

Establishment of Climate Changes Scenario from Extreme Climate Events - Key Step to Access Climate Impacts on Agriculture in China

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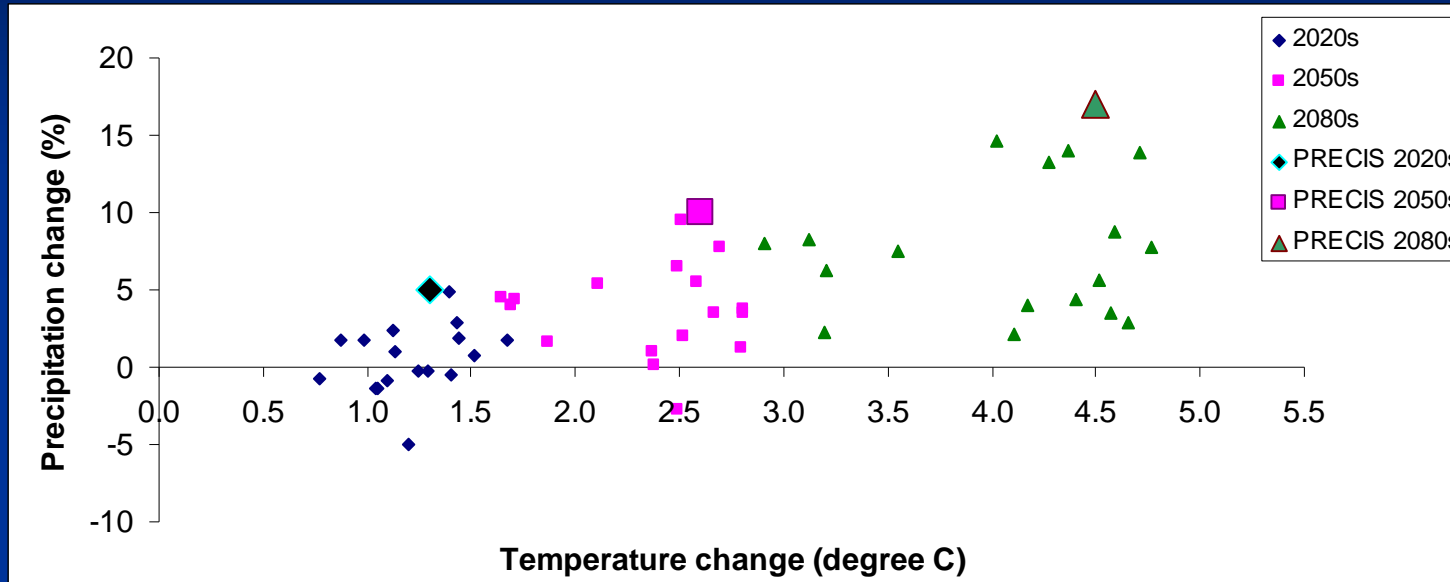
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1. Projections of climate changes in China



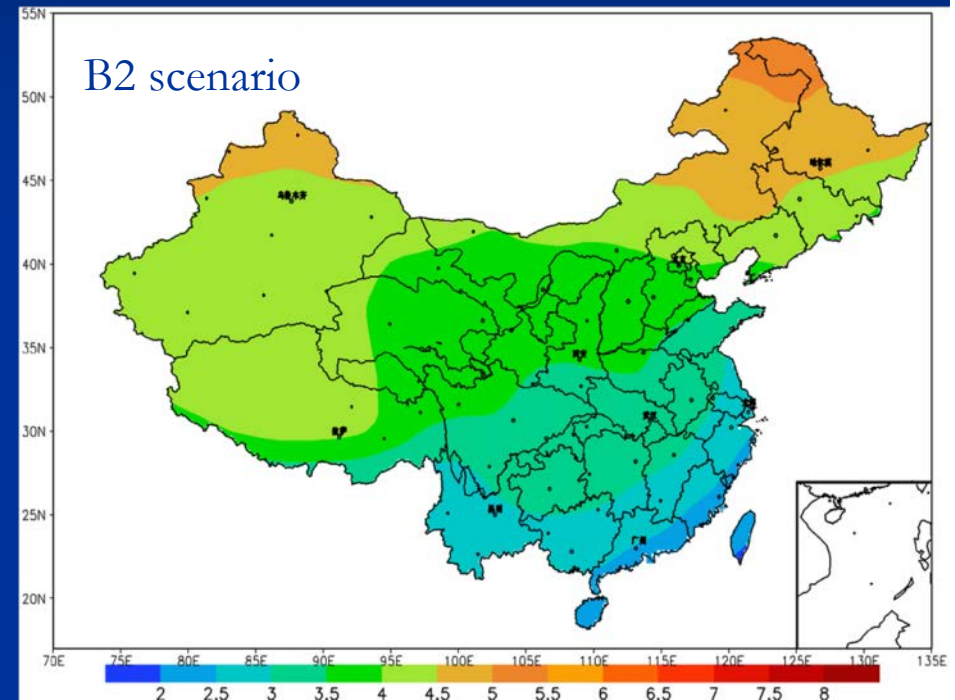
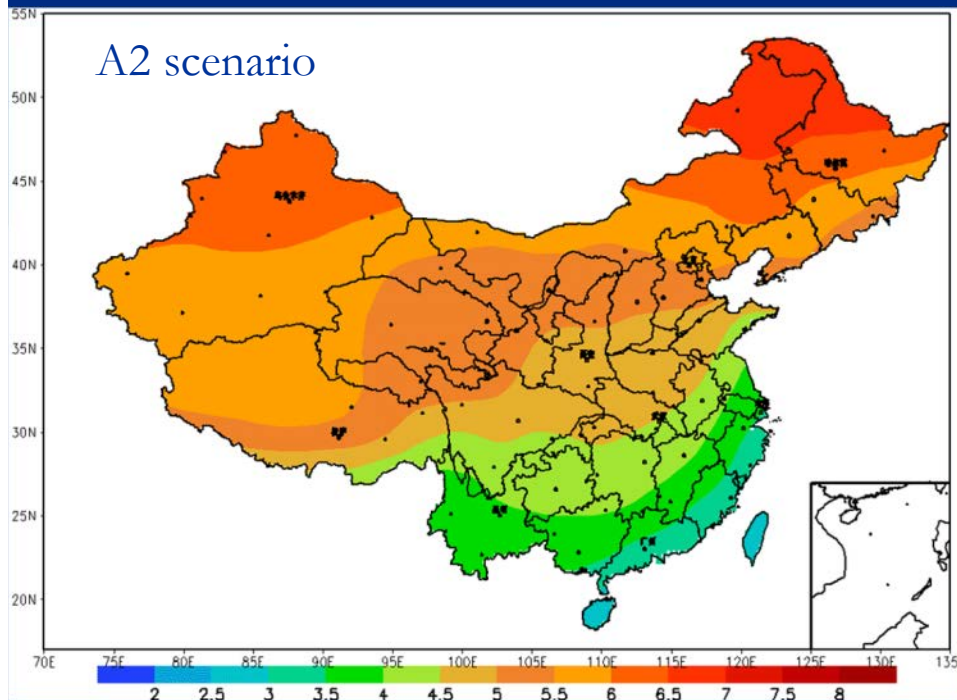
Annual changes in temperature and rainfall by the 2020s, 2050s, and 2080s with 17 GCMs from IPCC AR4 and PRECIS (A2 scenario) average for all China.

	Temperature (°C)	Precipitation
2020	1.1~2.1	2~3%
2050	2.3~3.3	5~7%
2100	3.9~6.0	11~17%

Compared to baseline (1961-1990)

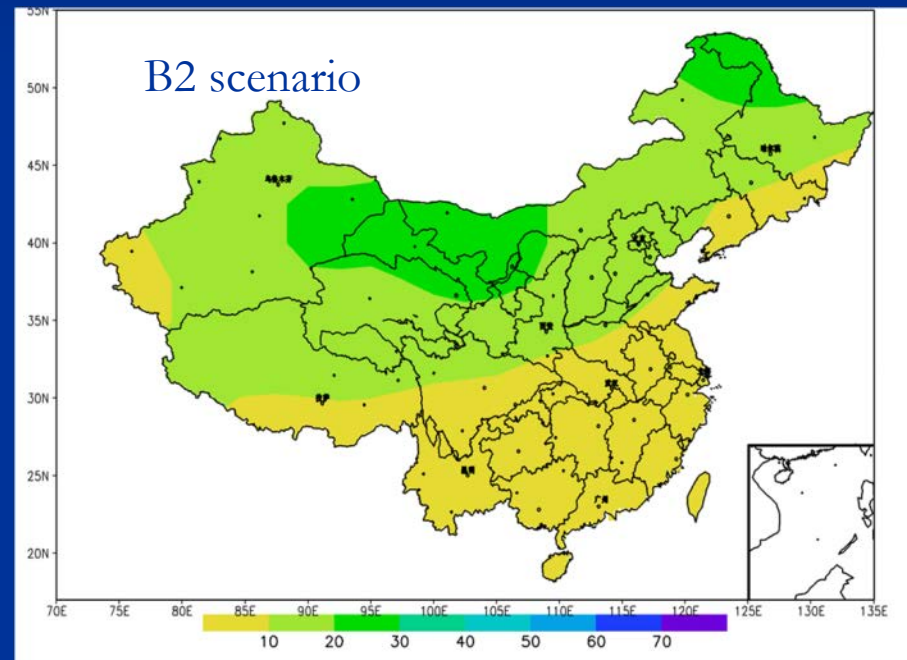
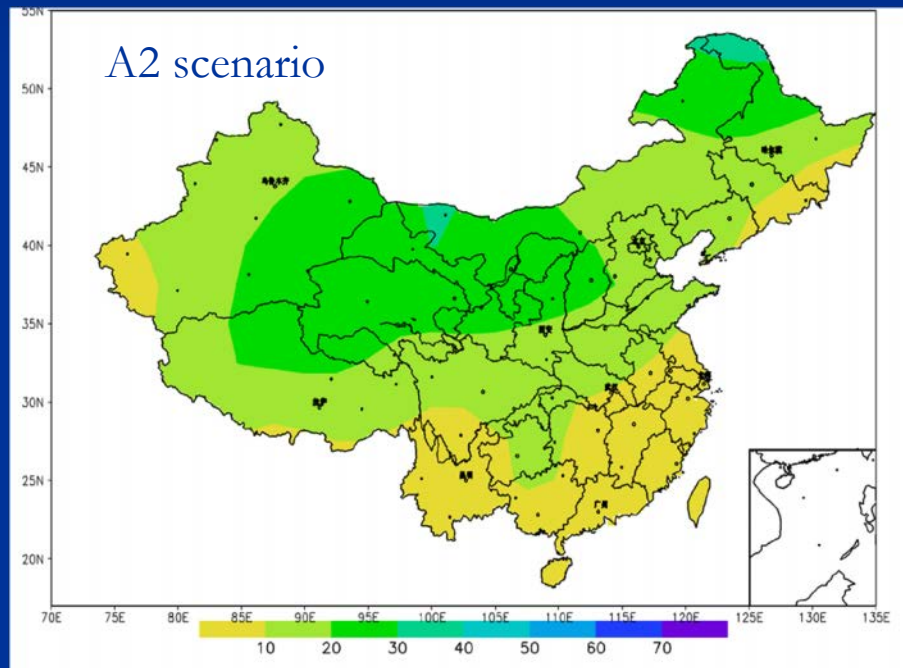
Both temperature and precipitation are expected to increase gradually!

Temperature changes for the years 2071 to 2100 compared to the period 1961 to 1990



Increase more in the northern China

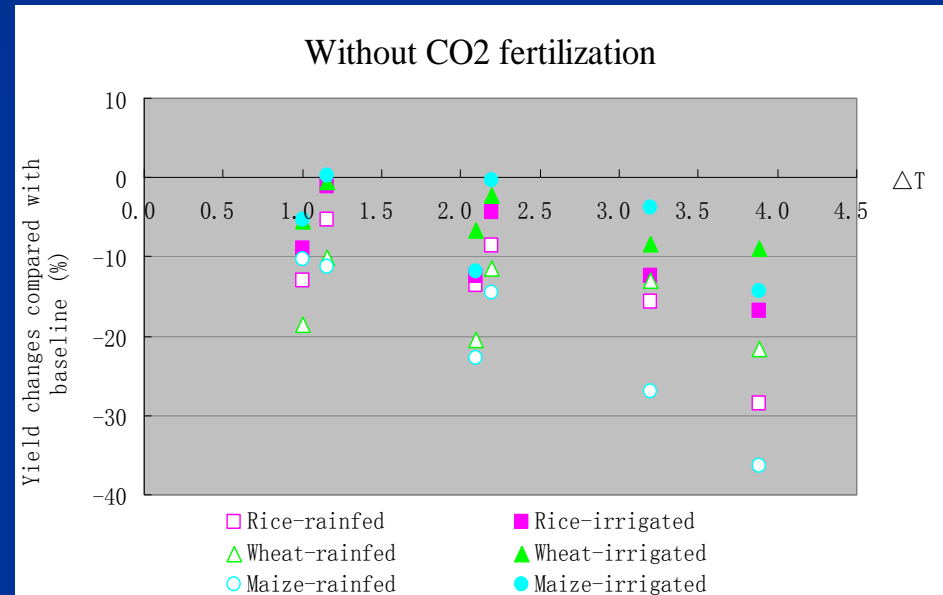
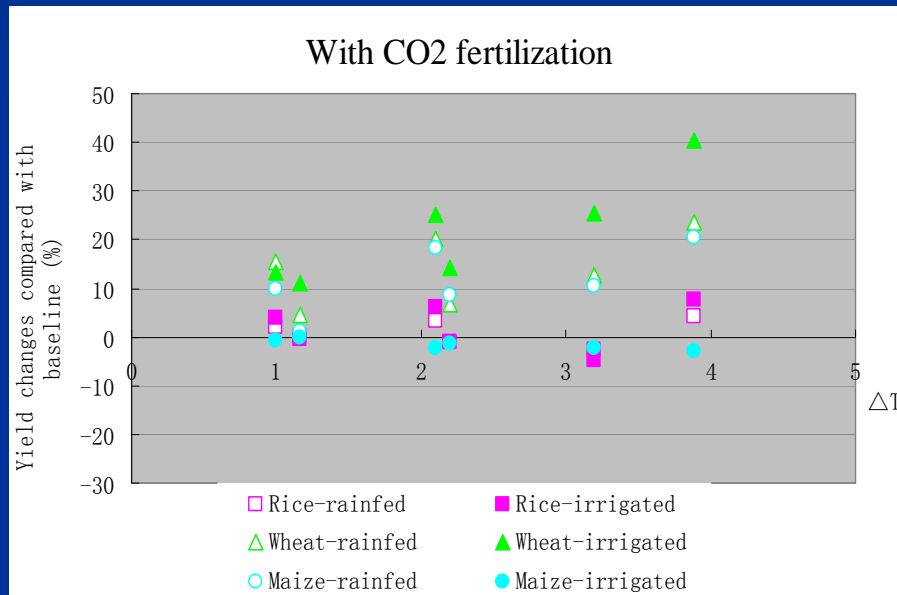
Precipitation changes for the years 2071 to 2100 compared to the period 1961 to 1990



Increase more in the northern China

2. Impacts on agricultural production - based on current GCM outputs

CO₂ fertilization:



- If CO₂ fertilization effect was not considered, wheat, rice, and maize yields with and without irrigation would decrease under A2 and B2 climate scenarios.
- If CO₂ fertilization effect was considered, rice yields under A2 scenarios, wheat yields under A2 and B2, rainfed maize yields would increase.

Sensitivity:

- Wheat is the most sensitive to CO₂ fertilization effect, while irrigated maize and rice are less sensitive to CO₂ fertilization effect;
- Irrigated maize and wheat are the least sensitive to temperature rise, while rainfed maize and rice are the most sensitive to temperature rise.

Grain quality:

- Elevated CO₂ levels cause a decrease in the quality of wheat in term of decreasing of protein content;
- At a doubled CO₂ concentration, the contents of lysine and protein in soybean, winter wheat, and maize decrease.

Growing season:

Growing season increase and the length of frost free period would increase by 15-25 days. When annual average temperature increase 1°C , accumulated temperature ($\geq 0^{\circ}\text{C}$) rises approximately:

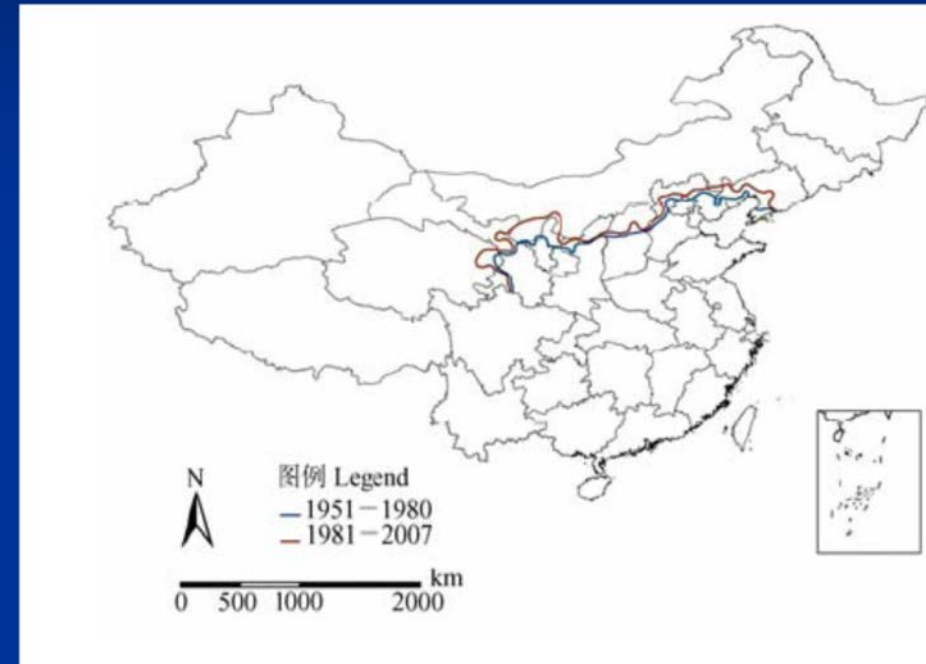
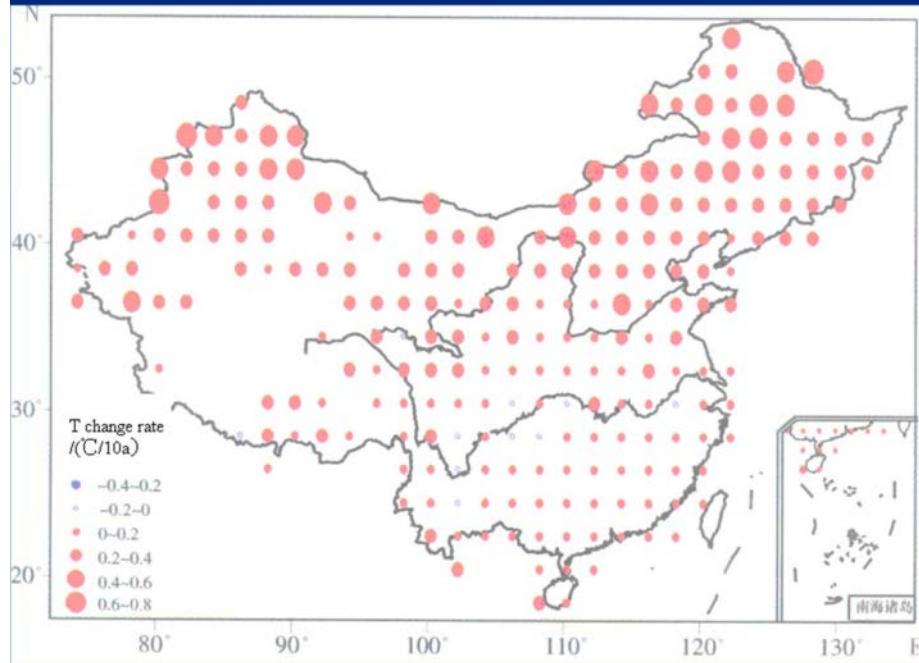
- $130^{\circ}\text{C}\cdot\text{day}$ in Northeastern China
- $250^{\circ}\text{C}\cdot\text{day}$ in North China Plain
- $350\text{-}450^{\circ}\text{C}\cdot\text{day}$ in Yangtze River basin and Southern China
- $300\text{-}350^{\circ}\text{C}\cdot\text{day}$ Yunnan and Guizhou
- $250\text{-}300^{\circ}\text{C}\cdot\text{day}$ in the Northwestern arid and semiarid regions
- $190^{\circ}\text{C}\cdot\text{day}$ in the Qinghai and Tibetan plateaus

Cropping system:

Under the 2*CO₂ scenario, by 2050 large changes in cropping systems would occur almost everywhere in China. The north boundary of double cropping systems would move to the centre part of current single cropping systems.

- Single cropping area: reduce by 23.1%.
- Triple cropping area: increase from 13.5% to 36%

Winter wheat planting moved northward 40km-200km, westward 20-120km



Warming trends in $^{\circ}\text{C}$ per decade from 1951 to
2002 (Source: EBNCCA, 2007)

2. Impacts on agricultural production - based on current GCM outputs

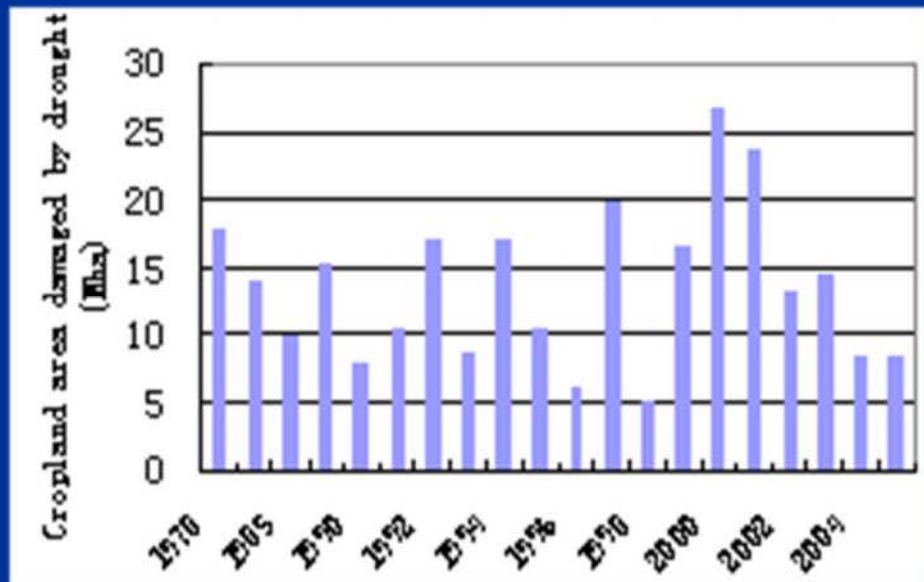
Conclusion:

China will Gain from climate changes if considered only temperature changes according to GCMs outputs, high temperature means long growing period and increasing possibility of high cropping index

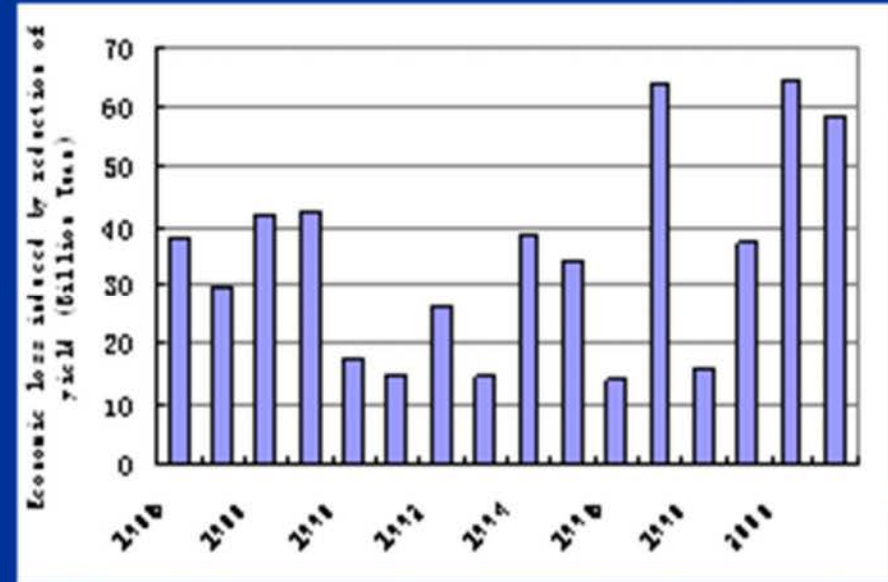
3. Impacts of extreme climatic events on agriculture

- Meteorological hazards are responsible for **over 70%** of the losses caused by natural hazards annually
- Droughts, floods, low temperature stress, and hail constitute the major meteorological hazards that affect China's agriculture
- Average grain loss from meteorological hazards reached 50.9 million tons/yr
- The annual direct economic effects of crop loss due to meteorological hazards amounts is up to 1-3% of GDP during last ten years

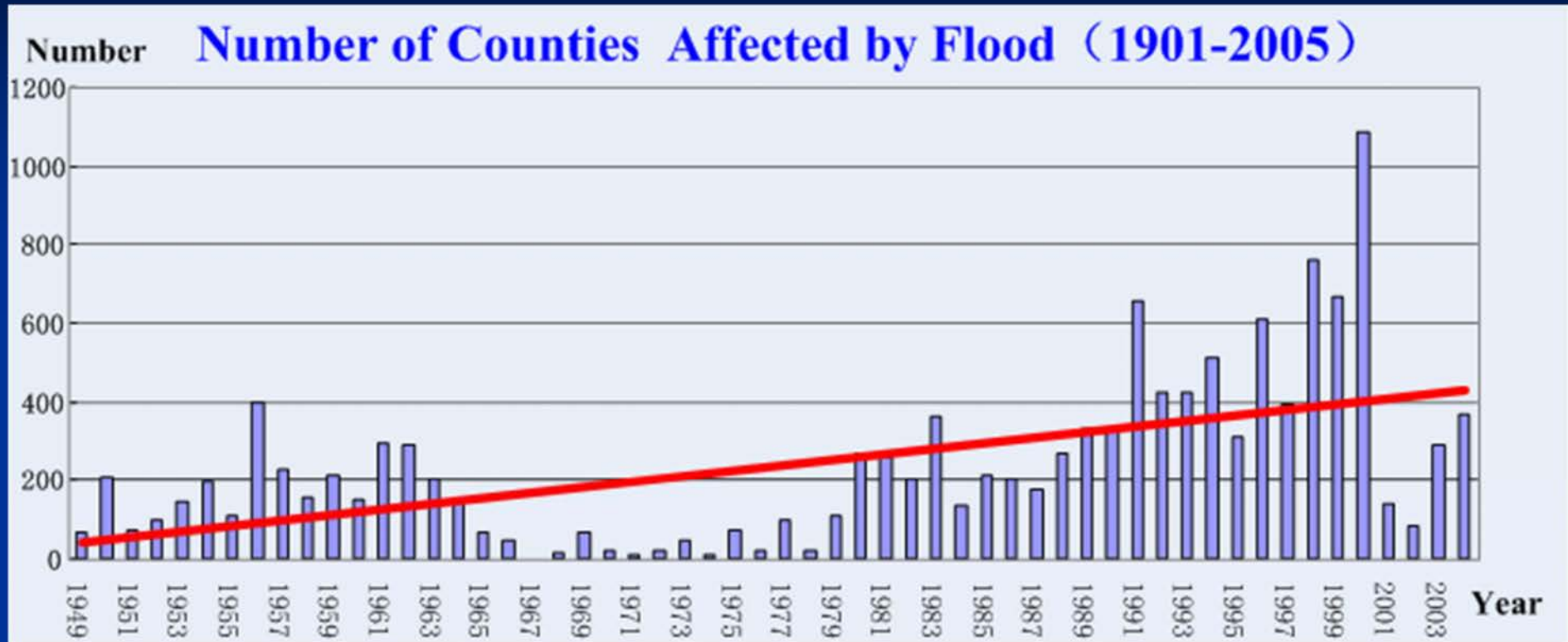
Top damage from droughts. The area affected by droughts reached 13.9 million ha/yr (1978-2004). Since the 1990s, losses caused by droughts have risen to 28.2 million tons, with economic losses of 34.5 million Yuan RMB.



Cropland area damaged by drought in China



Economic losses from reduced grain production due to drought during the period 1986 to 2001

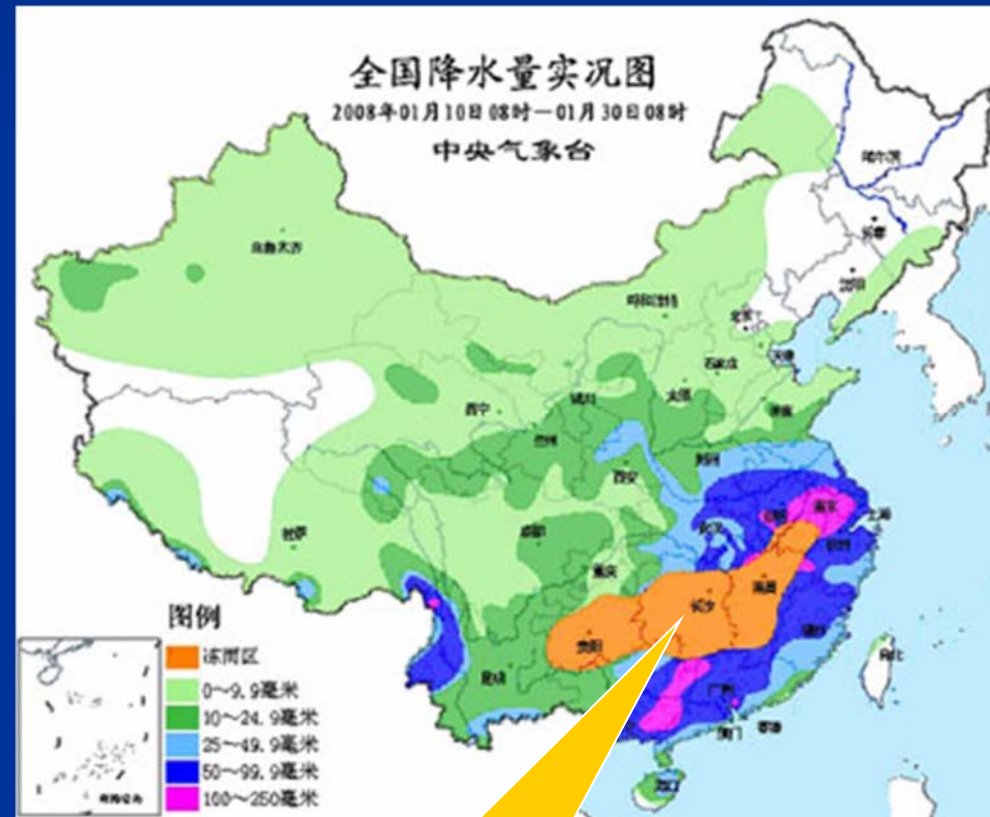


Occurrence of Disasters - Flood

Extreme climate events in last three years

■ The Unprecedented Freezing Disaster in January 2008 in Southern China

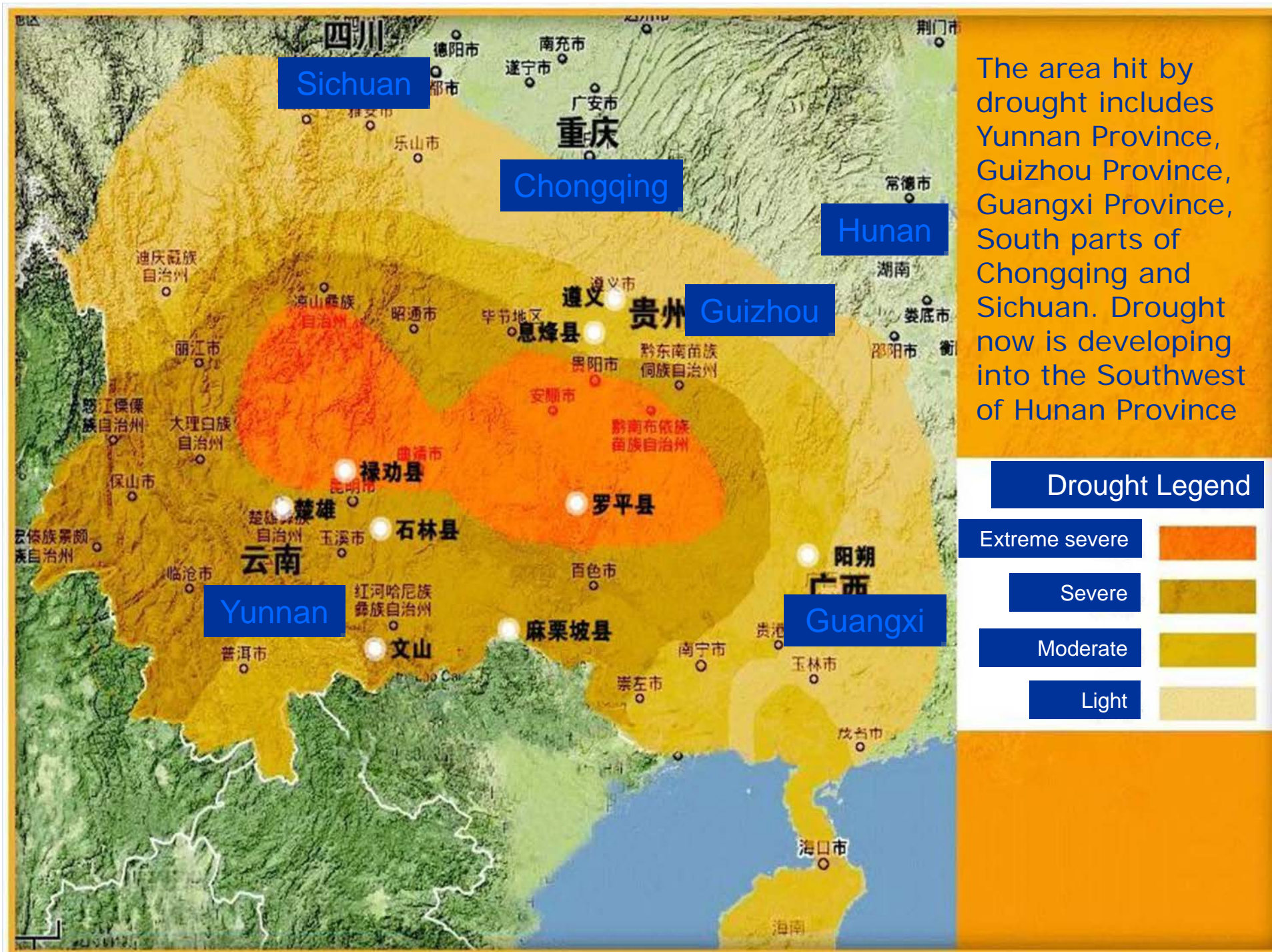
1. **Large area:** covers 19 provinces
2. **Extreme cold:** the mean temperature is 2-4 °C lower than the average in Hubei, Anhui, Hunan, Jiangxi and Guizhou provinces.
3. **Long lasting.** Meet or broke the historical record.
4. **Heavy lost,** 100 Million people affected, the direct loss is over 40 billion RMB Yuan, damage to agricultural crops from this event is more than the total damage in last year.



Freezing rain area

Extreme climate events in last three years

- Heavy Drought in the end of 2009 and beginning of 2010 in southern China



The area hit by drought includes Yunnan Province, Guizhou Province, Guangxi Province, South parts of Chongqing and Sichuan. Drought now is developing into the Southwest of Hunan Province

Drought Legend

Extreme severe	
Severe	
Moderate	
Light	

南方旱区气象干旱监测图



- Mar. 28, 2010
- Mar. 21, 2010
- Mar. 16, 2010
- Mar. 10, 2010
- Feb. 28, 2010

Extreme
Severe
Moderate
Light
No

监测信息来自国家气候中心

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As of March 18, 2010, **60 millions** people suffer from drought, **18 millions** people are in shortage of drinking water supply , **6 million ha** cultivated land hit by drought, the direct loss is **23 billion** RMB Yuan.

(from Xinhua News Agency, China, March 25, 2010)

In extreme situation, one of possible options is to relocate the inhabitants in the drought hit areas

(March 31. News from State Council, PRC)

If there is no effective precipitation before the middle ten days of May, all water in reservoirs will be used out in Yunan Province, in such case, relocation of inhabitants will be taken into consideration

(Office of State Flood Control and Drought Relief Headquarters, MWR, PRC)



March, 2010



March, 2009

Honghe River, Yunnan



March, 2010



March, 2009

Qinghai Lake, Xiangyun County, Yunnan



2010年3月23日，一位老农坐在云南省罗平县九龙镇干涸的牛街河水库库底。曲靖市罗平县是云南最大的油菜种植基地，去年以来的特大干旱却让这里40多万亩金黄饱满的油菜花几天内绝收。图/新华社

Niujiehe
Reservoir, Jiulong
Township,
Luoping County,
Yunnan Province



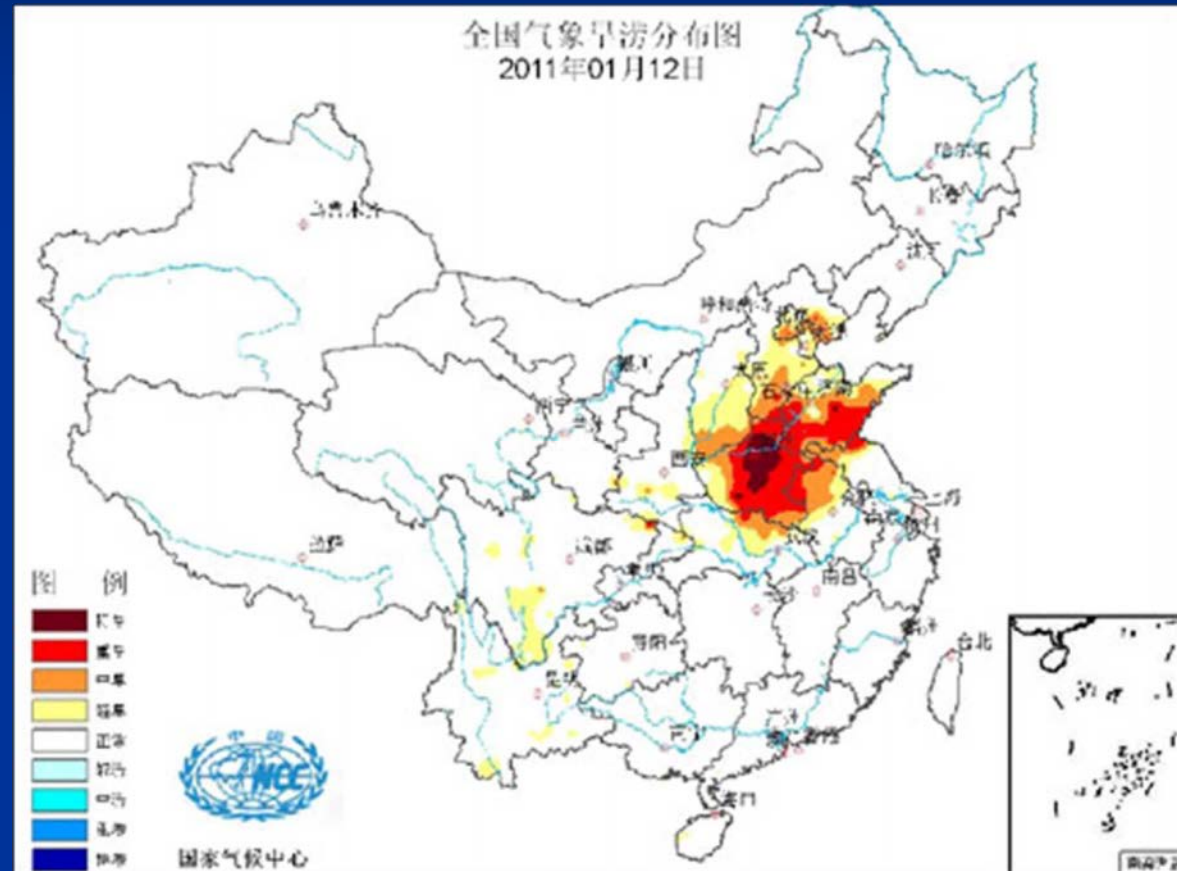
Dalongtan Township,
Panzhihua, Sichuan



Fuxing Townshp, Deyang, Sichuan

Extreme climate events in last three years

- Heavy Drought in the end of 2010 and beginning of 2011 in the North China Plain, the hit area, the winter wheat production base, includes Hebei, Shanxi, Shandong, Henan, Jiangsu and Anhui Provinces.



Assess the impacts based on extreme

There are many reports of researches on climate change impacts on crop yield and agriculture based on GCM output, unfortunately, no GCM simulated out the heavy freezing rain in southern China in 2008, heavy drought in southwest China in 2009/2010 and heavy drought in north China Plain in 2010/2011. Therefore, I, as principal investigator, together with researchers from other 5 research organizations/universities submitted a research proposal to the Ministry of Science and Technology of China in 2010, the title of proposal is “To assess the climate change impacts on grain food production based on scenarios created from extreme events”. This proposal passed through the all evaluation stages and is now on the list of waiting for launching. It is belong to the National Basic Research Program (also called 973 Program) .

Assess the impacts based on extreme

Since 1949, China's grain stock greatly increased. It was 15% in 1950s - end of 1970s, 20.2% in 1980s, 34.8% in 1990s. In last 10 years, China's grain stock index keeps at high level. High grain stock index guaranteed that China is able to resist 10% (or even 20%) decrease of grain food production, but if the decrease of grain food production occurs in two consecutive years, what will happen?

Thanks for your attention!

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