

# Drought, Water Scarcity in China: Some Approaches to Mitigation and Adaptation



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## Outline

- **Water scarcity and drought in China**
- **New policies on water**
- **Some new technologies**
- **Sustainable local development**

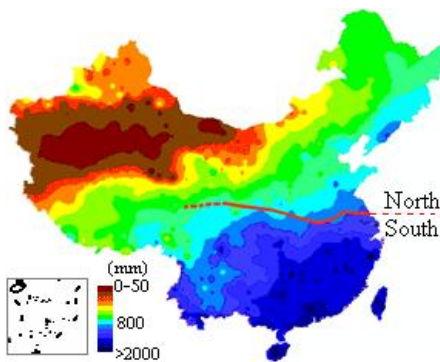


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## Unbalanced water resources

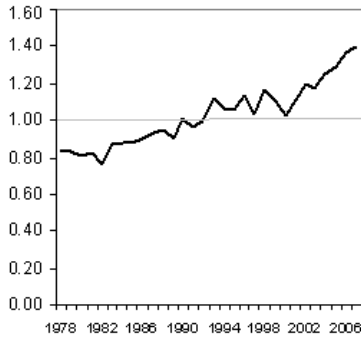


Annual precipitation

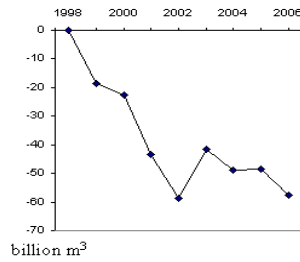
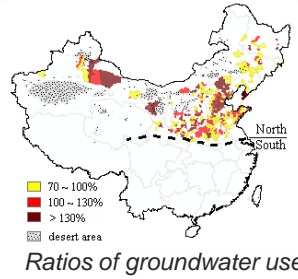
Resources	North	South
Water	19%	81%
Land	64%	36%
Agricultural Land	60%	40%
Population	46%	54%
GDP	44%	56%

# Food production and water usage

Agriculture: 65-70% of total water supply

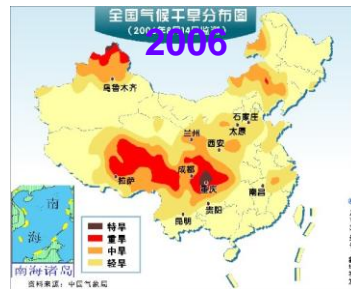
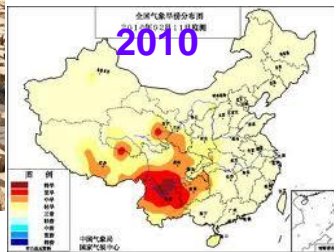


Ratio of the annual grain product in the North to that in the South

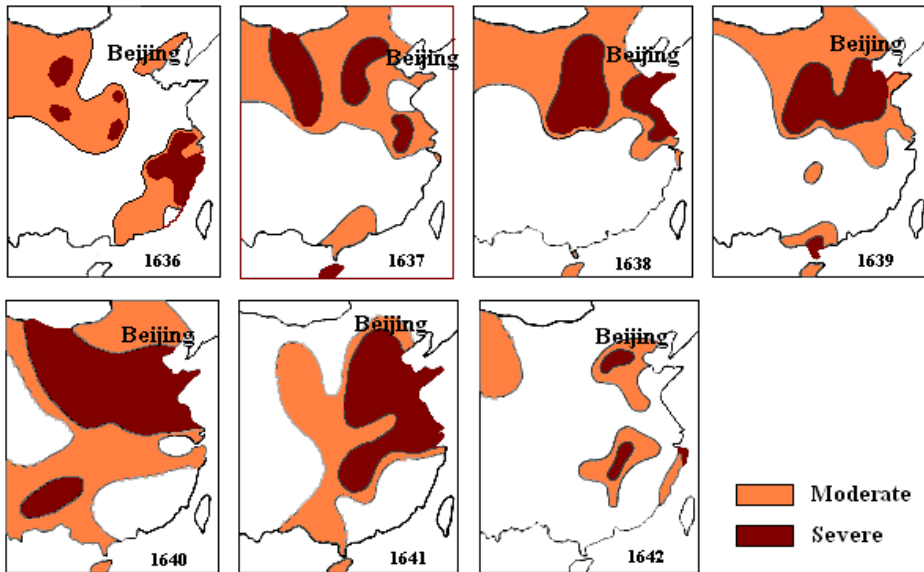


# Droughts in the South

2011



## If extreme droughts reoccur in the near future...



## Possible consequences

- 250 million people annually having less than  $100\text{m}^3$  water resources in three continuous years;
- Additional 150 million annually having  $100\text{-}200\text{m}^3$  water resources;
- If groundwater depleted in the North, the annual grain product per capita will drop from the current 490kg to a famine level: 250kg.

Note: the average annual domestic water use in urban is about  $75\text{m}^3$  per person in China



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## China's new policies on water

- **The central government's No 1 Document, 2011:**
  - Water viewed as critical for ecological, food, and national security
  - Planning to invest 4 trillion RMB (\$600 billion USD) on water in the next 10 years
  - Measures:
    - Controlling total water consumption
    - Improving irrigation efficiency
    - Restricting groundwater pumping
    - Reducing water pollution
    - Enhancing water management
    - Establishing funding mechanisms for water conservancy





Yu, 2011,  
Nature, 470:  
pp507

## WORLD VIEW

A personal take on events



### China's water crisis needs more than words

A new water strategy from the Chinese government is a step in the right direction, says Chaoqing Yu. But it will be difficult to put into practice.

Late last month, the Chinese government announced that it will invest four trillion renminbi (US\$600 billion) over the next ten years to protect and improve access to water. The policy was spelled out in this year's No 1 Document—the central government's first policy document of the year, setting the top priorities—released on 19 January, and comes as a severe and continuing drought in northern China threatens crops of winter wheat.

The Chinese government is right to highlight sustainable use of water resources as critical for China's food, economic, ecological and even national security. Among the measures it proposes are control of total water consumption, improved irrigation efficiency, restricted groundwater pumping, reduced water pollution and guaranteed funds for water-conservation projects. Such a national policy could go a long way to help secure and protect China's water. How to put the policy

into practice, however, remains challenging.

Since the 1950s, China has constructed 86,000 reservoirs, drilled more than four million wells, and developed 58 million hectares of irrigated land, which generates 70% of the country's total grain production. Efforts to conserve water have lagged far behind. The largest threat to sustainable water supplies in China is a growing geographical mismatch between agricultural development and water resources. The centre of grain production in China has moved from the humid south to the water-scarce north over the past 30 years, as southern cropland is built on and more land is irrigated further north. As the north has become drier, increased food production there has largely relied on unsustainable overuse of local water resources, especially groundwater. Wasteful irrigation infrastructure, poorly managed water use, as well as fast industrialization and urbanization, have led to serious depletion of groundwater aquifers, loss of natural habitats and water pollution.

To tackle water issues in China, one problem that must be addressed is the scatter of authority across different agencies. At present, major

As a starting point, China needs to build an integrated network to monitor surface and groundwater and use it to assess and set water policies through an integrated water-resource management system. And for this to happen, China needs a law that sets out clear policies on data sharing, and penalties for those who do not comply.

Other legislation is needed too. A water law introduced in 1988, and amended in 2002, is too vague to apply in practice, and there remains confusion over water rights of individuals, such as whether to grant them based on land ownership or use.

As political attention to water increases, a new, fair water law, based on transparent decisions, is essential to protect citizens' rights and prevent corruption. Low-income farmers would suffer greatly if water prices rise. To protect them, and so food supplies, China must keep irrigation costs low. Clear measures will also be needed to match better food production with water availability. Without regulation to increase food production in the south, it will be difficult to maintain food security, even if water-use efficiency is improved in the north.

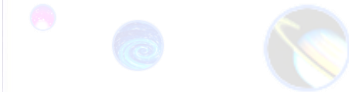
#### CHINA NEEDS TO BUILD AN INTEGRATED NETWORK TO MONITOR SURFACE AND GROUNDWATER.

Some of the areas identified in the document need more attention. Despite increasing concern about the effects of climate change on the availability and suitability of water resources, the document does not specifically define adaptation to climate impacts. It is also vague on how the departments of water resources and environment protection should cooperate on planned new limits on water pollutants. Ecological water use is mentioned, but it does not outline the specific measures that will be needed to protect the water supply of ecosystems against conflicting demands of economic activity. The role of ecosystems on water availability must be explicitly accounted for.

How will the money be raised to deliver the government's promises on water? The document demands that local governments reserve 10% of the annual income (currently 70 billion renminbi) from the land sales for real-estate development to be used for water projects.

## Outline

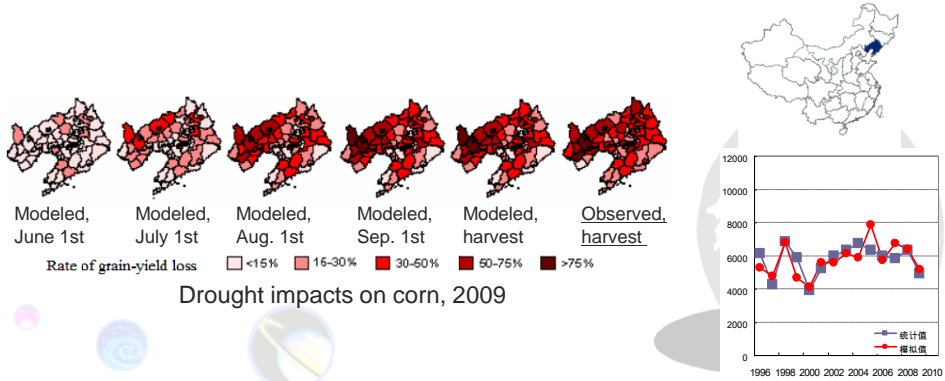
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# From reactive emergency responses to proactive management

## ➤ Early drought warning system

- Using DNDI model, inputting weather data
- Simulating daily crop growth and water deficits
- Early detecting drought impacts and identifying risks

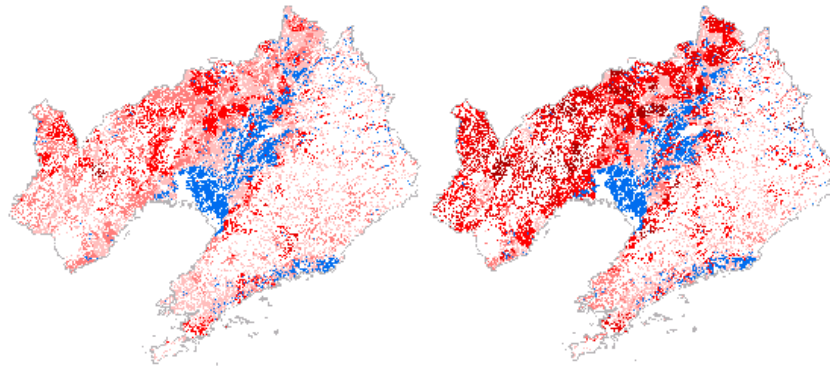


## Early drought warning system for The Liaoning Province

	Current loss of grain yield	No rain in Next 5 days	No rain in Next 10 days	No rain in Next 30 days	No rain in Next 50 days
June 1st					
July 1st					
Aug. 1st					

Rate of grain-yield loss:  <15%  15-30%  30-50%  50-75%  >75%

## Early drought warning system



July 1st

Sep. 1st

□ <15%   □ 15-30%   □ 30-50%   □ 50-75%   □ >75%   □ Rice

Spatial Resolution: 500m

## Retaining water underground

- ➔ **Bio-sealing technology (Professor Ruud J. Schotting)**
- ➔ **Changing the hydrogeological properties with Bacteria, by sealing underground fractions**
- ➔ **Retaining local water underground for the southern areas**

Universiteit Utrecht



The PA International Foundation is the initiator/sponsor of the Sultan Qaboos Chair of Quantitative Water Management at Utrecht University



**BACTERIA**

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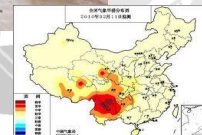


## A project to approach sustainability

- **A trip to Yunnan right after the drought, 2010**  
(Initiated and sponsored by the PA International Foundation)



- Soil erosion
- Ecosystem degradation
- Poverty
- Vulnerable to drought



## A project to approach sustainability

- **Initiated by the PA International Foundation**
- **Supported by:**
  - Deltares, the Netherlands
  - Utrecht University, the Netherlands
  - The government of Oman
  - IWHR, China
  - INBAR
  - Ajinomoto Co., Inc., Japan



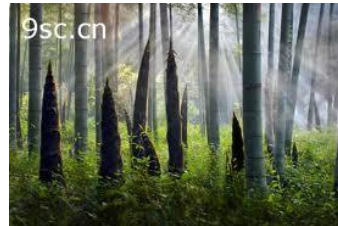
## A project to approach sustainability

- **Sustainable solutions:**
  - Creating jobs
  - Increasing income
  - Improving nutrition
  - Recovering ecosystems



# Bamboo

- Growing very fast
- Conserving soil
- Recovering ecosystems

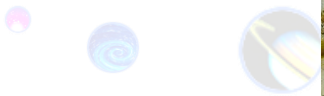


# Bamboo industrial chains

Bamboo clothes



Bamboo Furniture



# Bamboo industrial chains

Bamboo houses



Bamboo papers



# Bamboo industrial chains

Food



Bamboo shoots



Bamboo juice



Bamboo Beer

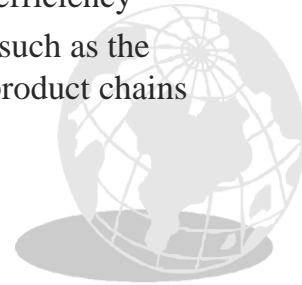
Panda Bamboo Bar !!



## A project to approach sustainability

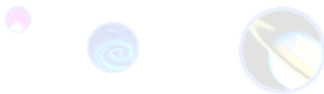
### → Project tasks:

- Recovering ecosystem by planting bamboo
- Retaining water underground by using bio-sealing technology
- Improving drought management using early warning systems, and increasing water-use efficiency
- Incorporating with food company, such as the Ajinomoto, to initializing bamboo product chains



**Thank you!**

**Comments?**



# Early drought warning systems

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- Simulating daily crop growth and water deficits
- Early detecting drought impacts and identifying risks
- From reactive responses to proactive management

