



# **Sustainability Issues Related to Water and Agriculture in China**

*The Environmental Impacts on Smallholder Farmers*

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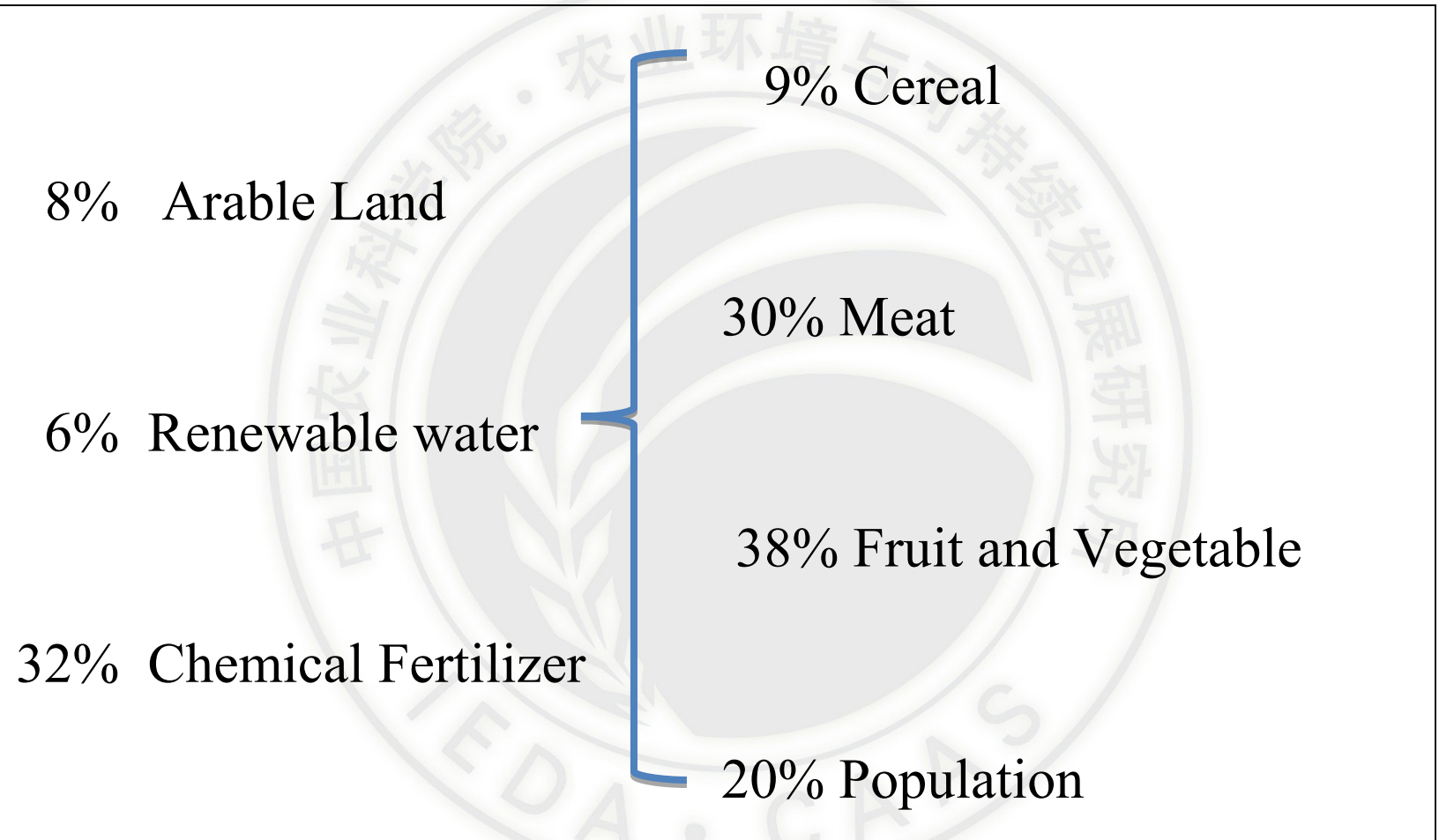


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# Agricultural Growth and Development





# Agricultural Growth and Development

- ***The major tasks agriculture in China***
  - Ensure the food security (*food sustainability*)
  - Protect and restore the health of agro-ecosystem (*environment sustainability*)
  - Poverty reduction in rural region (*economic sustainability*)
  - Promote urbanization and modern agriculture (*social sustainability*)



# Agricultural Growth and Development

- *Cereal Demand and Food security*
  - Cereal self-sufficiency: 95%
  - 1.55 B population, 0.62 BMT of cereal production needed by 2030
  - 0.1 BMT cereal increment, 1.3% increment annually (worldwide estimated 0.9%)



# Agricultural Growth and Development

- *Agro-ecosystem protection and restoration*
  - Reduce agricultural pollution
  - Restore degraded arable land
  - Perfect the Farming system
  - Enhance agro-biodiversity



# Agricultural Growth and Development

- *Poverty reduction*
  - Promoting agricultural industry such as food processing
  - Expand agricultural function to service, the tourism horticulture
  - Bio-fuel, biogas,.....



# Agricultural Growth and Development

- ***Urbanization and modernization***
  - Develop recycle rural economy
  - Perfect rural infrastructure and environment
  - Improve insurance system
  - Promote education



# Water Scarcity and Food Security

- *Water requirement*
  - Currently, cereal production consumes **570** BCM of water, in which **170** BCM is irrigated, **400** BCM is rainfall
  - IWUR=45%, RWUR=55%, WUE=1100m<sup>3</sup>/t
  - For cereal production by 2030, 680 BCM of water needed



# Water Scarcity and Food Security

- ***Gross water shortage***
  - 400 BCM allocated and limited for agriculture, in which 350 BCM for irrigation
  - Malfunction of land and water resources: northern China, 56% arable land, 19% water resource
  - $570(\text{current}) - 680(2030) = -110$  BCM (shortage)



# Water Scarcity and Food Security

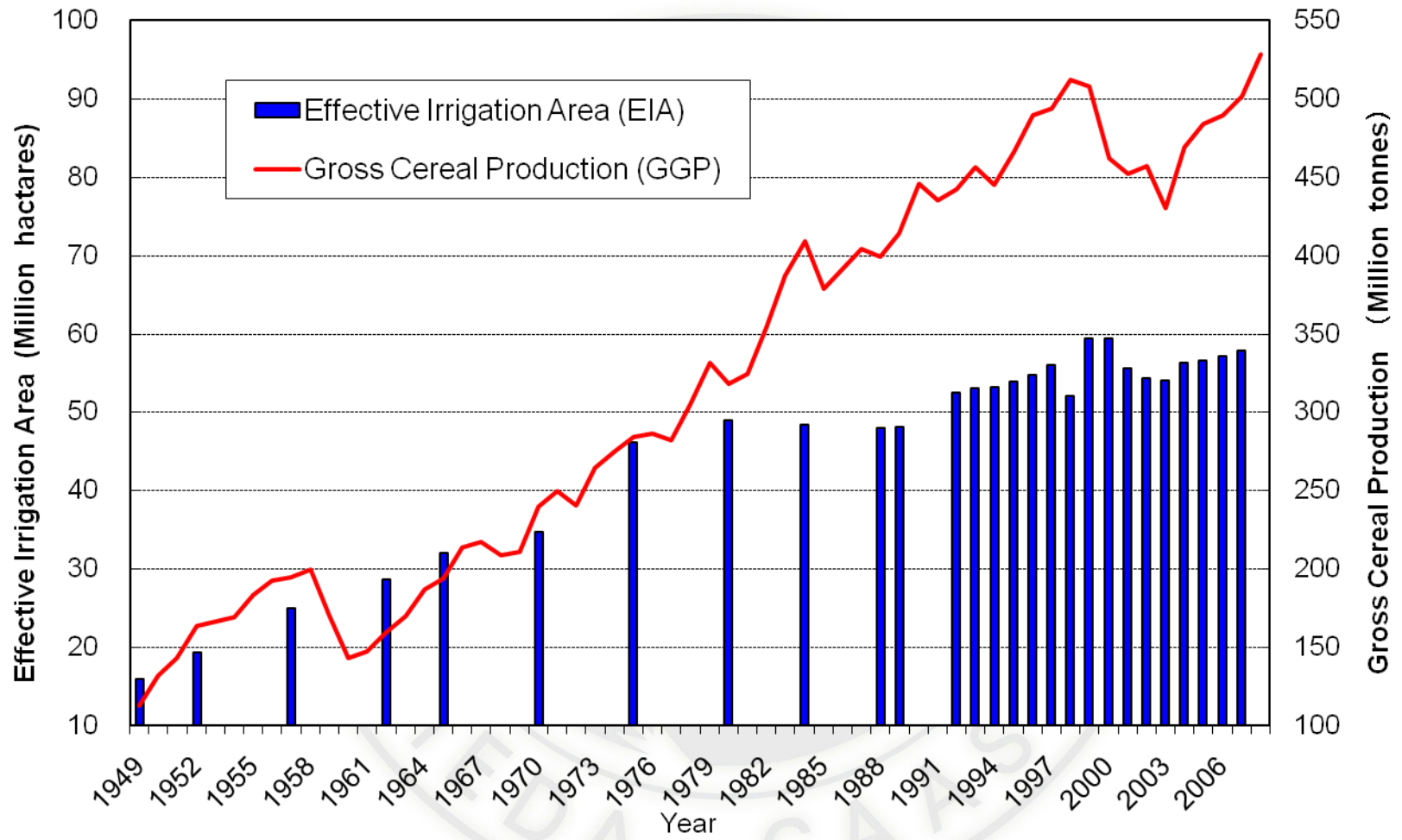
- *Limitation of agricultural water increment*
  - 100 BCM of water shortage in 2030
  - 1949~1980 □GCP vs EIA = 184% vs 207%
  - 1981~2000 □GCP vs EIA = 52% vs 9%
  - 2000~2030 □GCP vs EIA = 30% vs 0%?!

*GCP = Gross Cereal Production increment*

*EIA = Effective Irrigation Acreage increment*



# Water Scarcity and Food Security



**Comparison Between GCP and EIA in China (1949~2008)**

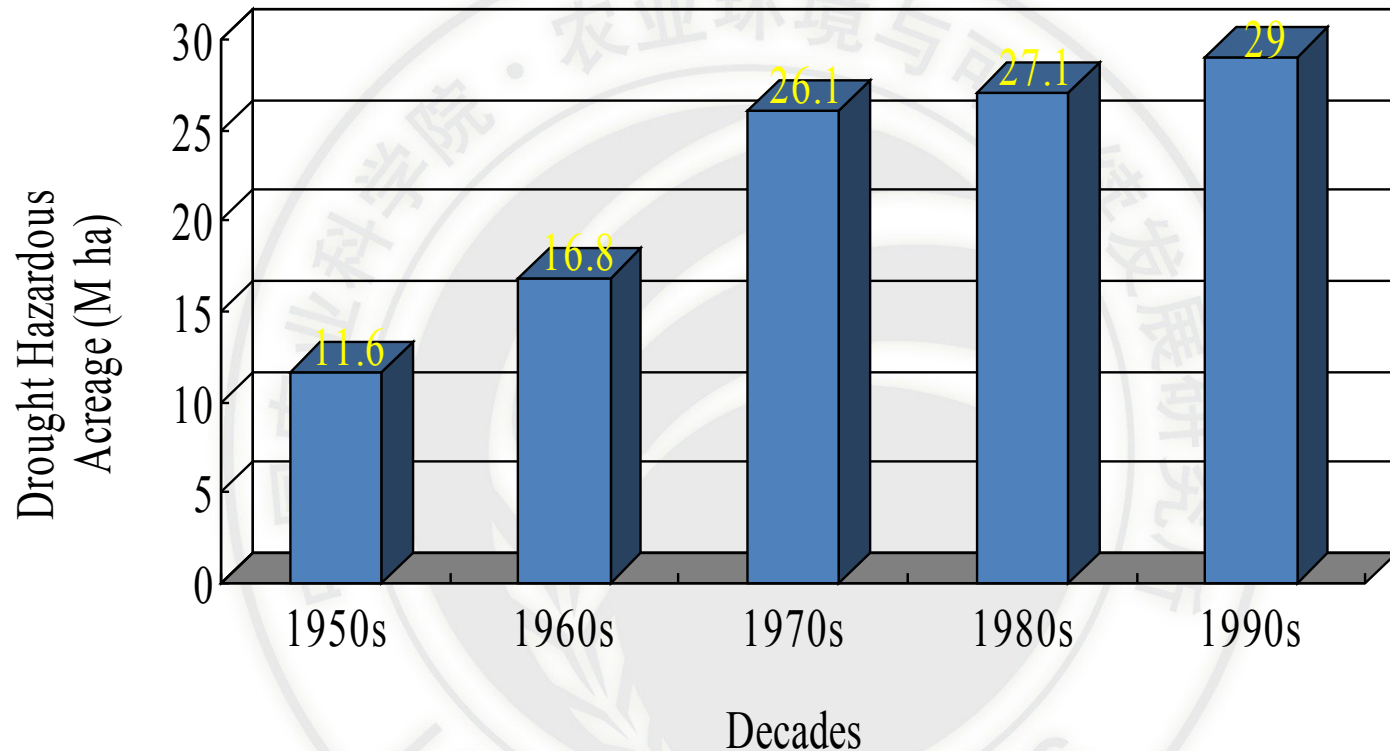


# Water Scarcity and Food Security

- ***Water pollution aggravates water scarcity***
  - 90% polluted water is emitted directly
  - 75% lakes are polluted severely
  - 11% irrigation water is below the quality limitation
- ***Global change induces water uncertainty***
  - Changing of drought scheme (frequent & density)
  - Strengthening of water scarcity in both temporal and spatial scale



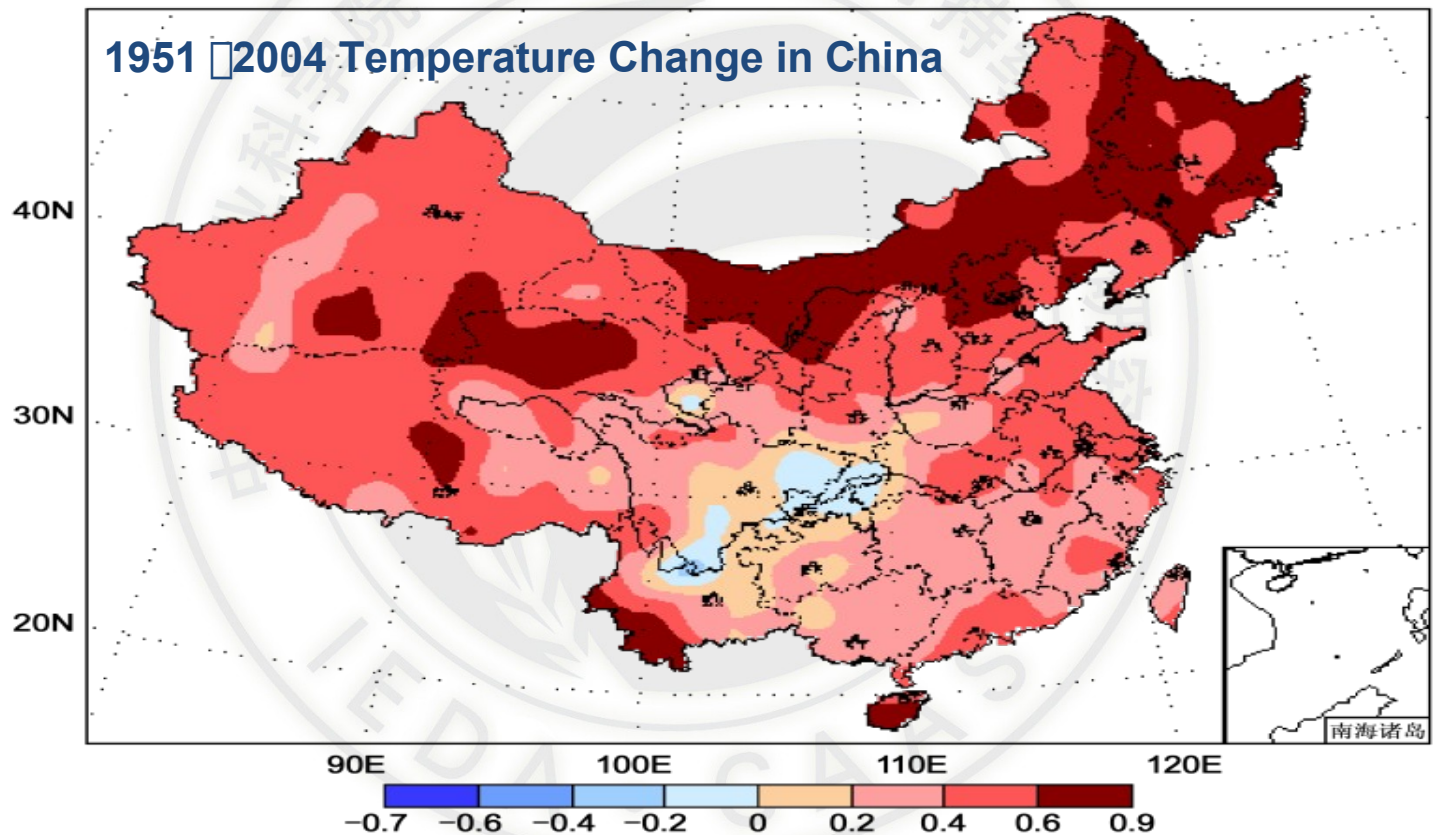
# Water Scarcity and Food Security



Drought Hazardous Acreage of Crops

# Other Sustainability Issues

- *Climate change*



# Other Sustainability Issues

- *Climate change*

Climate change responses  
under SRES A2 scenario in  
2071-2100 relative to  
baseline (1961~1990)

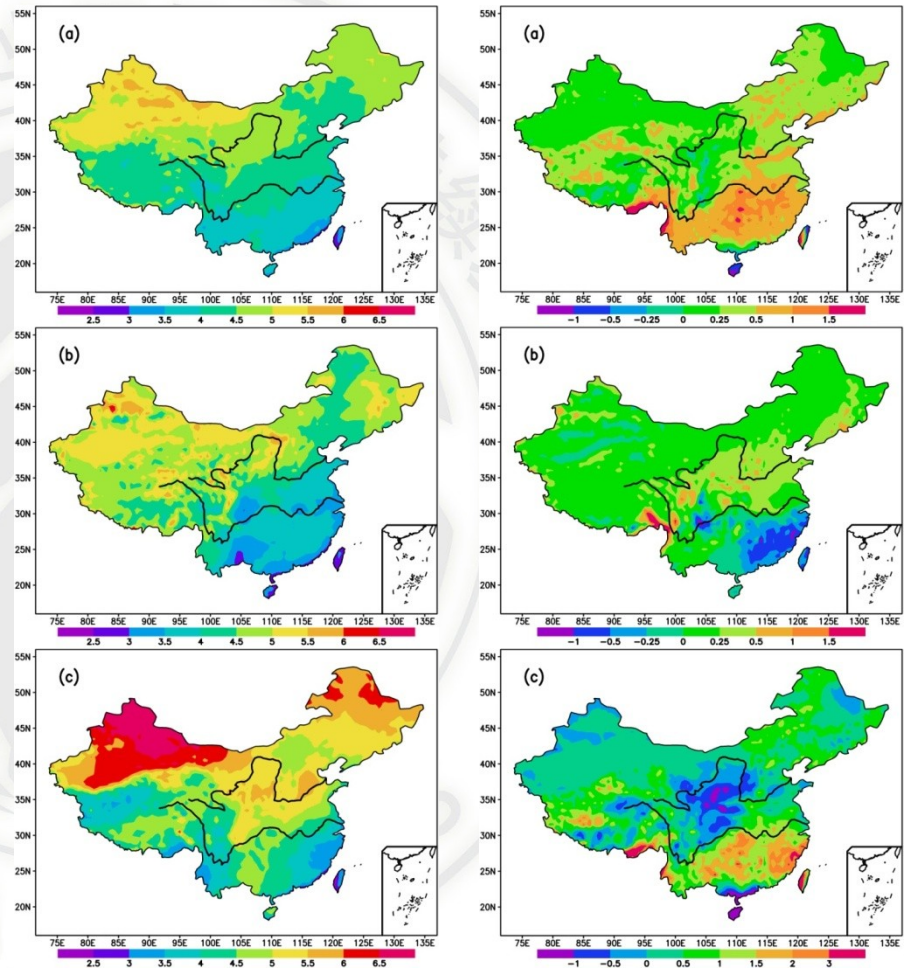
*Left: Temperature*

*Right: Precipitation*

*(a) Annual*

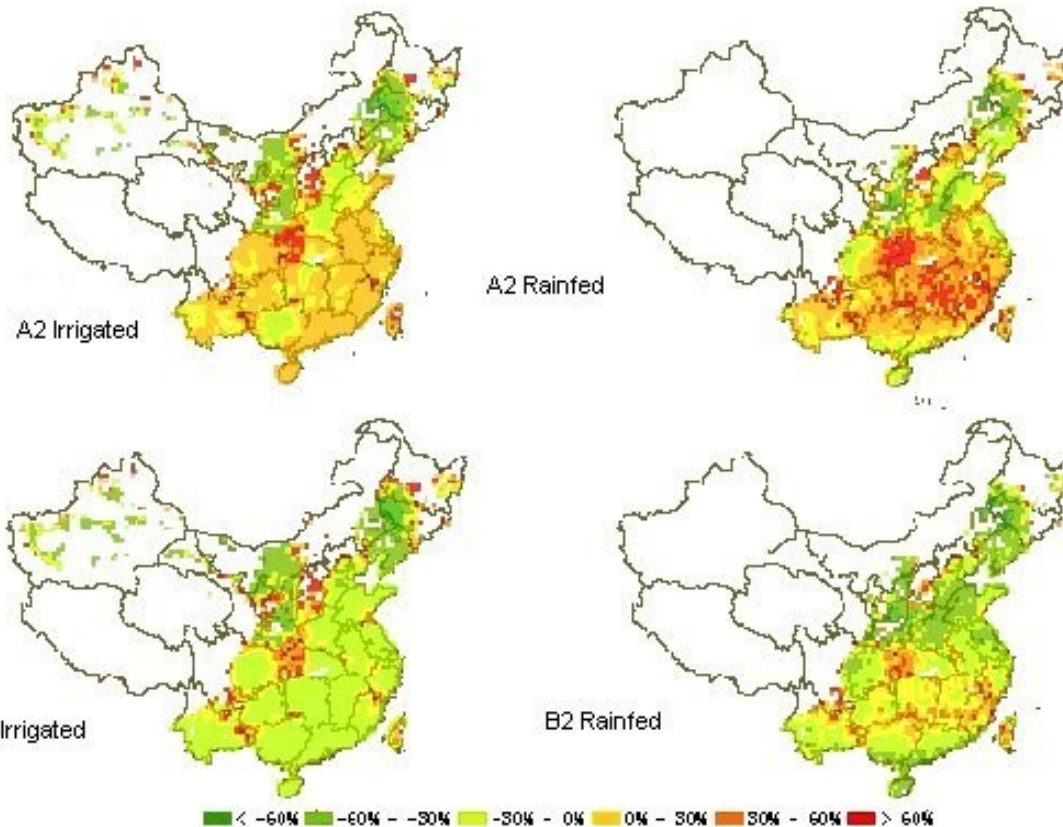
*(b) Winter*

*(c) Summer*



# Other Sustainability Issues

- *Climate change*



By 2030, gross cereal productivity in China can decrease 5~10% if no action is taken. By the second half of the 21st century, climate change can cause yield reduction in rice, maize and wheat up to 37%.

*Top: Rice Yield 2080*

*Down: Arable land -13%*



# Other Sustainability Issues

- *Domestic produce and trade pattern*
  - About 50% irrigation farmland is paddy rice, which mainly distributed in southern China
  - North deliver cereal to south, which delivers 15 BCM of water from dry north to wet south, 1/3 of annual Yellow River discharge



# Other Sustainability Issues

- ***Economic water transfer***
  - Within agriculture, fruit, vegetables and livestock competes land and water use with cereal
  - Competitive water utilization induces limited water transferring from agriculture to industry and urbanization (Non-farming procedure).
  - Agriculture is paid as compensation for infrastructure construction, particularly for irrigation improvement, but payment is under value



# Other Sustainability Issues

- *Commodity and water pricing*
  - Cereal price is controlled at low level. It helps inflation but side effects the farmer's income
  - Water price, as well as fertilizer, pesticide, gasoline, machinery are controlled and maintained low level, induces NPS pollution



# Other Sustainability Issues

- *National target and farmer's livelihoods*
  - National target: ensure food security, water and ecological safety
  - Farmer's livelihoods: food and income
  - Land and water competition under limitation acts as cereal vs cash crop, irrigation and fertilization vs NPS pollution control, etc.



# Other Sustainability Issues

- ***Smallholder farmer and technical extension***
  - Small and individual farmers are difficult to uniform the production.
  - Technical transfer has difficulty under different scale and education background
  - Lack of latest information

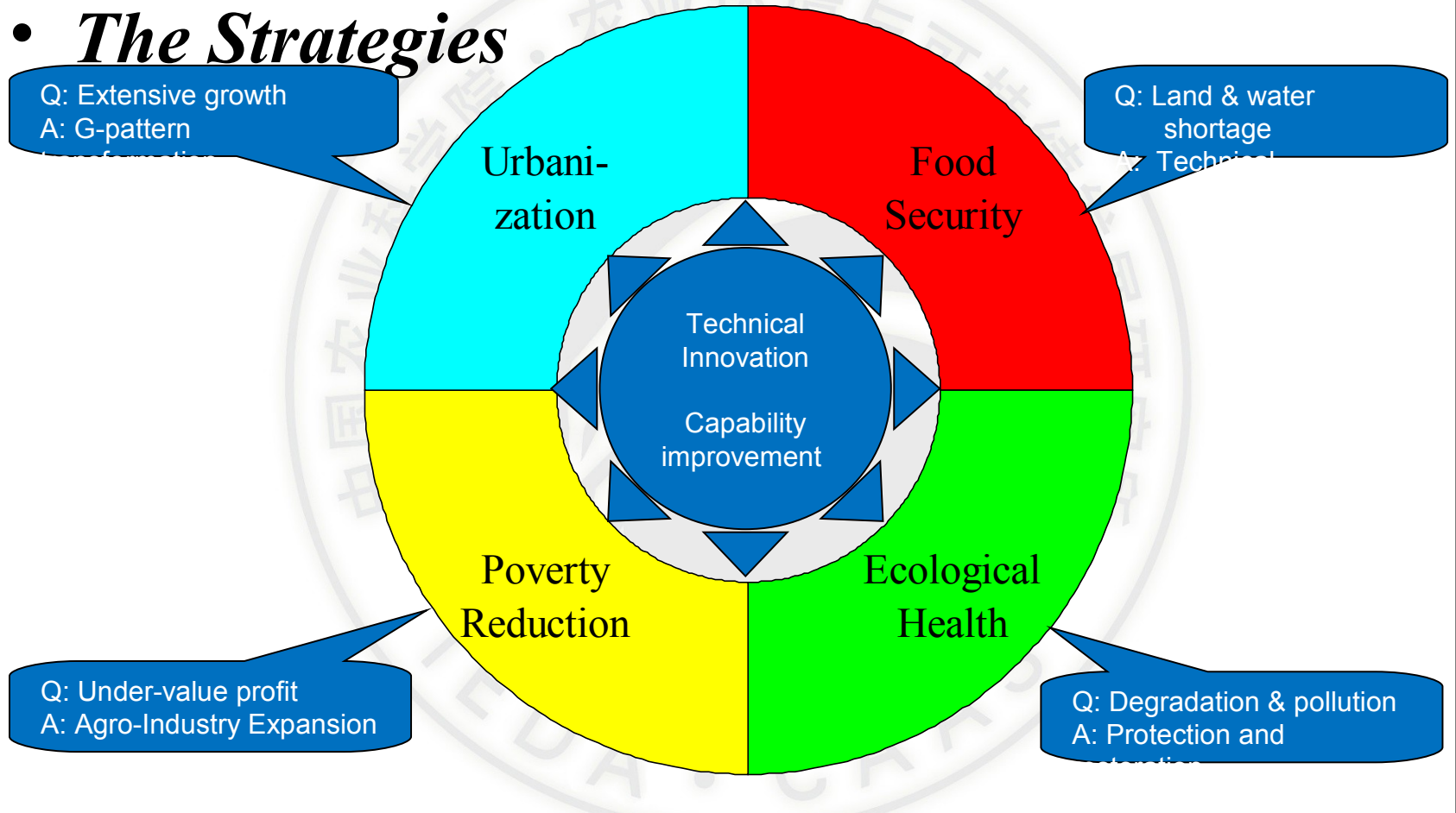


# Towards Sustainability

- *Integrated impacts on smallholder farmers*
  - Do not have *enough* and *clean* water in time
  - Suffer from severe *drought*
  - Reduce *willingness* for cereal production
  - Yield NPS *pollution*
  - .....

# Towards Sustainability

## • *The Strategies*



# Towards Sustainability

- Water balance for cereal production*

Prediction of Water Demand and Supply for Agriculture in 2030						
	2000	2030				
	Baseline	Scheme I	Scheme II	Scheme III	Scheme IV	
Gross Grain food ( $10^8$ MT)	4.80	6.20	6.20	6.20	6.20	
Dryland Acreage ( $10^8$ mu)	11.00	8.72	10.50	8.72	10.50	
Irrigation Acreage ( $10^8$ mu)	8.00	9.78	8.00	9.78	8.00	
WUE ( $\text{kg m}^{-3}$ )	Dryland	0.68	0.68	0.88	0.88	0.88
	Irrigation	1.00	1.00	1.20	1.20	1.20
	Mean	0.81	0.85	1.02	1.05	1.02
Gross Water Demand ( $10^8 \text{ m}^3$ )	5912.48	7321.93	6088.11	5909.66	6088.11	
Available Rainfall ( $10^8 \text{ m}^3$ )	7665.14	7665.14	7665.14	7665.14	7665.14	
Available Irri. Water ( $10^8 \text{ m}^3$ )	3600.00	3600.00	3600.00	3600.00	2945.45	
Irrigation Quota ( $\text{m}^3 \text{ mu}^{-1}$ )	450.00	368.18	450.00	368.18	368.18	
WUR (%)	Rainfall	56.00	66.00	56.00	66.00	66.00
	Irrigation	45.00	55.00	45.00	55.00	55.00
	Mean	51.37	60.19	51.24	60.19	61.24
Actual Water Supply ( $10^8 \text{ m}^3$ )	Rainfall	4292.48	5058.99	4292.48	5058.99	5058.99
	Irrigation	1620.00	1980.00	1620.00	1980.00	1620.00
	Total	5912.48	7038.99	5912.48	7038.99	6678.99
Actual Irri. Quota ( $\text{m}^3 \text{ mu}^{-1}$ )	202.50	202.50	202.50	202.50	202.50	
Water Balance ( $10^8 \text{ m}^3$ )	0.00	<b>-282.93</b>	<b>-175.63</b>	<b>1129.33</b>	<b>590.88</b>	



# Towards Sustainability

- ***Improve investment for infrastructure***
  - New Socialism Countryside building (undergoing)
  - Irrigation system and water harvesting (undergoing)
  - Soil fertility enhancement (undergoing)
  - Machinery (undergoing)
  - Technical service facility (undergoing)
- ***Strengthen technique extension and application***
  - R&D and Pilot demonstration
  - On site training (“Technique goes to farmer” Project)
  - Education and knowledge popularizing



# Towards Sustainability

- ***Perfect strategies and policies***
  - Reduce tax and fee from agriculture (done)
  - Increase subsidies (done)
  - Improve pricing system (in exam & preparation)
  - Compensation for resource-save and environmental-sound practices (in discussion)
- ***Promote socioeconomic supports***
  - Urban promote rural economy (undergoing strategy)
  - Commercial insurance to reduce farmer's risk (study)
  - Tax regulation to combat waste (discussion)



***Thank You!***