in GM Rice

- August in this year, EU announced the finding of GM rice imported from USA (long-grain rice contained GM Liberty Link rice LL601) and block the importation.
- Last month, Sept.5, Green Peace announced the discovery of GM components in import rice products (rice noodles).
- The same day, EU urged member countries to enhance the monitoring GM in food. To date, EU prohibit 25 member countries to sale and to import GM rice and its products.
- French administrators searched the largest rice noodle company (TangFreres) in France and tested their products. Asked them to stop the sale during the investigation.

# GM Rice Needed to Be Approved

- Last month, Aug.26, the China National Biosafety Committee of Agricultural GMOs had a meeting for approvals of GM rice.
- Total 7 GM rice varieties have been discussed
- 6 varieties are related to insects resistance with genes of cry1Ac, Cry1Ab and sck.
- 1 variety is related to bacterial resistance with gene Xa21

# GMO Debates and Facts: GMO food safety

- So far, only two major genes are used mostly, Bt and herbicide resistance genes, in GM crops.
- Since 1960s, Chinese and other parts of world have used Bt bacterial as biological control for insects in vegetables and pine trees. No any toxic reported
- China has imported GM soybean from USA since 1999 and products including soybean oil, soy sauce, tofu, feeds for animals have been used. No reports on unsafe issue.
- Over 2 billion people from USA, Argentina, Brazil, Canada and some other countries have been using GM food for over 6 to 10 years, no case reported that toxic GM food to consumer

# GMO Debates and Facts: Environment Safety

- Less pesticide or herbicide used in GM crops, create better or at least no worse environment.
- More other species of insects in Bt-cotton fields than fields spreading pesticides due to less pesticide.
- Cross pollination to wild rice if happened but the same when planting rice cultivars
- 40,-50,000 people poisoned due to pesticides in China annually, 400-500 people died.

# Insecticide Use on Bt and Non-Bt Cotton in China 1999-2001, (kg/hectare of formulated product)

	1999	2000	2001	Average
Non-Bt	60.7	48.5	87.5	65.5
Bt	11.8	20.5	32.9	21.7
<b>Non-Bt - Bt</b>	<b>48.9</b>	<b>28.0</b>	<b>54.6</b>	<b>43.8</b>

Source: Pray et al., 2002.

# Percentage of Bt and Non-Bt Cotton Farmers Suffering from Pesticide Poisonings in China 1999-2001

	<b>1999</b>	<b>2000</b>	<b>2001</b>
Non-Bt	22	29	12
Bt	5	7	8
<b>Non-Bt - Bt</b>	<b>17</b>	<b>22</b>	<b>4</b>

Source: Pray et al., 2002

# Distribution of Benefits between Farmers, Seed Companies, and Research Institutes

	CAAS		Ji Dai	
	Million USD	Percent	Million USD	Percent
Net Benefits to farmers	46-70	83-88	31-61	83-90
Gross revenues to seed co.	9.6	12-17	4.8	7-12
Returns to CAAS & Monsanto, Deltapine & Singapore Economic Development Board	0	0	1.9	3-5

# Labeling System for Agricultural GMOs

- 17 products are required to be labeled.
- Soybean seeds, soybean, soybean flour, soybean oil, and soybean meal.
- Corn seeds, corn, corn oil, corn flour
- Rape seeds, rapeseed, rapeseed oil, meal.
- Cotton seeds
- Tomato seeds, fresh tomatoes and tomato sauce



# Labeling in China:



- Required to be labeled in 2002
- 6 months after announcement, none of foods are labeled as “transgenic”
- Many vegetables are labeled as “non-transgenic”

*Science and Technology Diary  
Sept.12, 2002*

- Soybean oil products have been reinforced to be labeled in 2004, markets are not affected
- Cost increases over 50% in production and sale management with labeling system

# Biotech crops foods: non organic?

- Transgenes and their proteins are organic!
- Biotech crops should not be discriminated
- Green revolution continues.

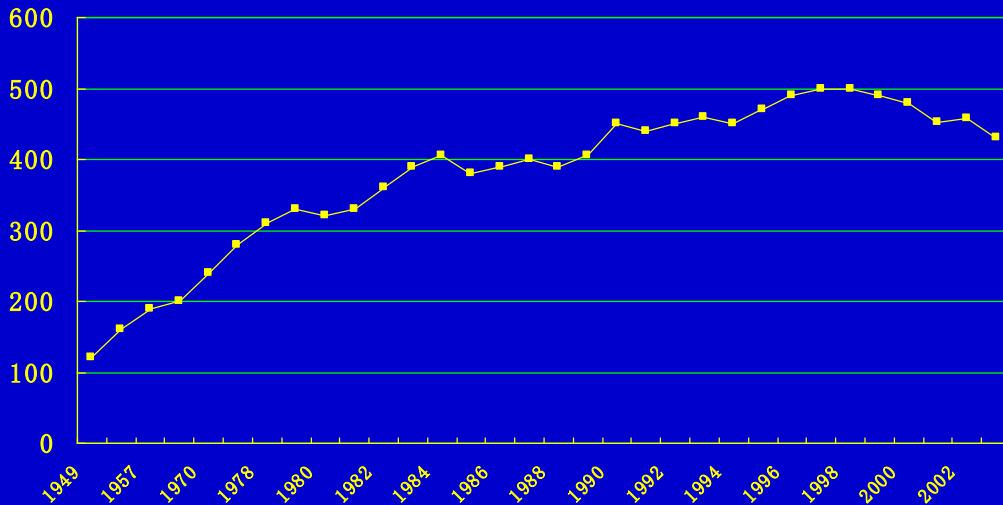
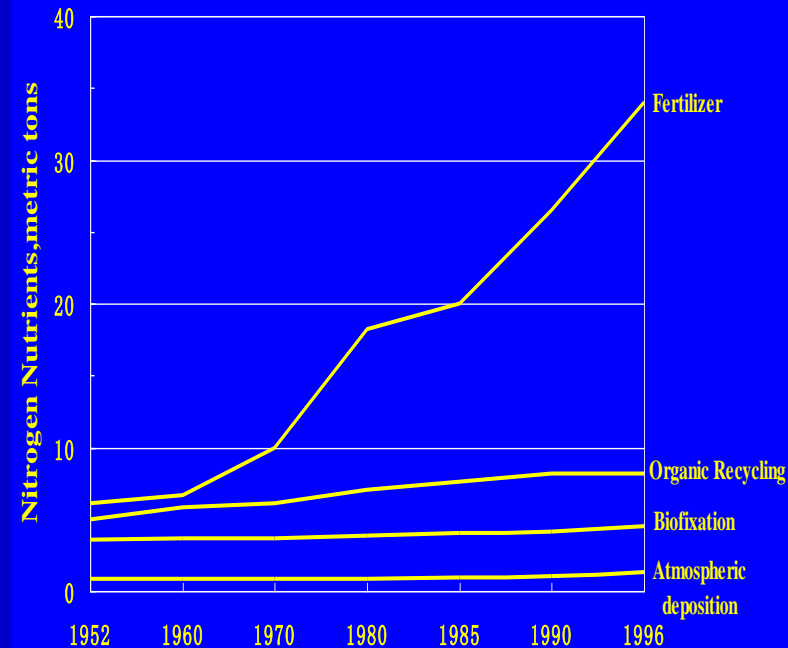


Figure 1. Nitrogen Inputs in China's Agriculture, 1952-96



# Consideration

- It has spent great amount of money in the world recently years for studying the safety of GMO and show no any evidence of toxic to human or animals or to environment. But because of regulation in each country, people still repeat each other for this work.
- People in many parts of the world are suffering from shortage of food. But this important technology could not be used in these countries
- We should learn the experiences from DNA recombinant drugs
- Europe is key region for application of biotech crops in the world. “Luxury Syndrome” should be changed.
- Agriculture Biotechnology combined with conventional breeding methods are very effective in crop improvements and should be considered as an important step in Green Revolution.



**Thank you.**

[chen@cau.edu.cn](mailto:chen@cau.edu.cn)