

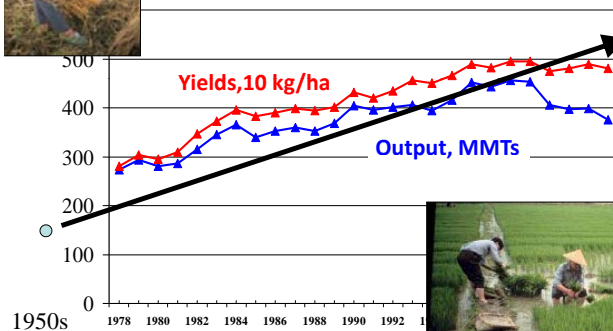
## Groundwater in China: Development, Regulation and Farmers' Responses

### Policy or Peasants: Who Can Build the "Bridge over China's Troubled Waters?"

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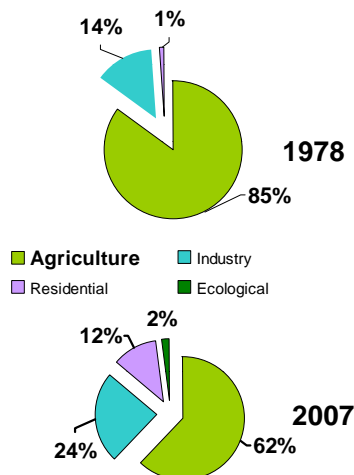
## Grain production in China, 1950s – 2000s



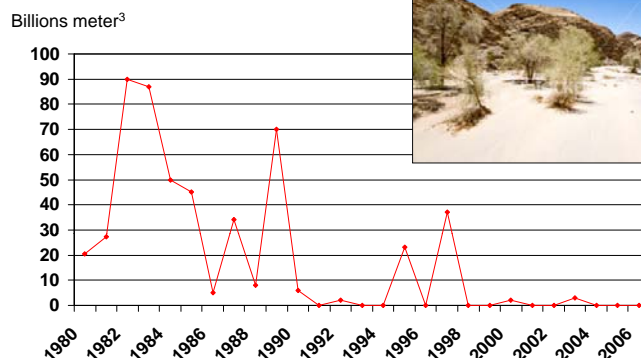
## Competition for Water

- More and more water being allocated to urban and industrial uses

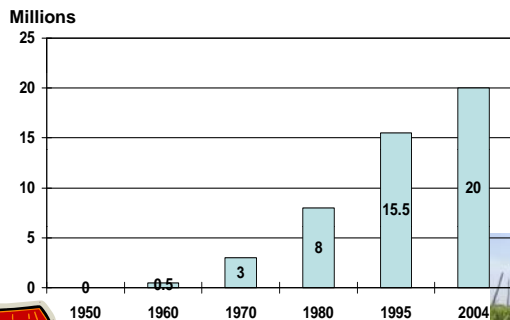
- National policy: Water use priorities  
 Urban residential  
 Industry  
 Rural residential  
 Irrigation



## Hai River Basin Surface Water Flows – 1980 to 2006



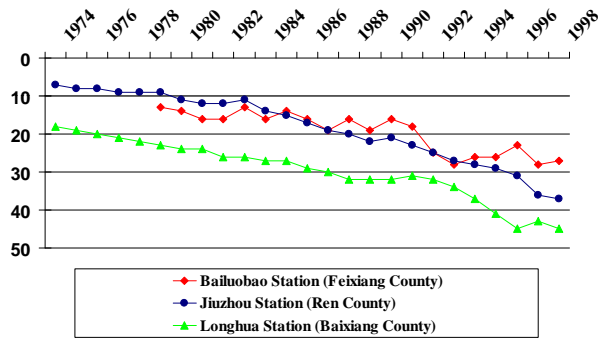
## Increase of Tubewells in China



## Increase of Groundwater Irrigation in north China, 2004

Crop	% of irrigated sown area from Groundwater
Rice	24
Wheat	72
Maize	70
Cotton	70
Field vegetables	67

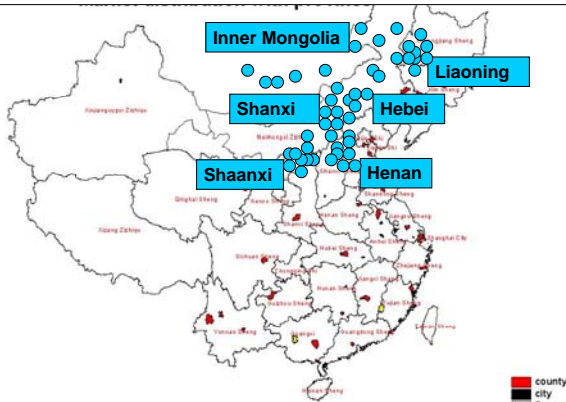
## North China: Falling Groundwater Table



## Is China Facing a Water Crisis?

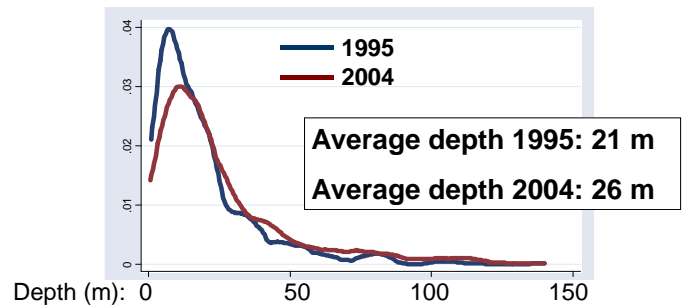
- Some say yes. It could push China to “starve the world”.
- Others argue good policy can solve the problem [Sound policy bridges can be built over even the most troubled waters!]
- Who is right?
- Who is to blame? / What can be done?

Data set – collected by CAS, Stanford University and UC Davis in 2005,  
400 village; 50 counties, 6 provinces  
National Representative of North China



## Depth to groundwater in GW Using Villages

Estimated Density  
~% of villages



## Although groundwater levels are falling, the nature of the fall varies across North China

Change in Average Water Level 1995-2004

- |                                 |     |       |
|---------------------------------|-----|-------|
| • Increased                     | 9%  | } 51% |
| • No Change                     | 26% |       |
| • Decreased < 0.25 m/year       | 18% |       |
| • Decreasing 0.25 to 1.5 m/year | 38% |       |
| • Decreasing > 1.5 m/year       | 11% |       |

Where there is a problem, is there a response by the government?

## Water Policies of MWR

- Wells drilled by permit only
- Regulation on well spacing
- Water extraction fee
- Moving towards pricing policy
- Irrigation management reform

## Actual policy implementation: almost ZERO!

- Wells drilled by permit only **Less than 10% of wells**
- Regulation on well spacing **Less than 5% of villages**
- Water extraction fee **Zero**
- Moving towards pricing policy **Not very fast**
- Irrigation management reform **Cannot be implemented effectively**

*No wonder ... how do you assume control over 20 million wells ... an administrative impossibility*

Is the government building the “bridges”?

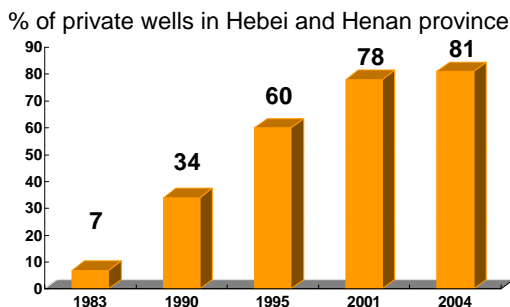
*No ... obviously!*

Are policymakers a part of “troubling the waters”?

*YES: through their non-action*

Is there a response by farmers?

## Rapid rise of Privatization of Wells



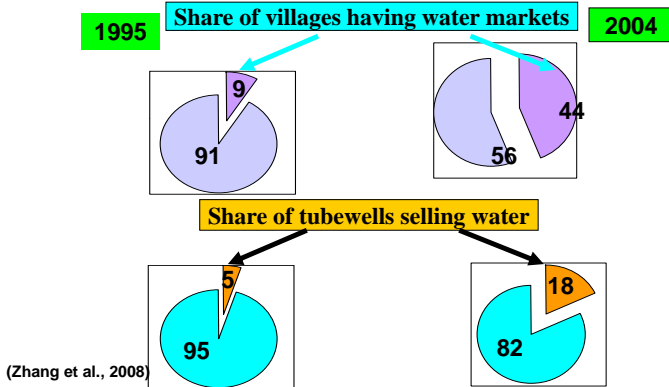
According to the six province survey in north China, 69% of wells are now owned by private individuals in 2004.

Privatization of wells does not lead to GW conservation

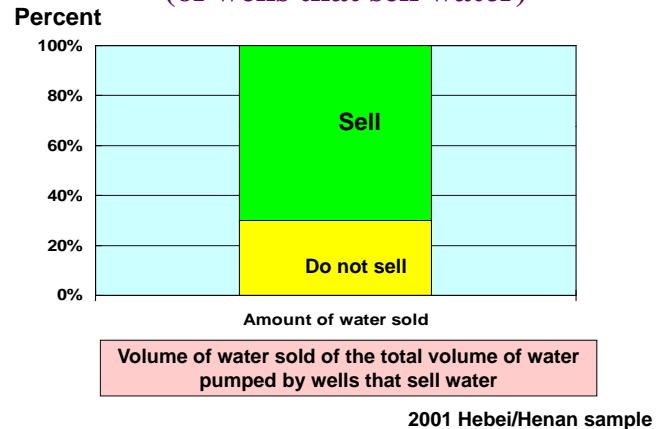
## Impacts of the shift from collective to private well ownership

- Cropping patterns: Increase in relatively high value and more water sensitive crops, such as wheat and horticulture crops
- Have no effect on crop yields
- Have not accelerated the fall of groundwater table

## Growing importance of GW markets in northern China



## Magnitude of Water Sales (of wells that sell water)



## Impacts of Groundwater Markets

- Help more farmers access water (and they do not need to invest in their own well).
- Water buyers use less water than those that have their own wells or that use collective wells
- Although water use per hectare falls, yields do not.
- do not have a negative effect on incomes (different from some of the findings in South Asia)

Are farmers building the “bridges”?  
*No. No incentive to do so!*

Are farmers a part of “troubling the waters”?

Almost by definition: YES

BUT, is it their fault?

- Could it be that they are doing exactly what we should expect them to do – given the policy environment?
- Could it be that they would just as easily be part of the solution – given the right incentives?

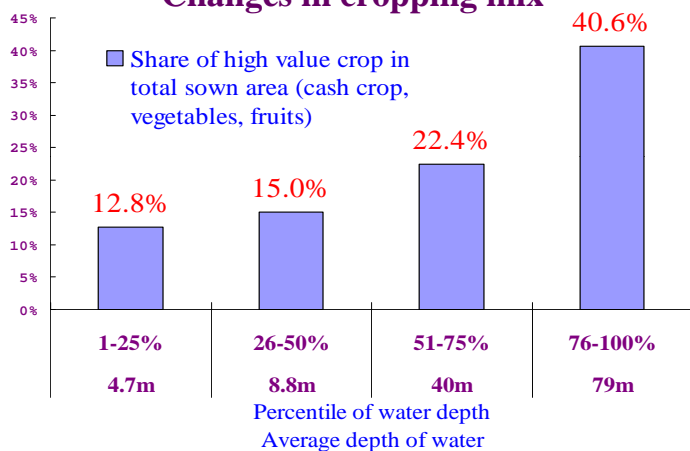
## In fact, research has shown us the basis of some bridges

- Water pricing ...
  - Do farmers respond to higher prices by using less water?
- Water saving technology ...
  - Do farmers respond to higher prices by adopting water-saving technologies?

## Farmers’ response at the intensive margin: Reduction in water use per unit of land

Average water depth (m)	Average cost of water (yuan/m <sup>3</sup> )	Average volume of water applied to wheat (m <sup>3</sup> /mu)
4.4	0.096	513
6.7	0.084	306
24.6	0.201	257
77.5	0.414	150

## Farmer's response at the extensive margin: Changes in cropping mix



Cang County  
(water-short area)



## Would price policy work?

- If China raised the price of water (e.g., by taxing electricity / diesel fuel) → would lead to sharp declines in demand → lots of conservation, adoption of water saving technology.
- But, the incomes of farmers would suffer ... need a complementary policy to give farmers a subsidy to offset higher costs ...

## Share of Sown Areas Adopting Water Saving Technologies in north China

	1995	2004
<b>Traditional (pre 1949)</b> Level Fields, Border/Furrow Irrigation	20%	25%
<b>Household-based</b> Plastic Sheeting, Surface Pipe, Drought Resistant Varieties, Retain Stubble / No Till	8%	21%
<b>Community-based</b> Underground Pipe, Lined Canals, Sprinklers	3%	7%

China – like many developing countries – are ready to build bridges over troubled waters.

“If I knew a water policy worked and if I knew where an investment would have the most effect, I would allocate up to a quarter of my budget to this one activity!”

Du Ying, Director of the Agricultural Division, Development and Reform Commission, Beijing, August 30, 2004

## key research or technical progress/breakthrough/work that would be needed to overcome current policy/decision making challenges

- Lack of hydrology information for the purpose of groundwater management
- More research on options to manage water demand, in particular mechanism design for implementing water policies that can overcome challenges in managing millions of small farms.
- Build research-based, data-driven decision support systems for government