



The researches and application on brackish water for irrigation in China

Zhanyi GAO

China National Committee on Irrigation and Drainage (CNCID)
National Center for Efficient Irrigation Technology Research (NCEI)

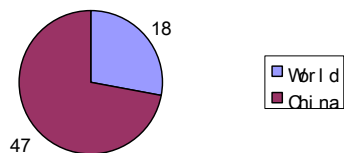
October 18, 2011



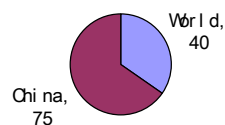
Challenge 1

- The agricultural production in China relies heavily on irrigation.

Irrigated area



Product ion



Challenge 2

- The shortage of water resources is getting more and more serious due to uneven distribution of rainfall and water resources in both time and space.



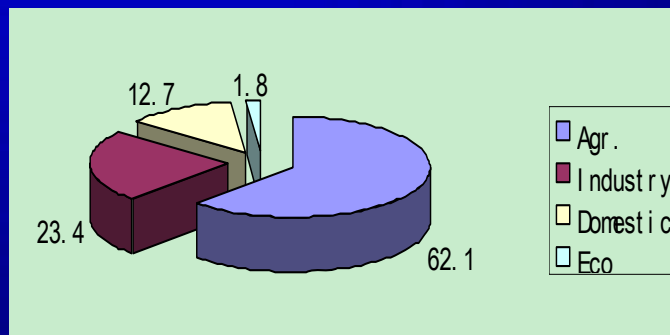
Agricultural Water Shortage

- Normal year:
Water shortage : 25 billion m³, 4% of demand
- Dry year :
Water shortage: 30~40 billion m³, 6% of demand



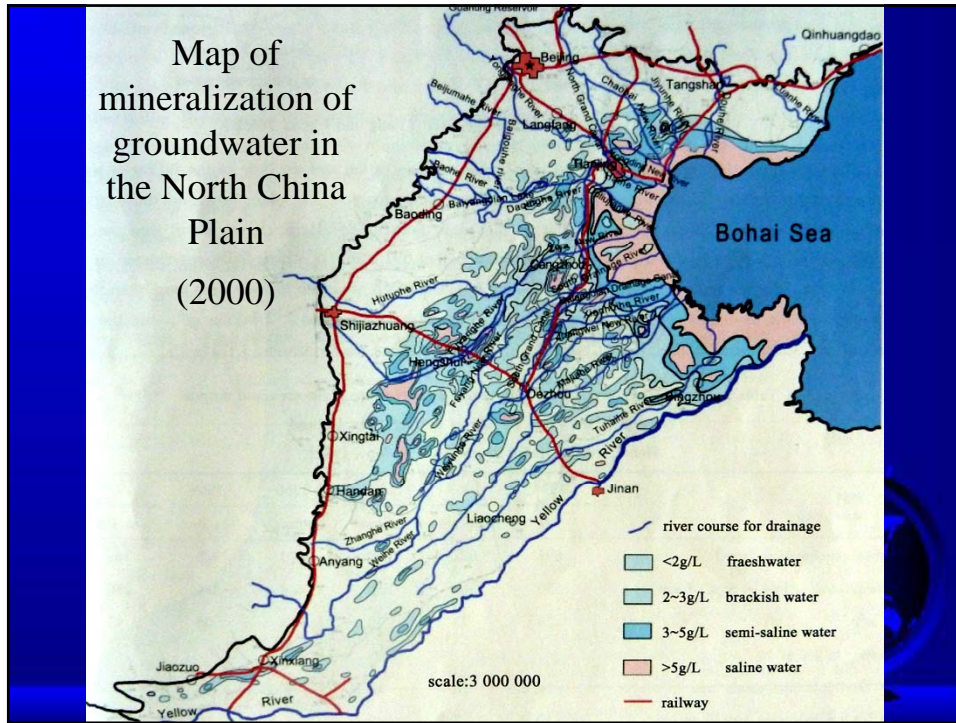
Challenge 3

- With the rapid social and economic development, water demand has been increased continuously. Water competition among various sectors is getting higher and higher.

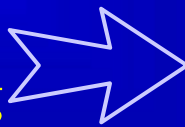


Brackish water – a solution

- Brackish water resources are widely distributed in China, especially in drought-prone north, northwest and coastal areas.
- According to survey, underground brackish water resources is about 20 billion m³/a in China, out of which 13.0 billion m³/a is exploitable.
- Most of the brackish water resources are located 10 to 100 m below surface, which are easy for exploitation.



What can we do under these exiting situations?

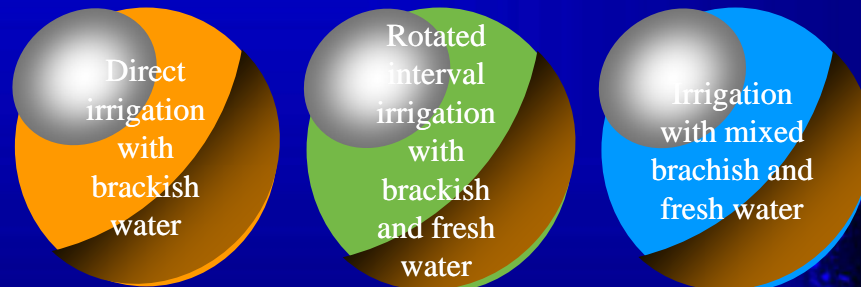


Brackish water can be used for irrigation under proper technical and management conditions.




Methods in using brackish water for irrigation

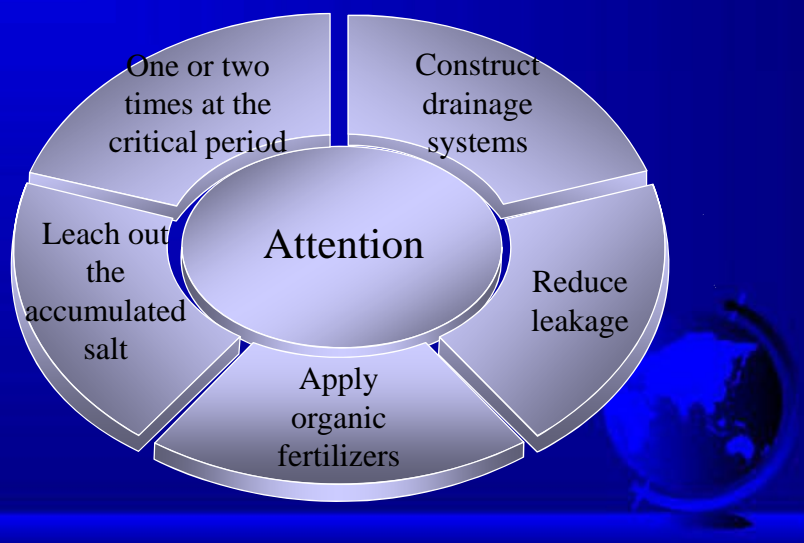
There are three methods in using brackish water for irrigation:



Method 1: Direct irrigation with brackish water

- Brackish water can be directly used for irrigation if there is no fresh water or fresh water resources are very scarce.
 - The soil salinity and solution concentration should not exceed the limit of crops salt tolerance after irrigation.
 - Brackish water should not be used to irrigate crops at seedling stage in order to avoid the hazards to crop growth.
- 

The attention should be paid to the following aspects with direct brackish water irrigation.





- Experiences: the good results can be achieved by using brackish water to irrigate wheat, cotton, corn and other crops timely and properly in the growing seasons.

crops	1g/L		2~4g/L		4~6g/L		Non-irri. (kg/hm ²)
	kg/hm ²	Inc.(%)	kg/hm ²	Inc.(%)	kg/hm ²	Inc.(%)	
wheat	4848.0	477.0	3630	332.0	2925.0	248.0	840.0
summer corn	5542.5	137.0	4725	102.0	4036.5	72.5	2340.0
Total of above	10390.5	227.0	8355	163.0	6961.5	119.0	3180.0
spring corn	5883.0	20.5	5332.5	9.2	4797.0	-1.8	4882.5
soybean	1704.0	86.2	1252.5	36.9	960.0	4.9	915.0

Yield of crops irrigated with different qualities of water
(average yield from 1980~1989) (Fang et al.)

Method 2: Rotated interval irrigation with brackish and fresh water

- In this method:
 - Brackish water: salt-tolerant crops or crops at the salt-tolerant growth stages
 - Fresh water: salt sensitive crops or crops at salt sensitive growth stages
 - The application time and volume changed with mineralization of water, crop patterns and water supply conditions.
- 

- **Experiences:**
 - Irrigation times with brackish water should be reduced with the increase of salt concentration.
 - For the areas always irrigated with brackish water, irrigation quota should be increased in order to reduce the salt concentration in soil solution and leach salt.
- 

Growth stages				Yield of wheat	
before seeding	turn green	jointing	booting	yield (kg/hm ²)	relative yields (%)
fresh water	fresh water	fresh water	fresh water	4650	100
fresh water	fresh water	saline water	saline water	4550	97.8
saline water	saline water	saline water	saline water	3660	73.7
Non-irrigated				2258	48.4

Experimental results of cyclic irrigation with saline and freshwater in Nanpi Pilot Area (1989~1990) (Fang et al.)




Method 3: Irrigation with mixed brackish and fresh water

◆ The mechanism:

Salinity and alkalinity can be diluted and decreased, and the reaction of ions after mixing can reduce the RSC in mixed irrigation water.

◆ Benefits:

This method can improve the irrigation water quality and increase the amount of irrigation water. It can also generate significant economic and social benefits.



The key points for irrigation with brackish water

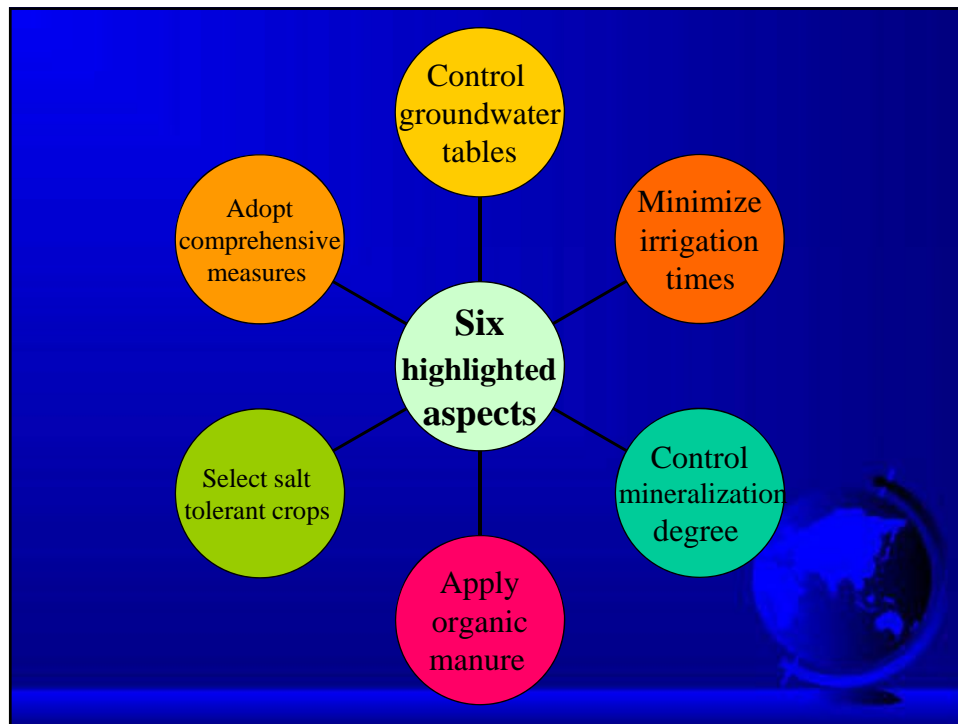
Irrigation with brackish water not only increases the soil moisture but also increases the soil salinity. Therefore, the relationship between meeting crop water demand and controlling salinity must be balanced.

Two key points

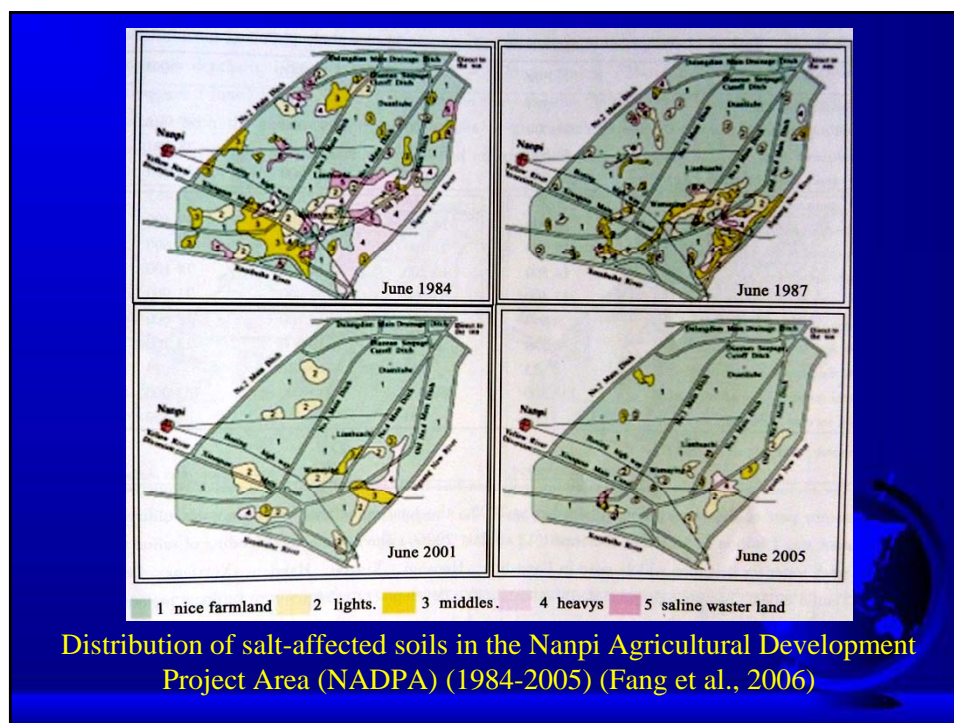
Keep the salinity in root zone of soil below the threshold level of crops tolerance

The salt accumulated in soil should be leached out by rainfall or irrigation with fresh water.

The following aspects should be highlighted during the irrigation. Otherwise the normal crop growth could be affected, and consequently resulting in yield reduction and soil degradation with increased salinity in soil.



- Under appropriate conditions, irrigation with brackish water in proper practices can not only increase water supply and crop yield, but also improve groundwater quality.
- A small globe is visible in the bottom right corner of the slide's background.



Future researches

- To maintain the sustainable application of brackish water for irrigation, the following researches should be carried out:
 - Integrated technology researches by considering regional characteristics to achieve sustainability;
 - Water and salt balance and management strategies under large-scale brackish water irrigation;
 - Development and cultivation of salt-tolerant crops.

