Ecological Intensification for Dry Land Agriculture

– Rethink the Agricultural Strategies in China

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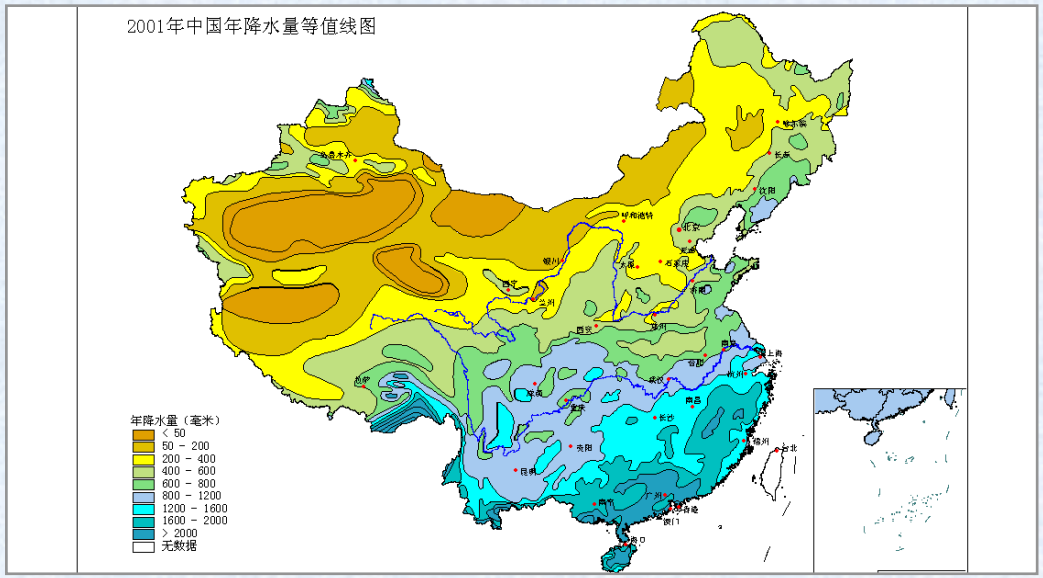
Chinese Academy of Agricultural Sciences

The Story of Agriculture Development in Xinjiang Autonomous Region, China

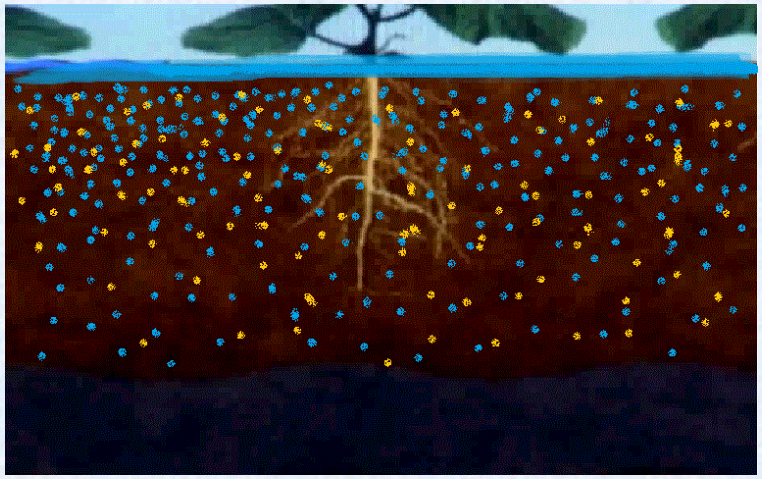


Application of drip irrigation during the recent 5 years

- ✓ **Average yield: 12,750-15,000kg/ha**
- ✓ **Water use was ½ of the amount in sprinkler and 1/7 of furrow irrigated field**

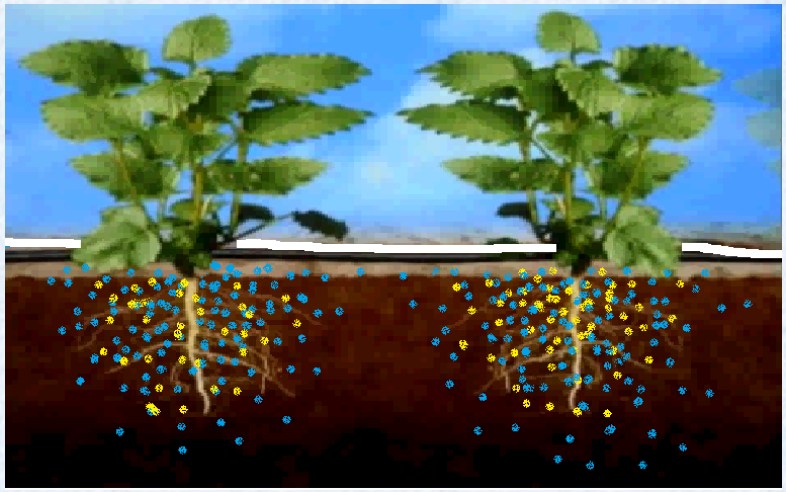
Drip irrigation is currently the best technology for improving water and nutrient productivity

Conventional irrigation and fertilizer application



CI: High waste of water and fertilizers, low water use efficiency

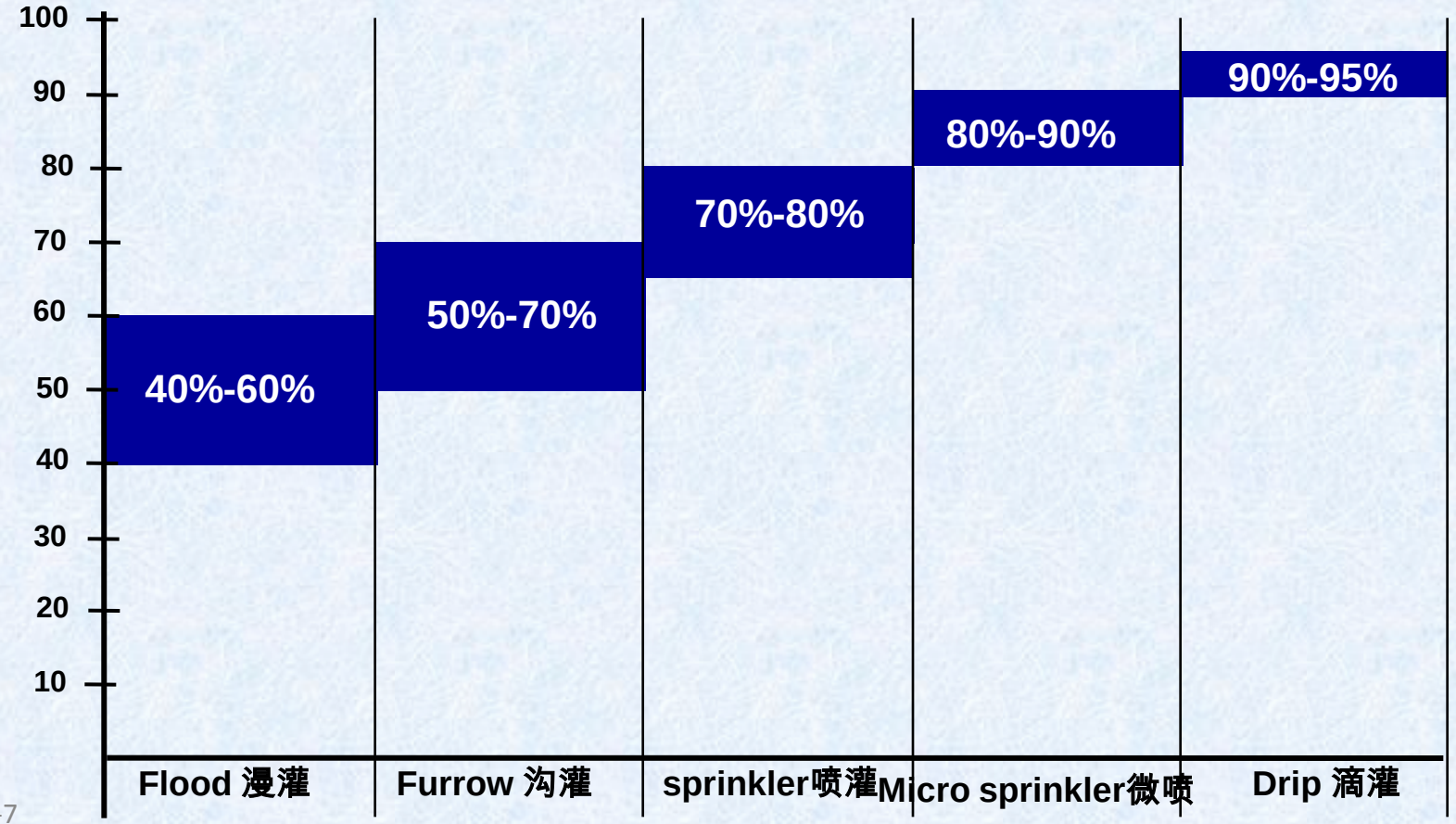
Drip irrigation integrated with fertilizer use - fertigation



DI: Water and fertilizer retained at the crop root zone, high water use efficiency

Drip irrigation: A core technology for eco-intensification

Water use efficiency of different irrigation methods:



Drip irrigation under mulch film for row crops – a recent innovation in Xinjiang, China

Drip irrigation under mulch film (DIUMF) is a great technology innovation that integrates drip irrigation, fertilization and plastic film mulching into one process in planting

Other applications of drip irrigation

Pepper—Jilin and Hebei

Desert afforestation — Xinjiang

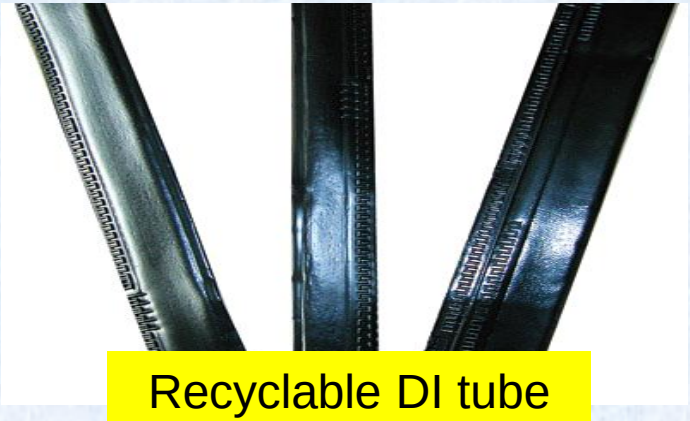
Grape—Liaoning and Xinjiang

Application of drip irrigation in mosaic crop fields, Shi-he-zi, Xinjiang

DI equipment & products by Xinjiang Tianye Co.

Filter system

Automatic tube and nozzle machine



Recyclable DI tube

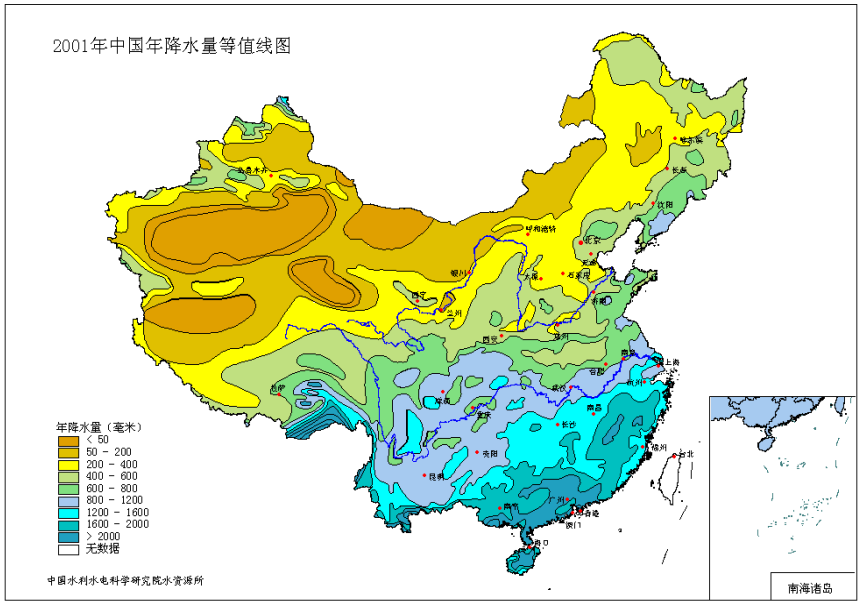
Tube recycling

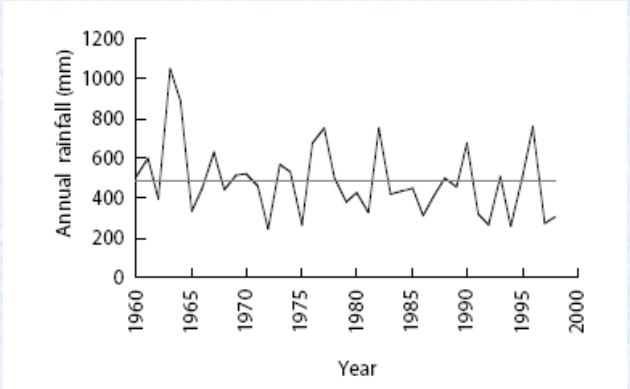
Comparison of the Tianye DI technology and products with imported Israeli products

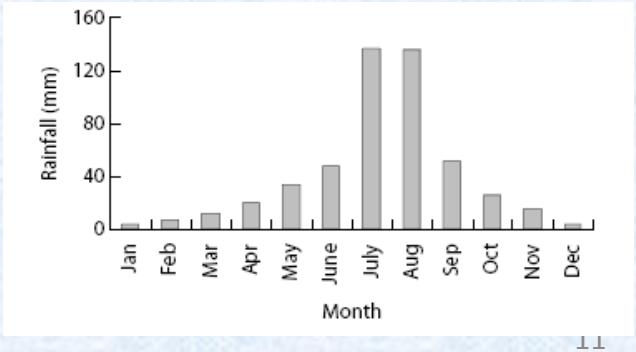
Item	Israeli Products	Tianye Products
Application Fields	**Mainly in protected agriculture (greenhouses)**	**Mainly in open field crops**
Water quality requirement	**High**	**Low**
One time system investment	**2300 Yuan/mu (34,500 Yuan/ha)**	**600Yuan/Mu (9,000 Yuan/ha)**
Annual replacing material cost	100 Yuan/Mu (1,500 Yuan/ha)	80-120 Yuan/Mu (1,200-1,800 Yuan/ha)

Water scarcity is the first obstacle for intensified agriculture in North and Southwest China

- water resource per capita of about 2200 m^3, only 1/4 of the global average
- Water distribution is uneven in both time and space







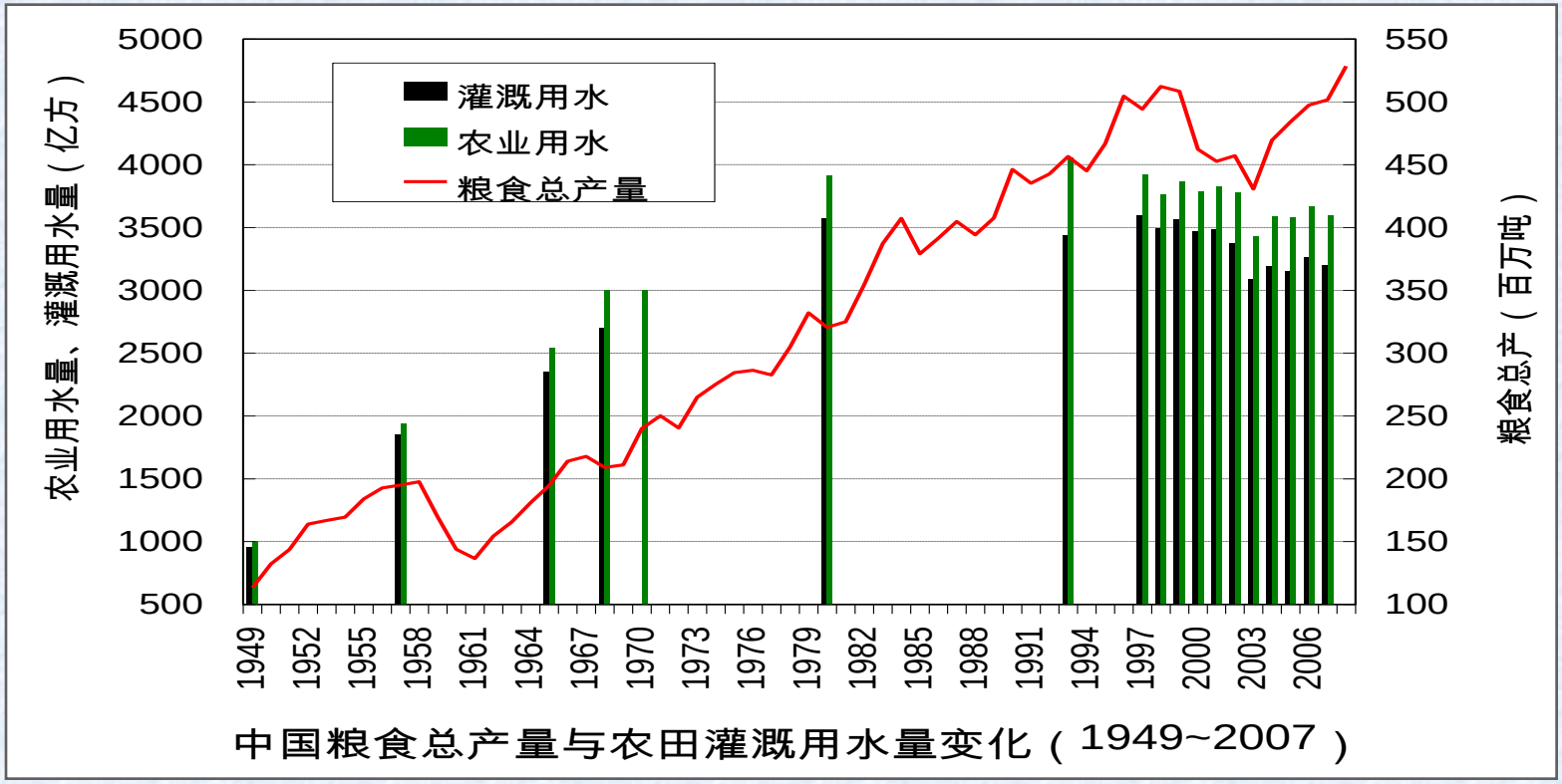
Water Scarcity & Food Security in China

—*Water use*

- **570** billion m^3 of water for grain production
  - **170** billion m^3 irrigated water
  - **400** billion m^3M soil water (rainfall -green water)
- Irrigated Water Use Ratio=48%,
- Rain Water Use Ratio=56%
- Water Use Efficiency=1100m^3/ton of gain production
- 30 billion m^3 of water shortage (current)

Water Scarcity & Food Security in China

—*No water increment for agriculture*

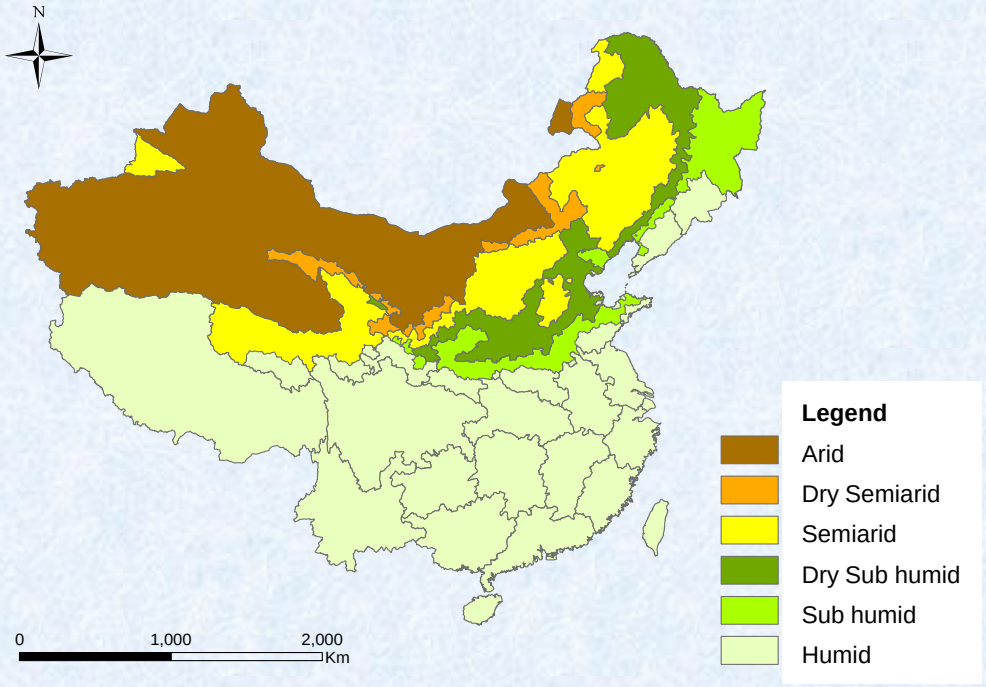


Distribution of Grain Production In China

- Main grain producing areas: 13 provinces produce over 75% of China's grain.
- Grain self-supply areas: 11 provinces.
- Grain deficit areas.

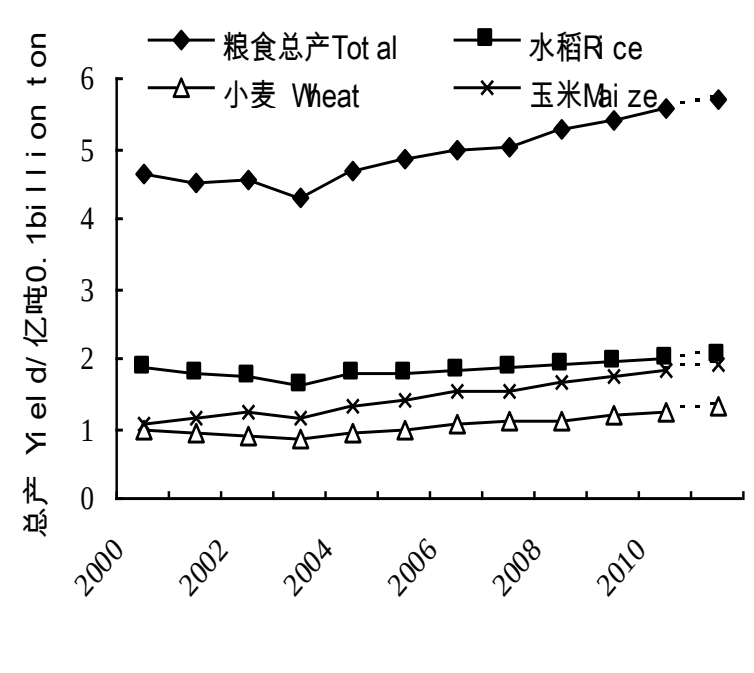
Dry land agriculture plays an important role in China's national grain security

- ***Provides*** 45% of gross grain production
- ***Occupies*** 56% of cultivated farmland acreage



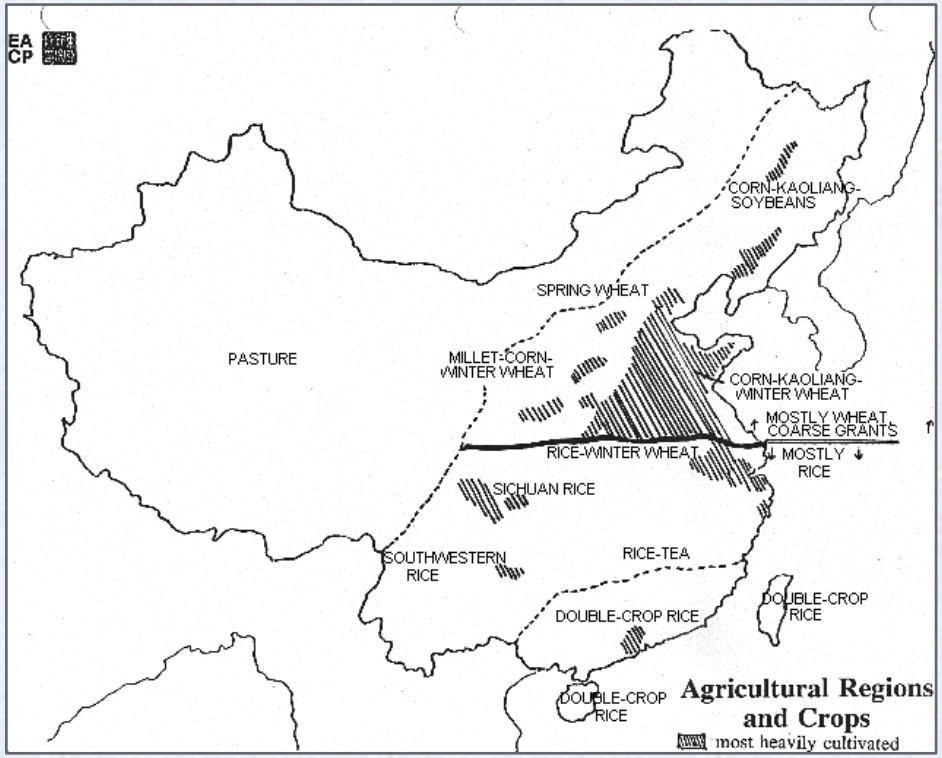
Increasing maize production will be a key strategy to China's national grain security

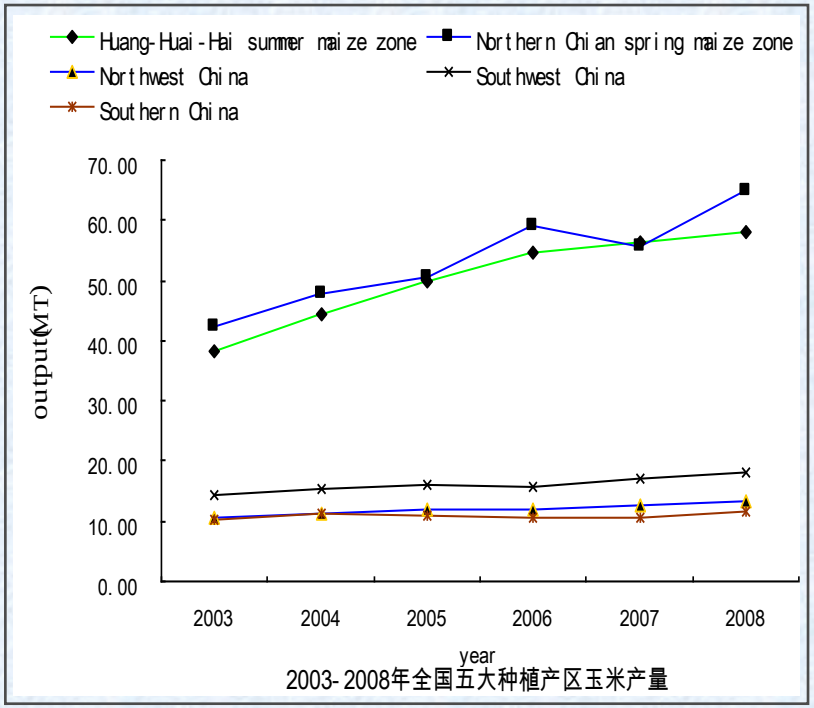
- **53.1% of the national grain production capacity is allocated to Maize currently**
- **65% of the increased grain production capacity will likely be from maize by 2020**



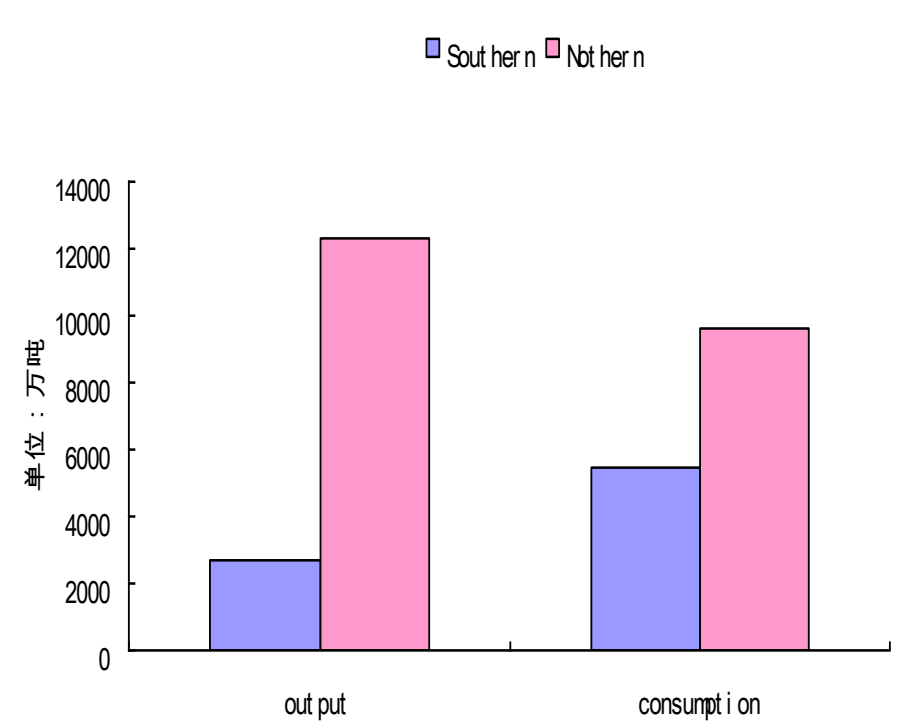
Distribution of maize production in China

85% of the maize is produced in the summer maize zone of Huang-Huai-Hai River Basin and the Northern China spring maize zone





The Imbalance between output and consumption of maize in China



Maize production and consumption in the South and the North China, 2006-2007

- **Southern china:**

  deficit of 2.75 million tons

- **Northern china:**

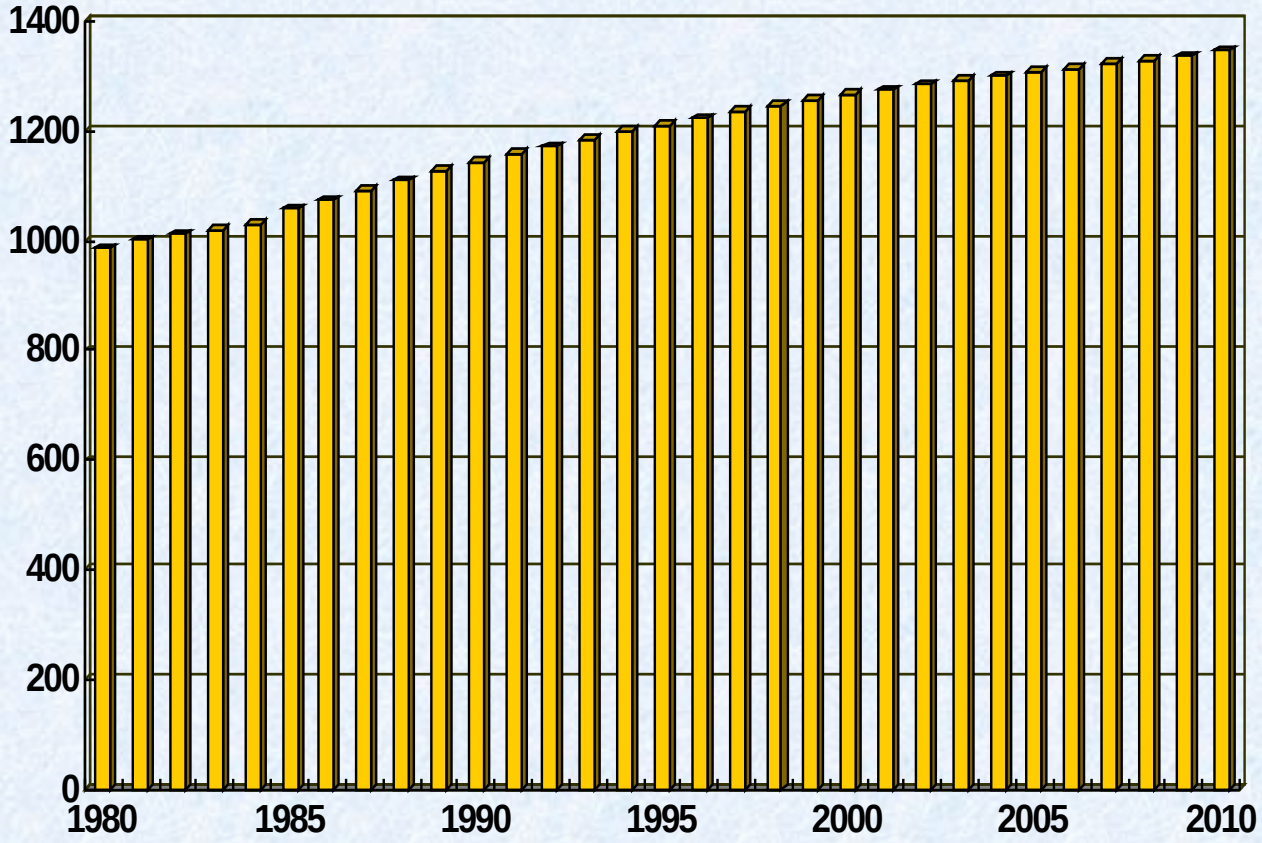
  surplus of 2.67 million tons

China's dry land areas in the Northwest and Southwest can become a new major granary, with a focus on maize

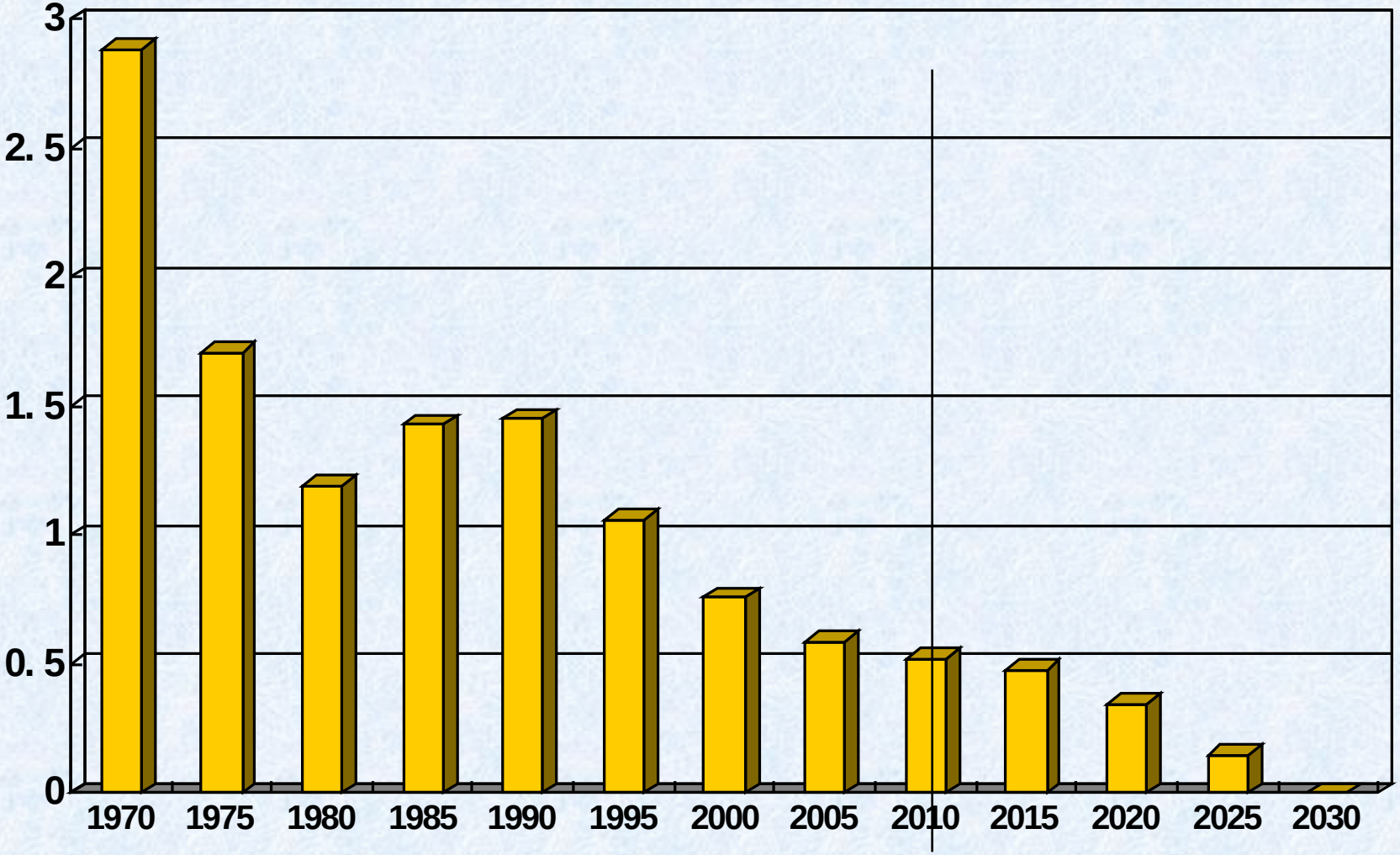
- Promote drip irrigation as a core technology for eco-intensification of agriculture.
- Adopt new HY varieties suitable for eco-intensification
- Promote mechanization suitable for large, medium and small size farms.
- Optimize crop management
- Intensify government support in policy, investment and extension service
- Encourage investment and participation by the private sector in dry land agriculture.

China's Population (million)

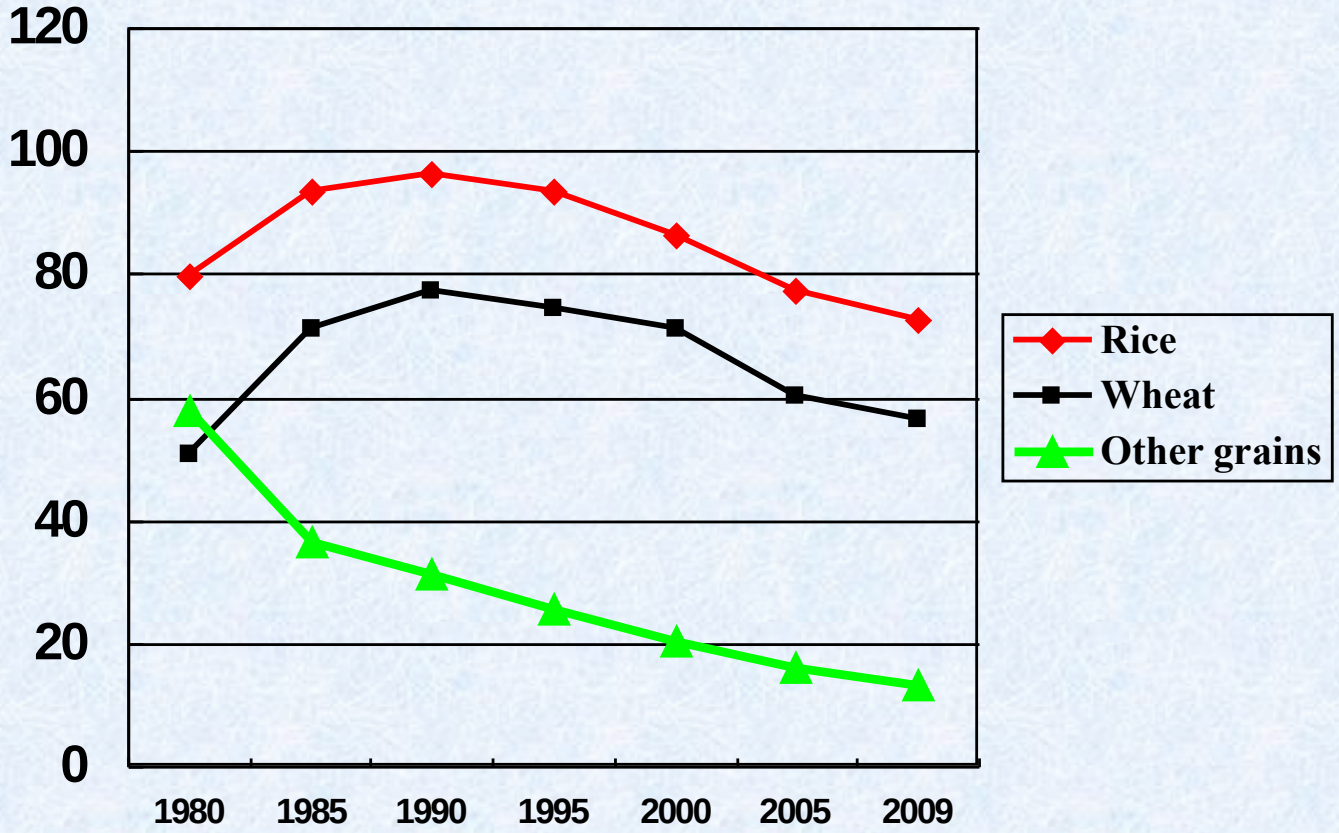
Average annual growth rate in 1980-2010: 1.1%



Population growth rate will decline significantly in the coming decades



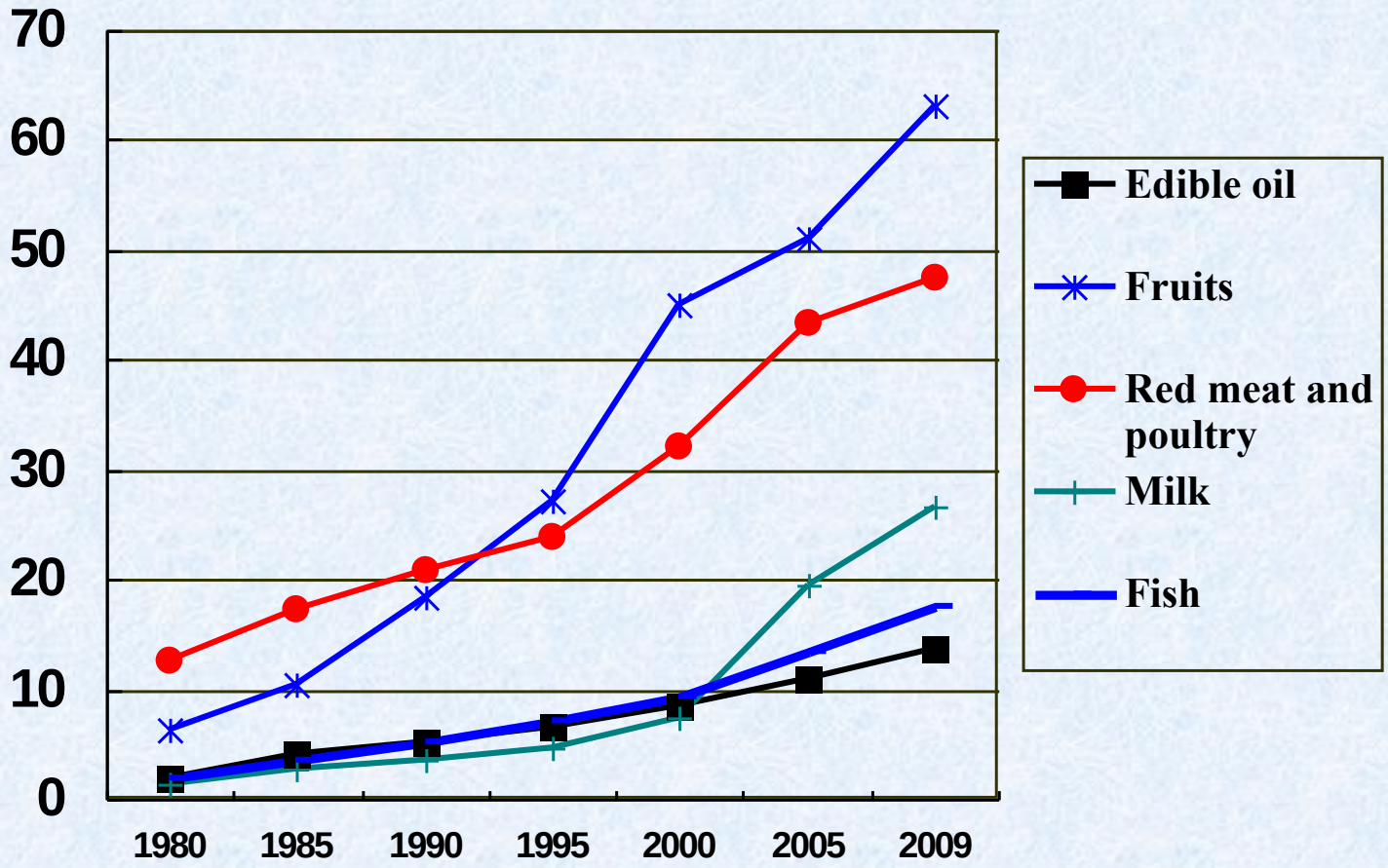
Per capita food grain consumption (kg)



Significant fall in food grain consumption as income increased

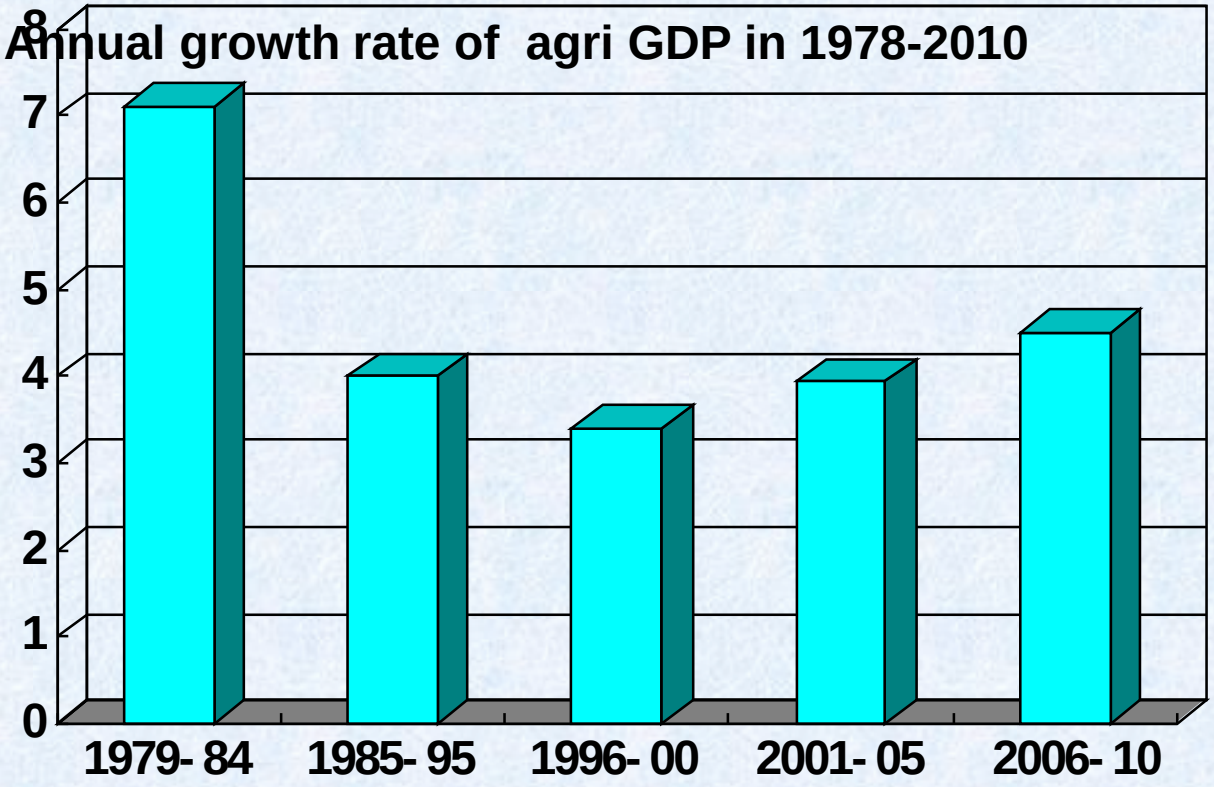
(Jikun Huang, CCAP, 2011)

Per capita meat and other food consumption (kg/person)



(Jikun Huang, CCAP, 2011)

4.4% of annual growth rate of agri GDP in past 30 years

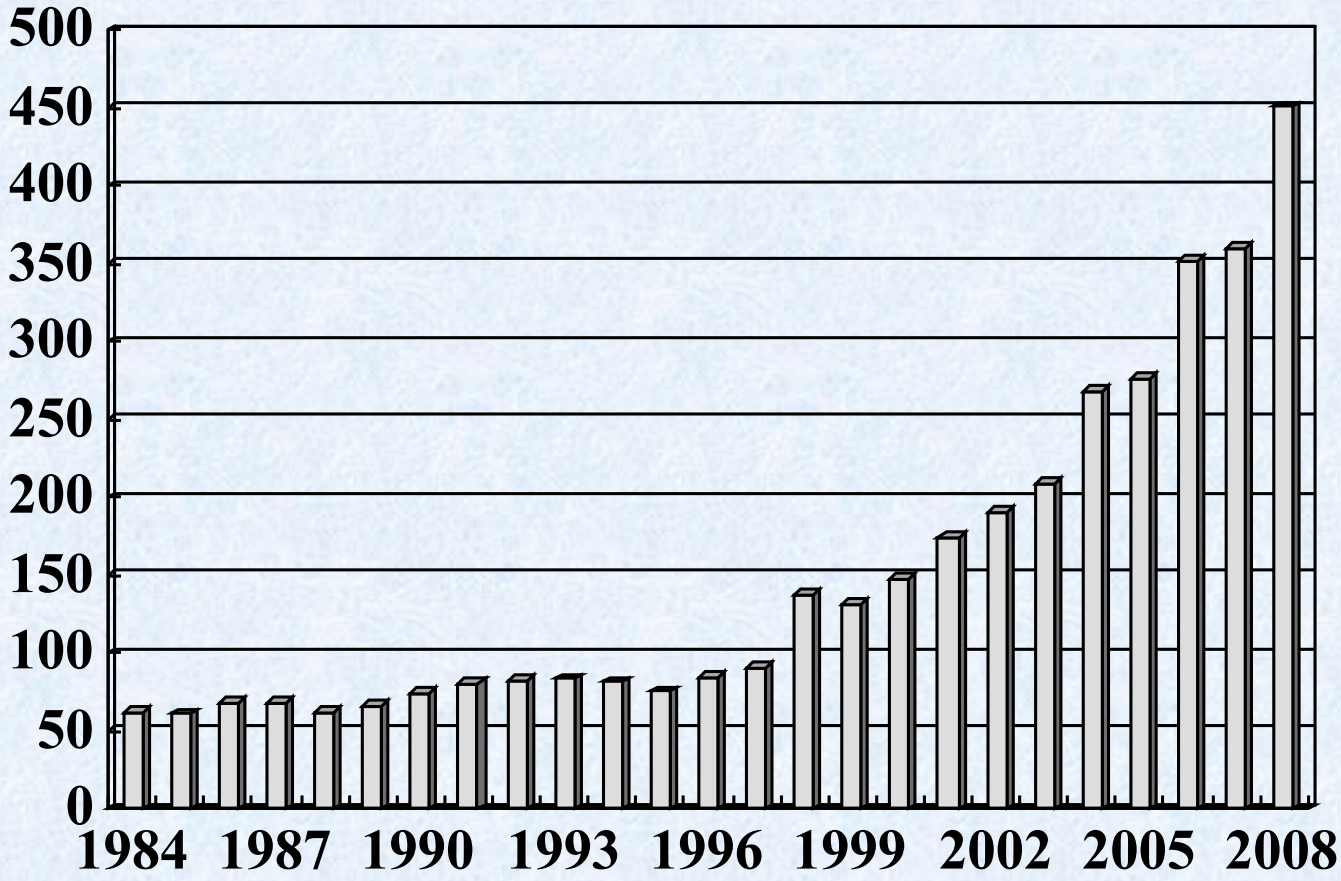


About 4 times of population growth rate

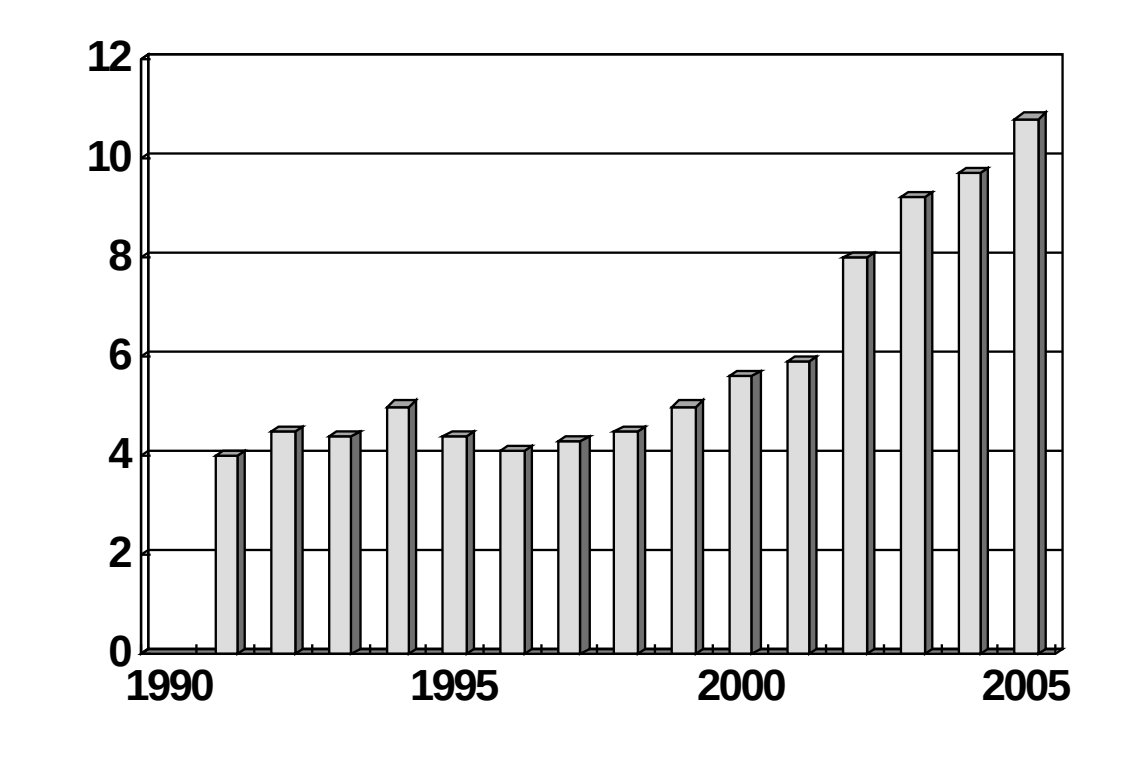
(Jikun Huang, CCAP, 2011)

Investment into agricultural sector

Central government budget support
(billion yuan in 2008 prices)

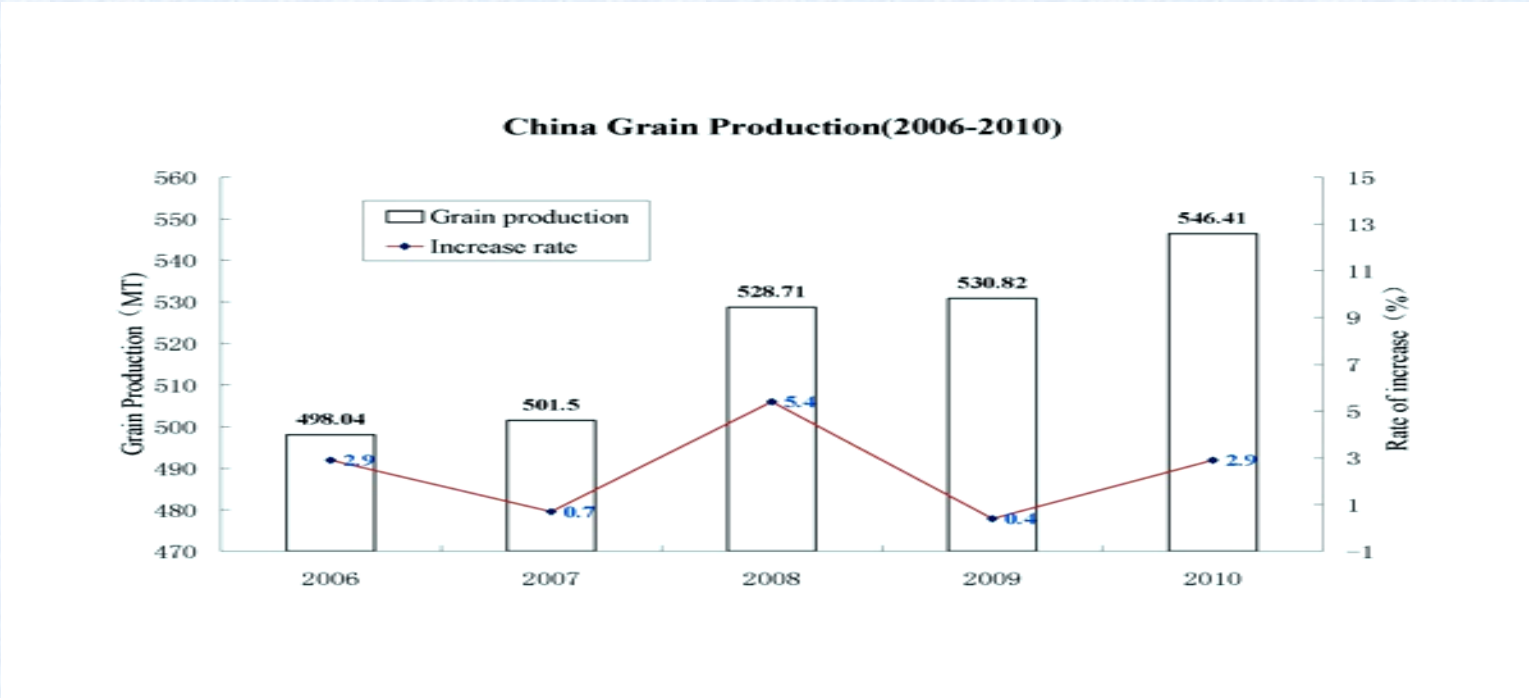


Government fiscal investment in agricultural research (billion yuan in 2005 price)



In 2010, China's public sector investment in agricultural R&D was 0.8% of the total national agricultural GDP, a significant increase from that of 0.25% in the 1990's, but still less than the 1-1.2% agricultural GDP for developing countries as recommended by FAO.

Grain Production Situation in China



- In 2011, China's grain output reached 546 million tons, the eighth consecutive year of bumper harvest.
- In the long run, supply and demand of grain will be in tight balance towards China’s goal of 92% self-sufficiency

Some Take Home Messages for Transforming global agricultural research FOR DEVELOPMENT and Rethinking Agricultural Strategies

- **China will be able to produce 92% of the grain to feed its population by 2030, and support a sustainable development**
- **Ecological intensification is the direction for the resource-poor countries like China**
  - Producing more food and agricultural products from the same overall resources (e.g. land, labor and water) while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services.
- **Reversing underinvestment in agricultural research**
  - Global expenditure on agricultural research as a percentage of GDP is only **one percent**. It is even lower in most developing countries.
  - Public agricultural R&D for developing countries would need to increase from the current **$5.1billion** to **$16.4 billion** by **2025** – of which **$1.6 billion** (minimum) would need to be the CGIAR element to achieve its projected increases in production.
- **Improving technology transfer and scaling up the application and adoption of suitable technologies by the farmers in the developing countries will be a key and a major challenge in achieving sustainable development. This needs to be done through new mechanisms for strengthening public-private and government-nongovernment partnerships.**

Thank You!