Water Footprint and Its Application in Agricultural Water Management

--an introduction of WF research group in Northwest A&F University

Institute of water saving Agriculture in Arid Regions of China, Northwest A&F University ;
Institute of soil and Water Conservation, Chinese Academy of Sciences.

Outline

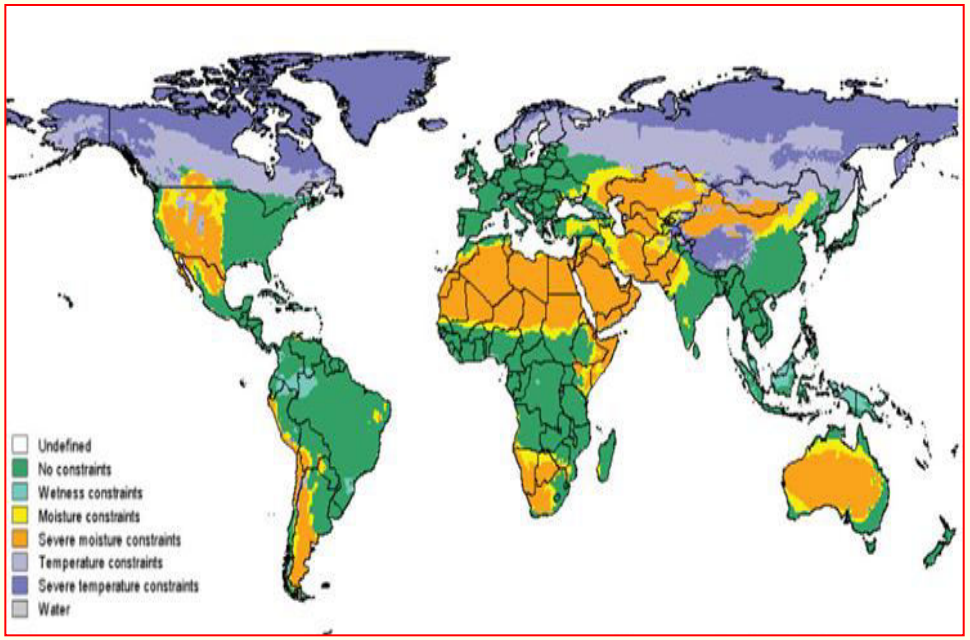
- Background
- Research Interests
- Research work

Background

◆ A total of 842 million people in 2011–13 were estimated to be suffering from chronic hunger.

◆ Food policy must not lose sight of rising water scarcity.

Water is a key driver of agricultural production.

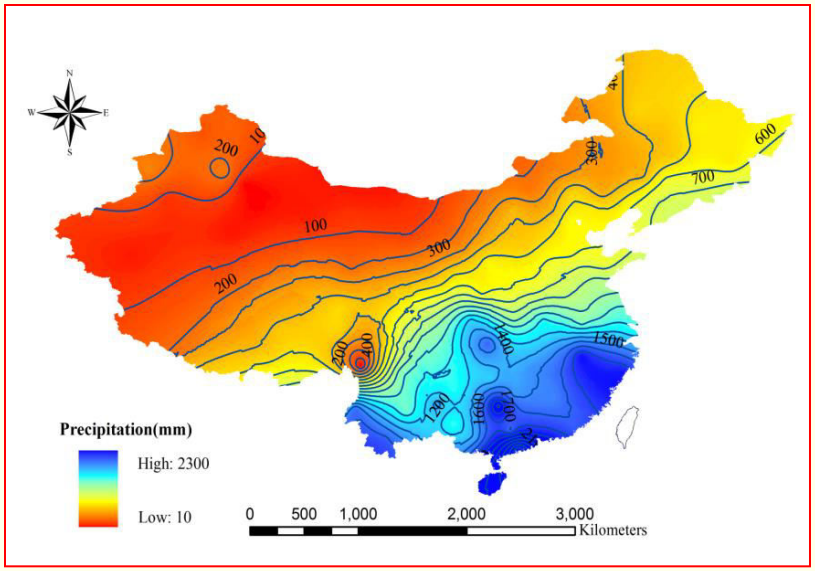


Sources: 《The State of Food Insecurity in the World》 from FAO

Background

◆ Food security in China has attracted much concern around the world.

◆ Shortage and disproportional distribution of arable land and water resources have become bottlenecks for guaranteeing food security in China.



Outline

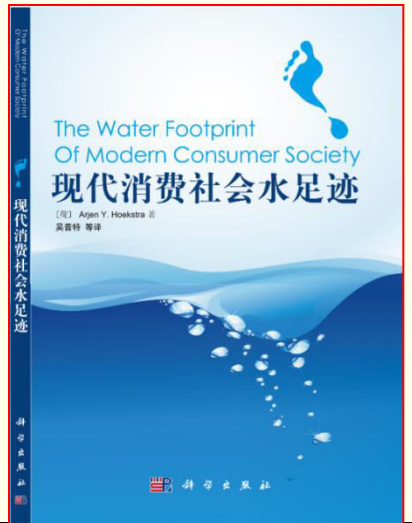
- Background
- Research Interest
- Research work
- Cooperation Potential

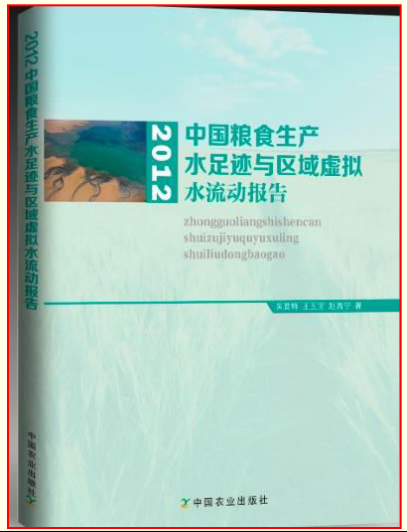
Research Interests

Focusing on agricultural water resources management.

To guarantee water resources and food security in China.

In recently years, we are working on the study of water footprint and its application in agricultural water management.





Research Interests

We are focusing on the following aspects:

1) calculation methods of water footprint for crop production at different scales;

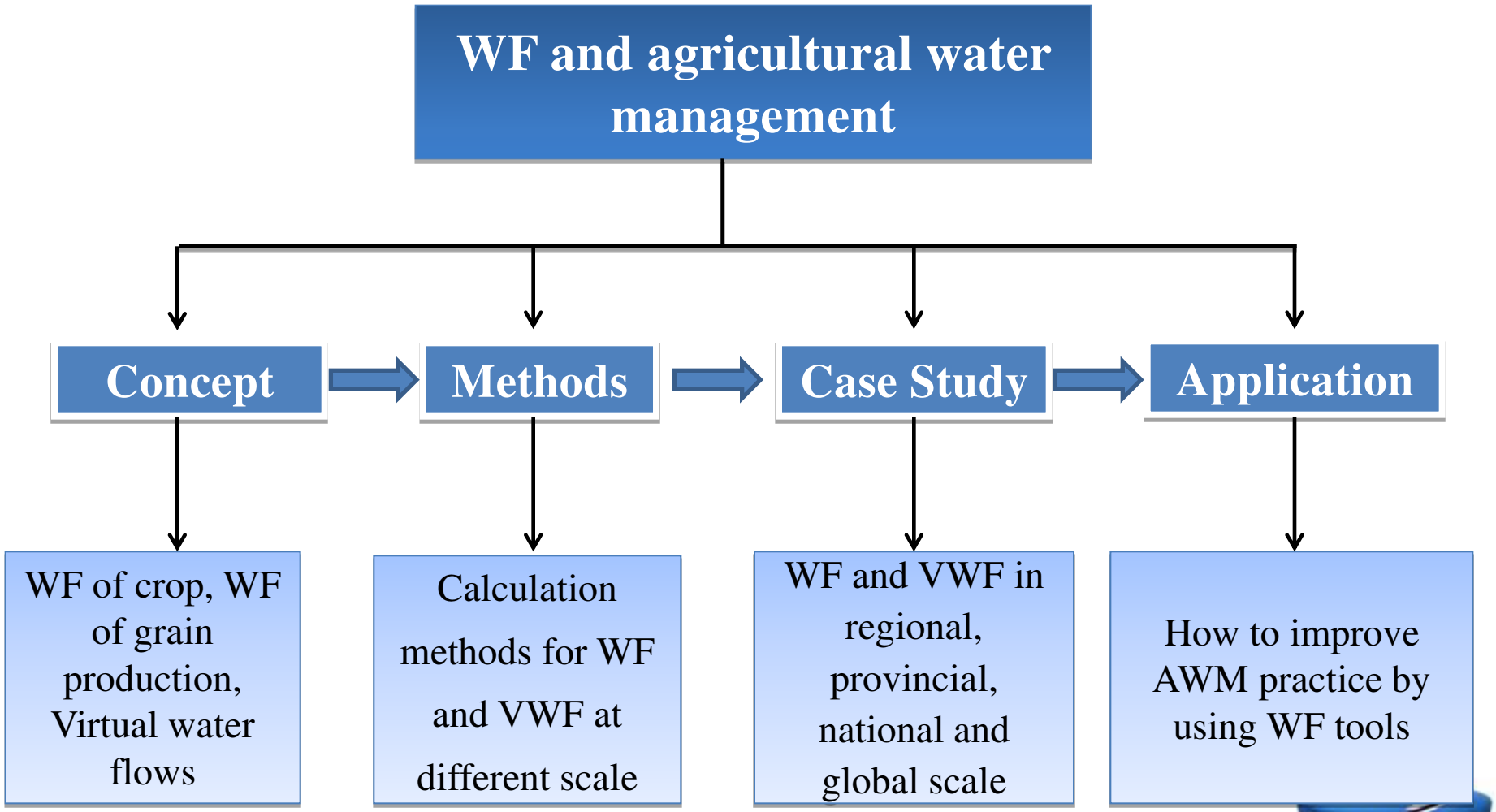
2) evaluation of the temporal and spatial variation of water footprint and virtual water flows;

3) how to improve agricultural water resources management practices by using water footprint theory.

Outline

- Background
- Research Interest
- Research work
- Potential Collaboration

Research work



Water footprint of grain production

Water footprint of grain production (WFGP) → **the volume of water that is used to produce per unit weight of grain, m^3/kg.**

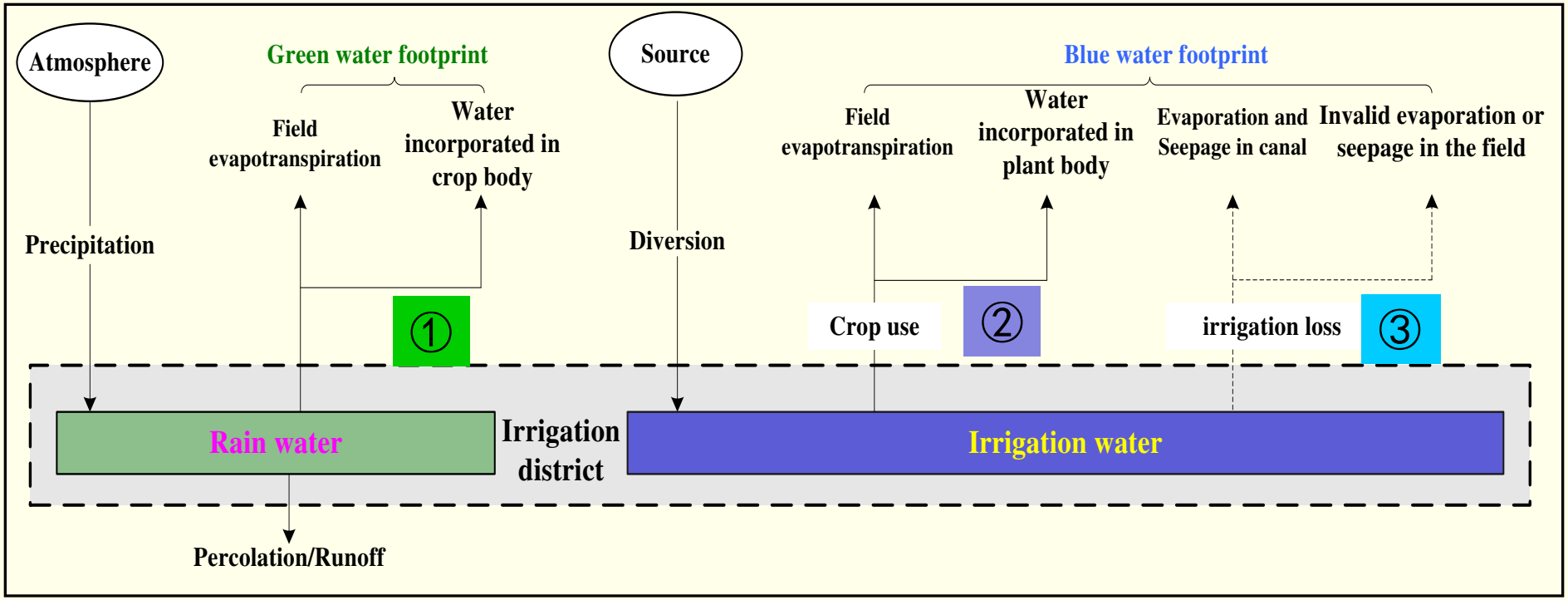
Green water footprint

Blue water footprint

Note: The grain crops in this study include cereals, beans and eatable tubers.

Methods

Components of WF during crop production



$$WF = (① + ② + ③) / Y$$

$$BWF = (② + ③) / Y$$

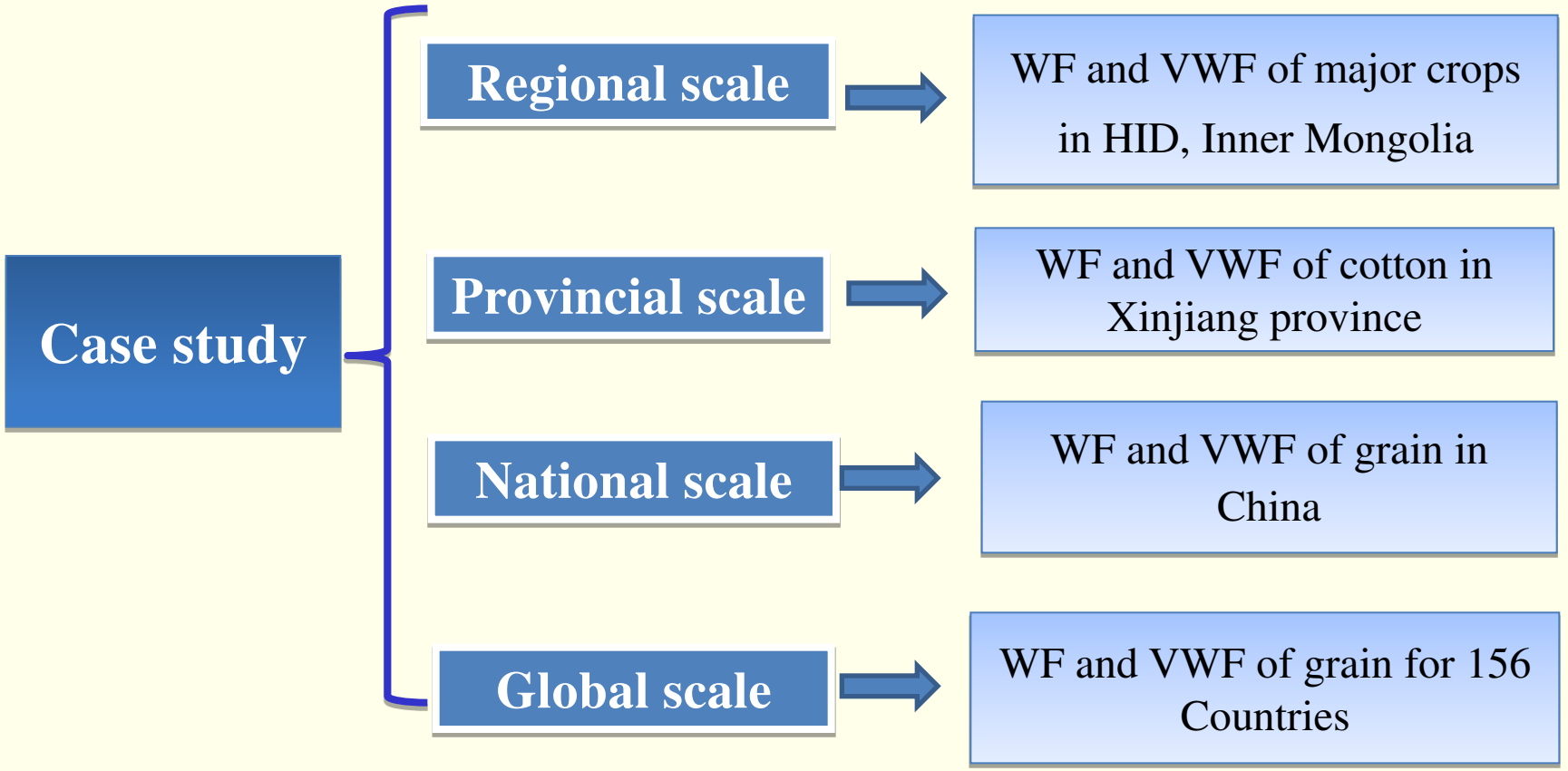
$$GWF = ① / Y$$

Methods

WF calculation model for crop production

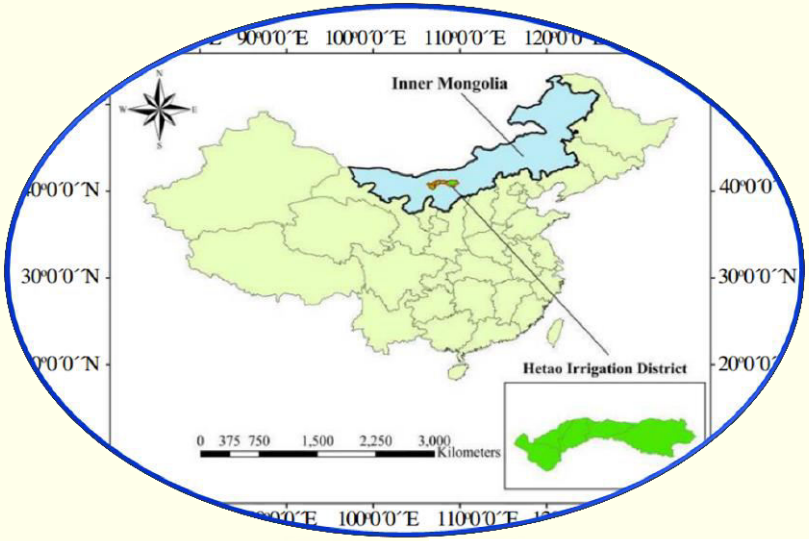
Case study

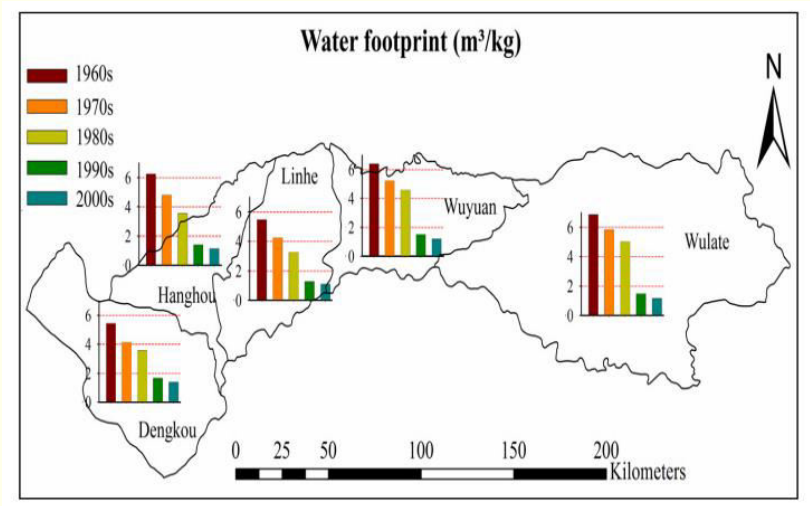
- **WF and VWF of agricultural products at different scales**

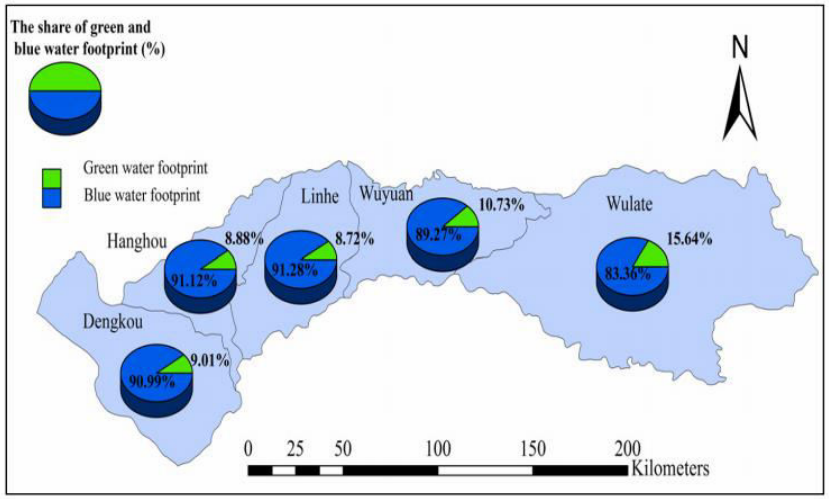


Case study---at the regional scale

➢WF and VWF of crops in Hetao Irrigation District, China

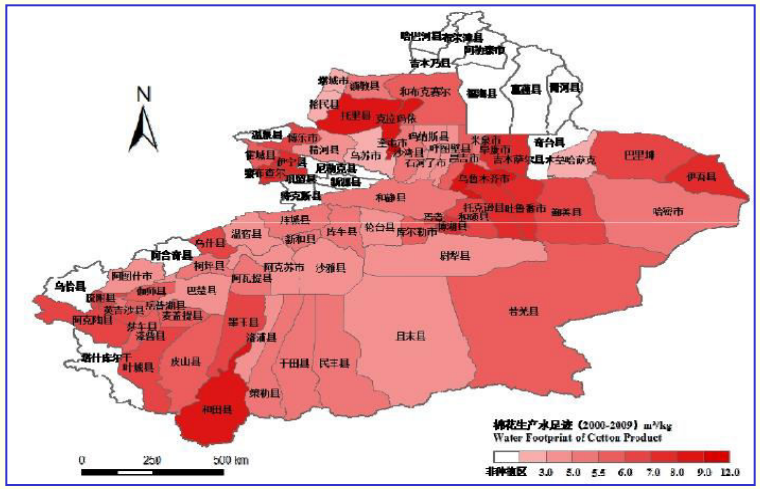


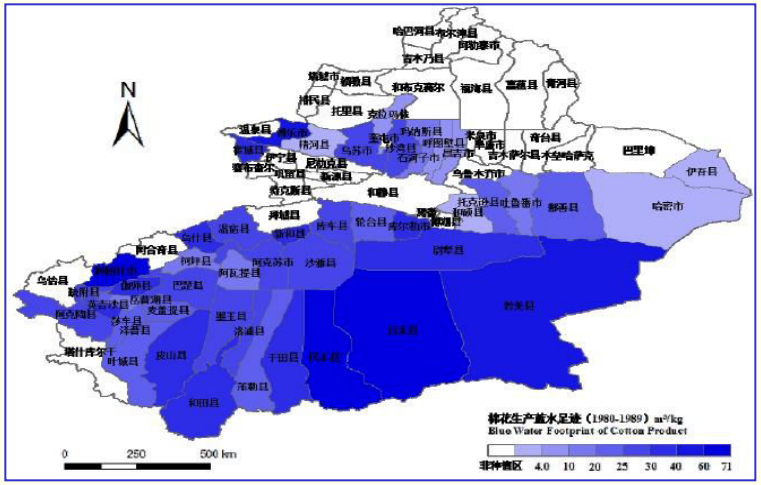


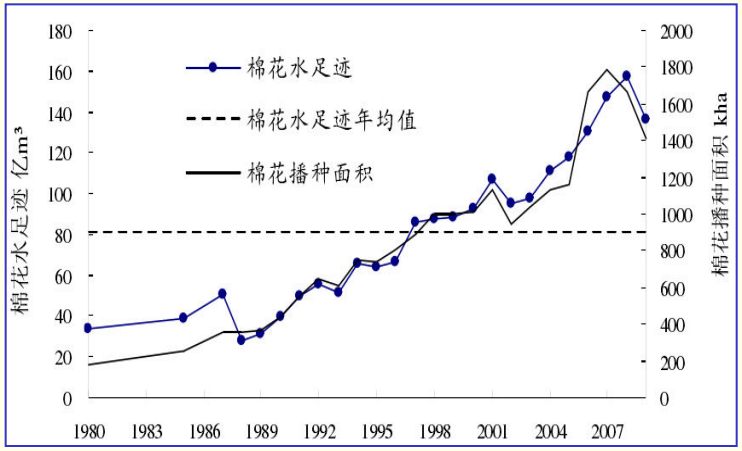


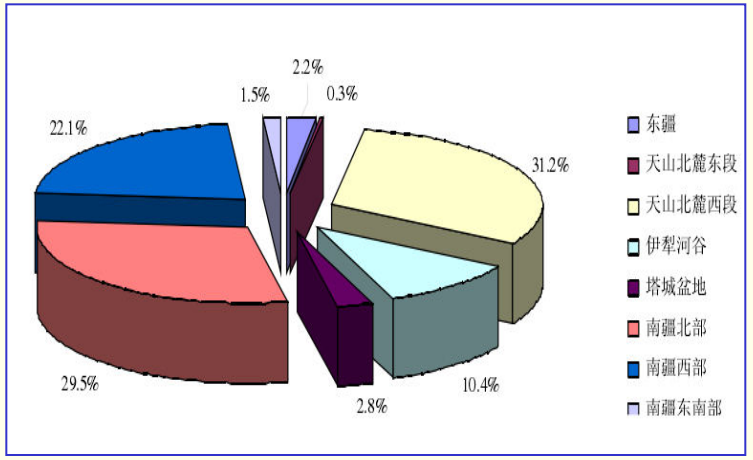
Case study--- at the provincial scale

- **WF of cotton in Xinjiang Province, China**





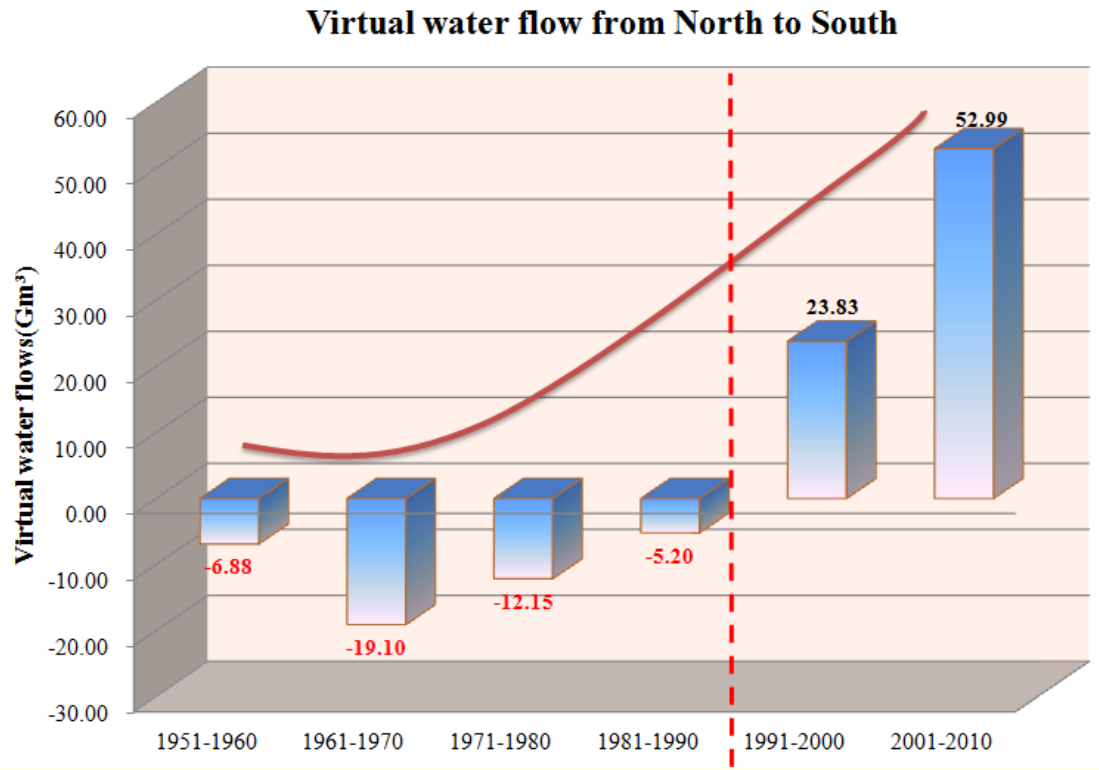




Case study---at the national scale

➢WF and VWF of grain in China

The pattern of "virtual water flow" was from south regions to north regions before 1990s.

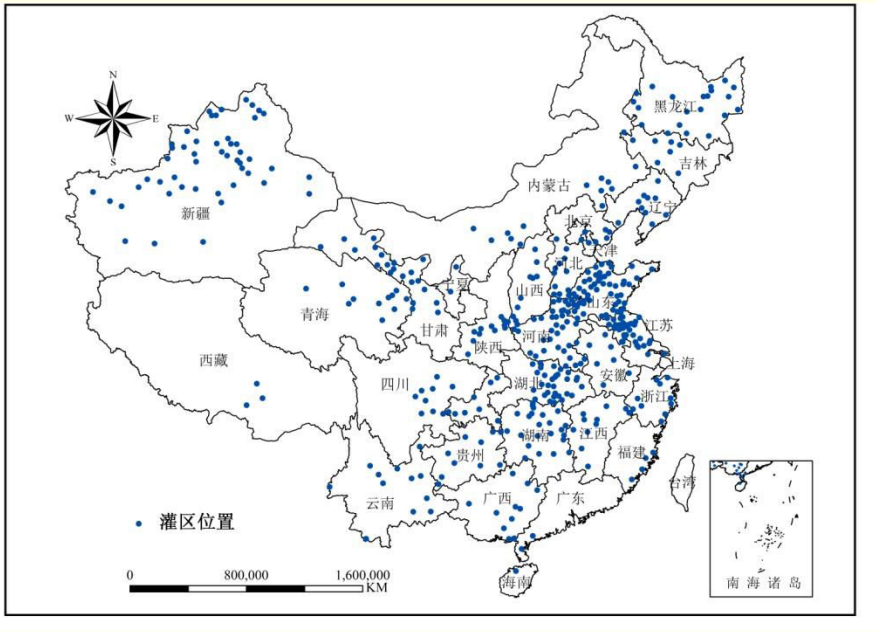


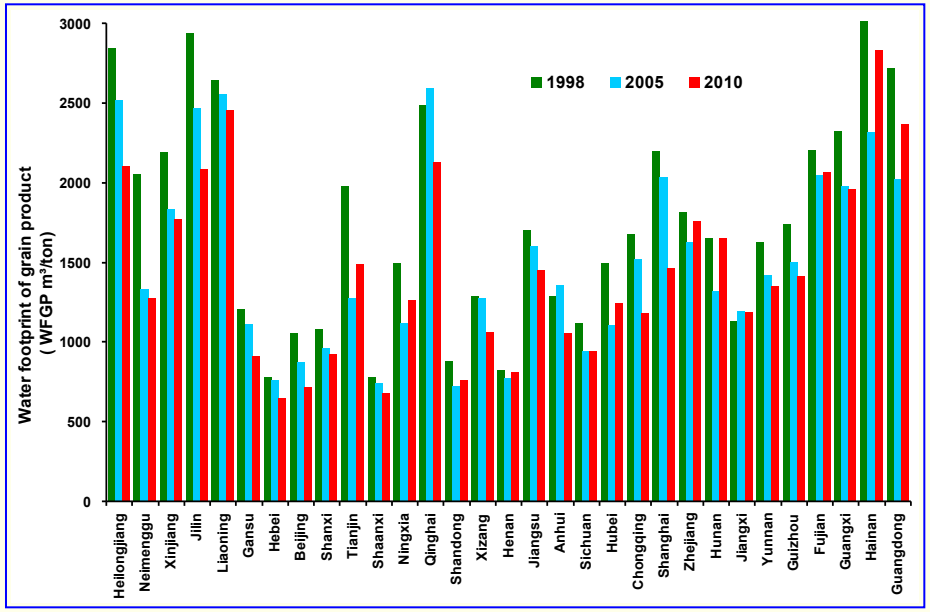
The pattern of "virtual water flow" has become from north regions to south regions since the 1990s.

Case study---at the national scale

➢WFGP of large-scale irrigation districts in China

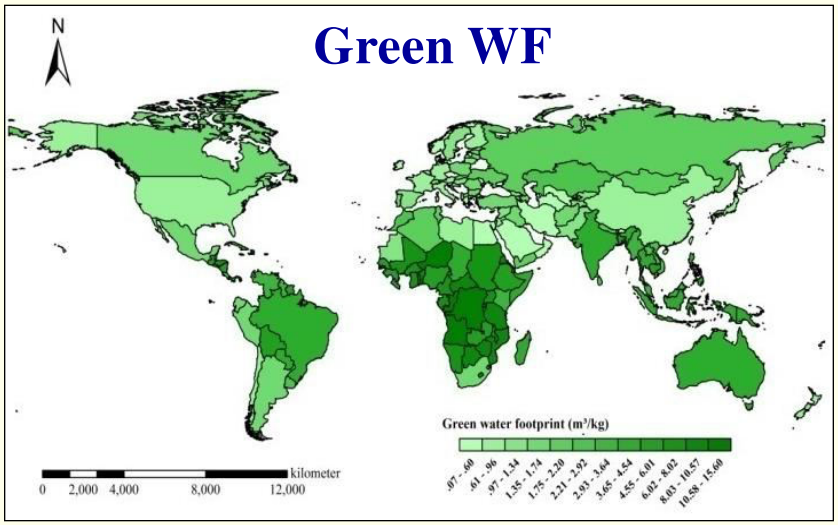
More than 400 large-scale irrigation districts are taken as study areas, and the WFGP is analyzed in each district.

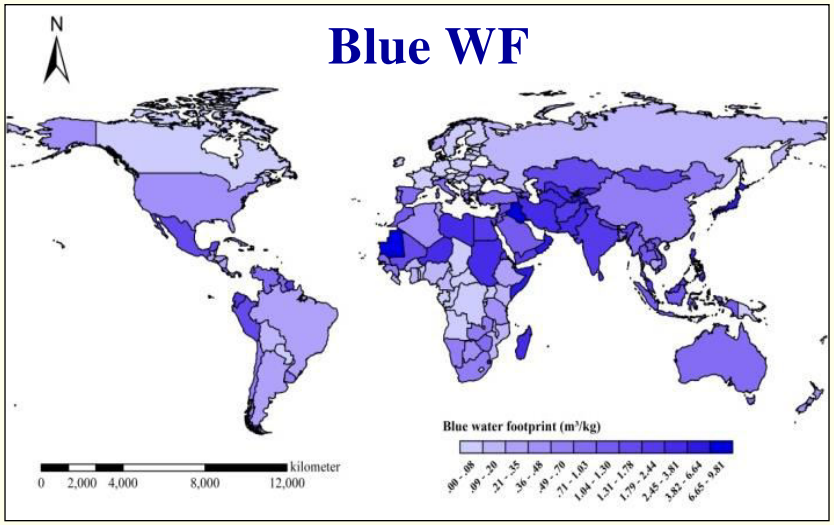


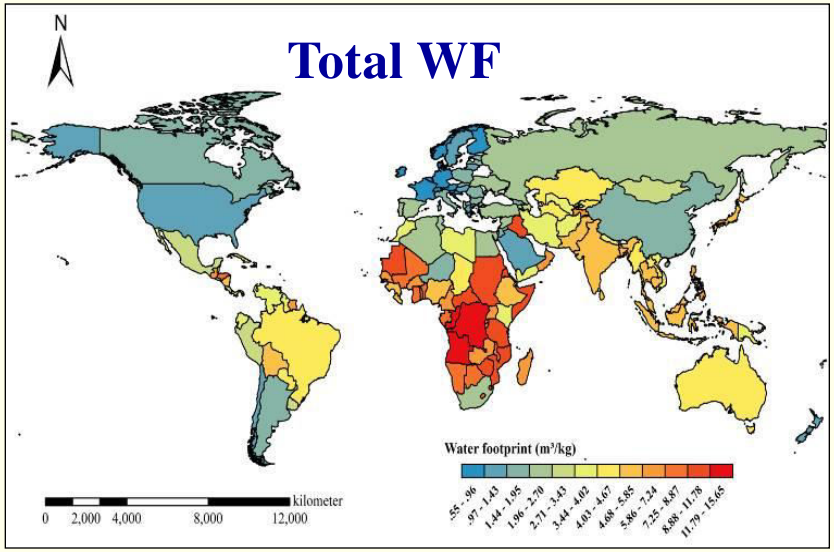


Case study---at the global scale

- **WFGP and virtual water flow of 156 Countries**







High green WF : South of Africa, South America.

High blue WF : irrigated region, such as Central Asia and South Asia.

Average total WF : 2.18m³/kg, with 1.70m³/kg of green water, 0.48 m³/kg of blue water.

Case study---at the global scale

Virtual water flow related to grain transfer for major country

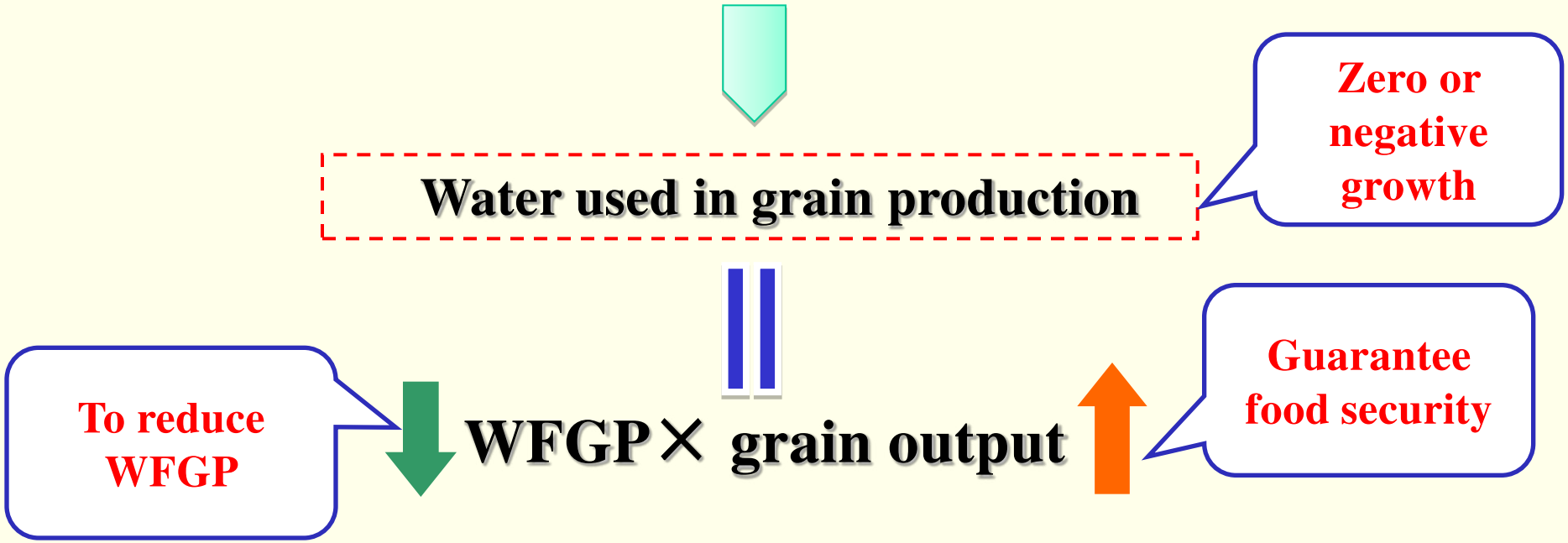
Nation	Outflow ($10^9 m^3$)	Proportion (%)	Accumulated Proportion (%)
USA	167.5	20.13	20.13
Brazil	139.3	16.73	36.86
Argentina	129	15.49	52.35
Australia	78.6	9.45	61.8
India	54.3	6.53	68.32
Canada	35.6	4.27	72.59
Russia	29.6	3.56	76.15
Paraguay	29.4	3.53	79.68
Kazakhstan	28.8	3.46	83.15
Ukraine	24.4	2.93	86.08

Nation	Inflow ($10^9 m^3$)	Proportion (%)	Accumulated Proportion (%)
China	144.3	11.68	11.68
Japan	68.1	5.51	17.19
Egypt	40.7	3.29	20.48
Mexico	39.6	3.2	23.68
R.O. Korea	36.3	2.93	26.62
Spain	32.3	2.61	29.23
Saudi Arab	27.8	2.25	31.48
Italy	27.7	2.24	33.72
Indonesia	26.6	2.16	35.88
Netherland	26.1	2.11	37.98

The major virtual water importing countries are located in arid regions or countries with large population.

Application WF in AWM in China

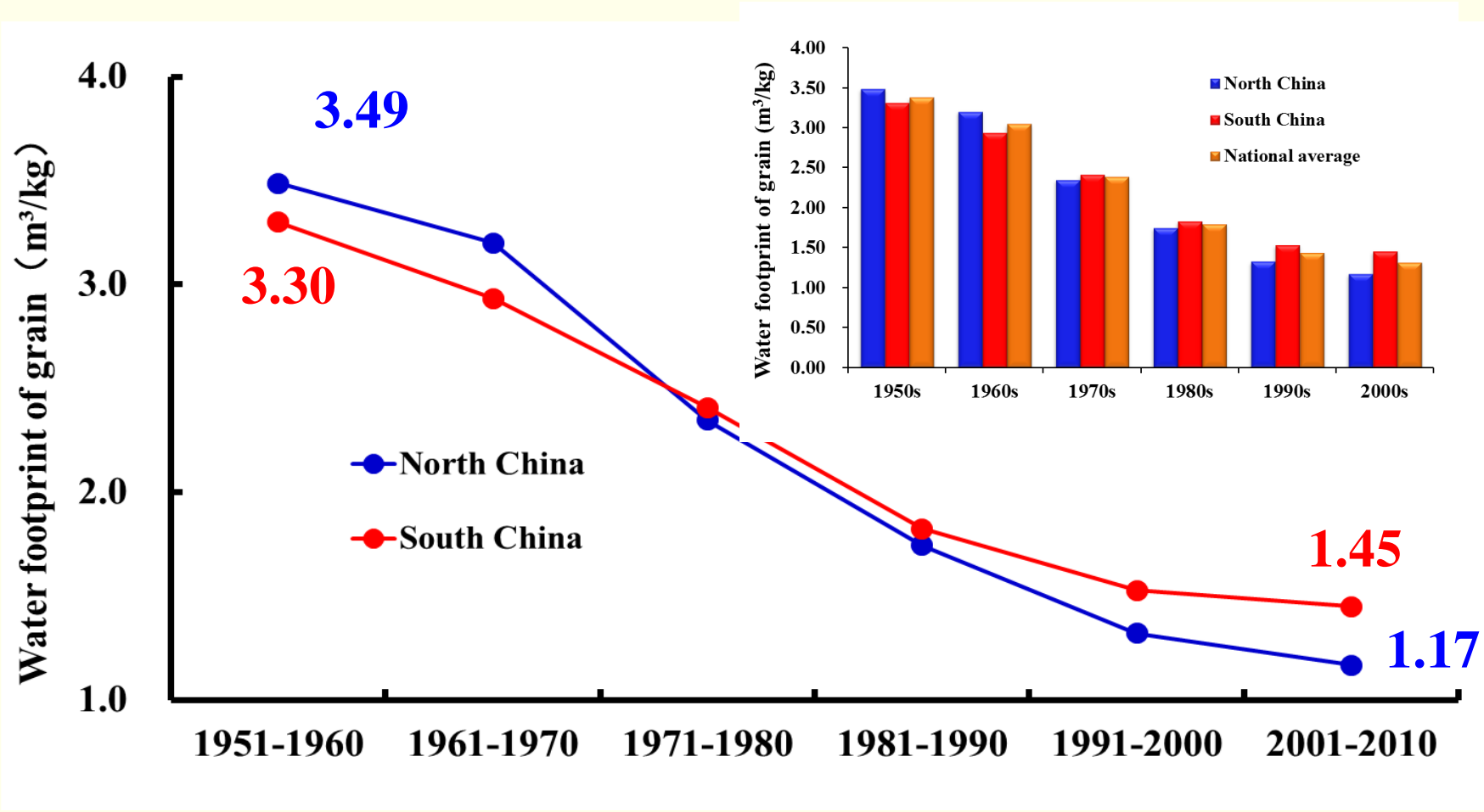
To guarantee water resource security



Could we reduce WFGP in the current situation?

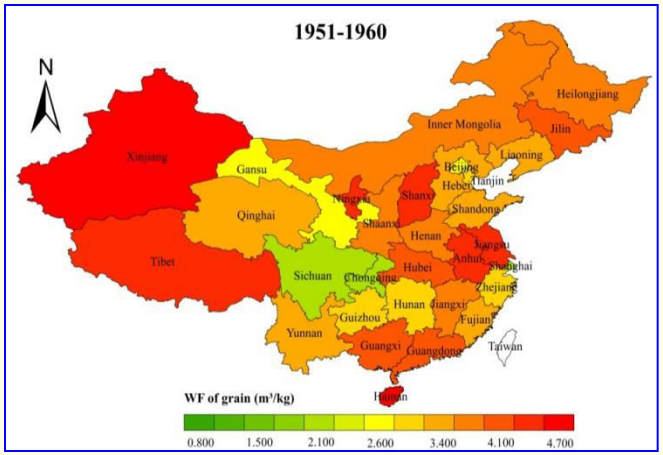
Application WF in AWM in China

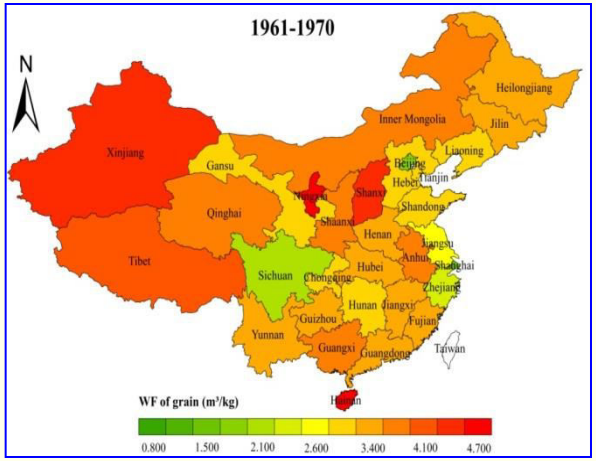
From the temporal evolution perspective:

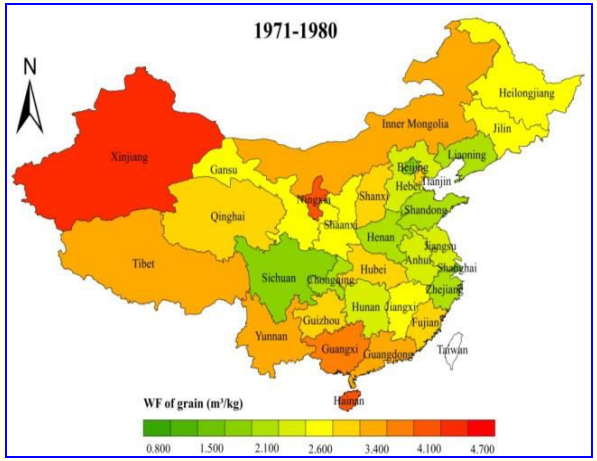


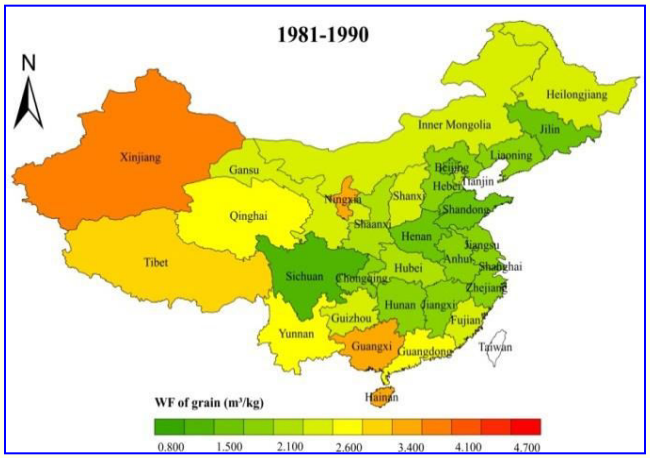
Application WF in AWM in china

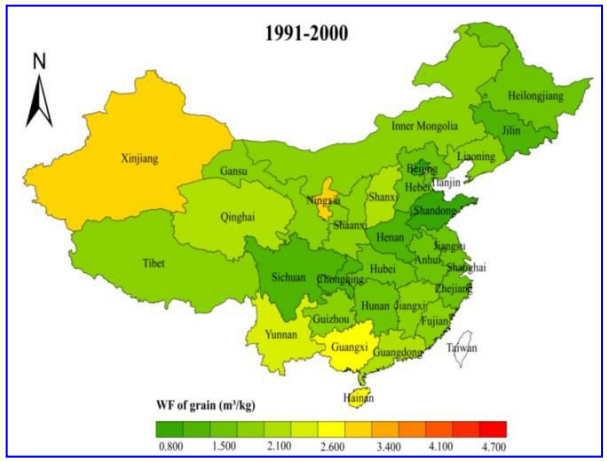
From the spatial distribution perspective:

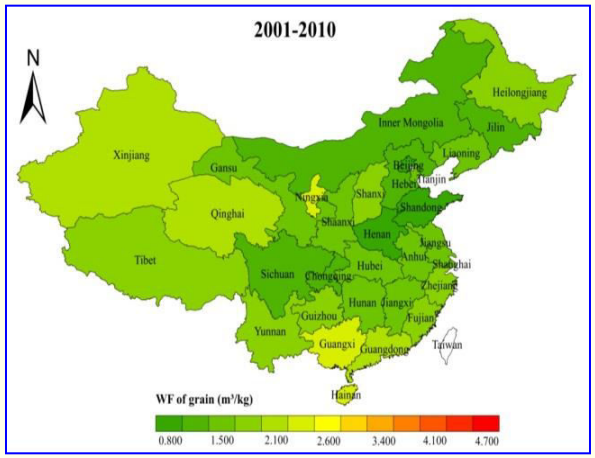






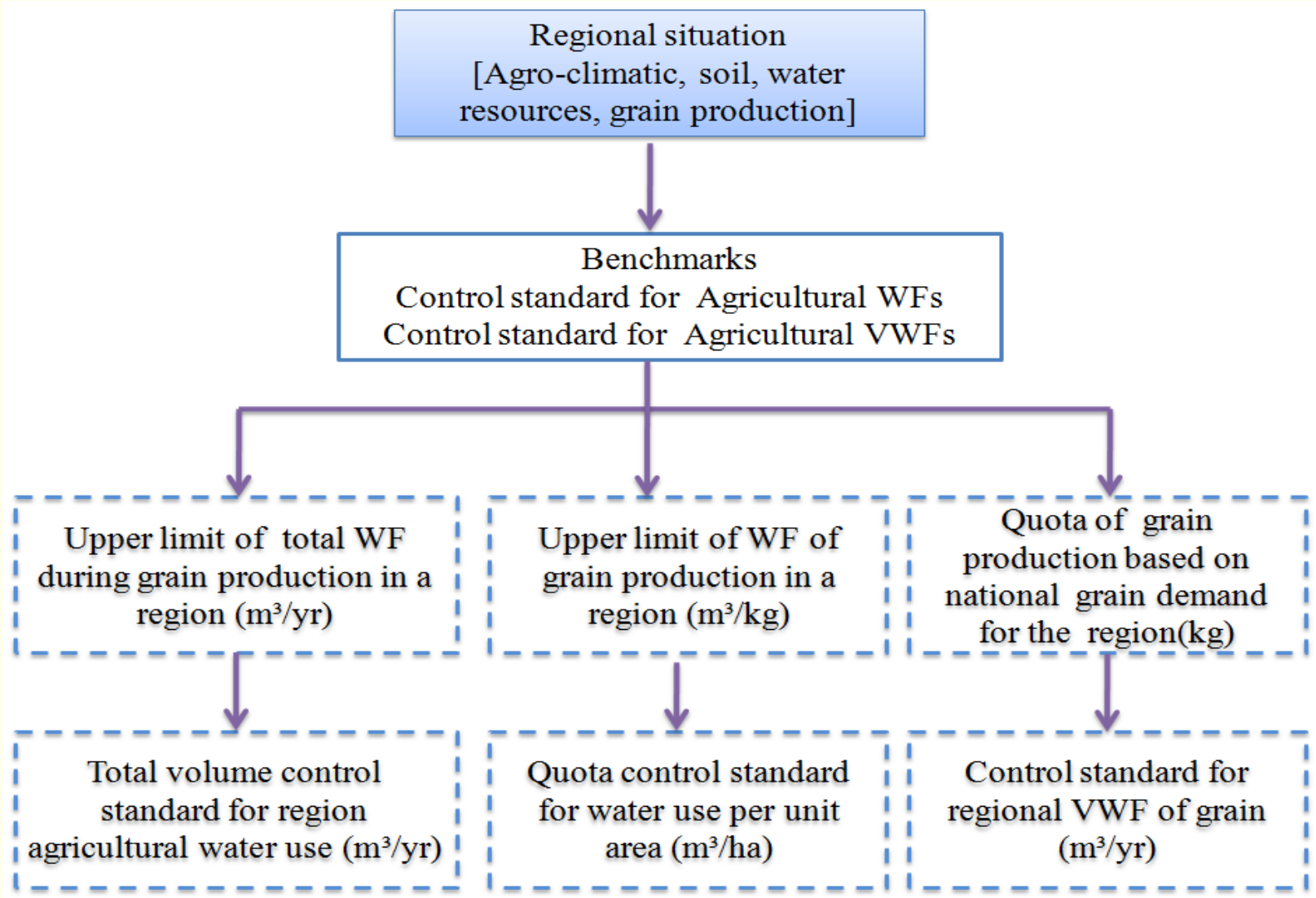




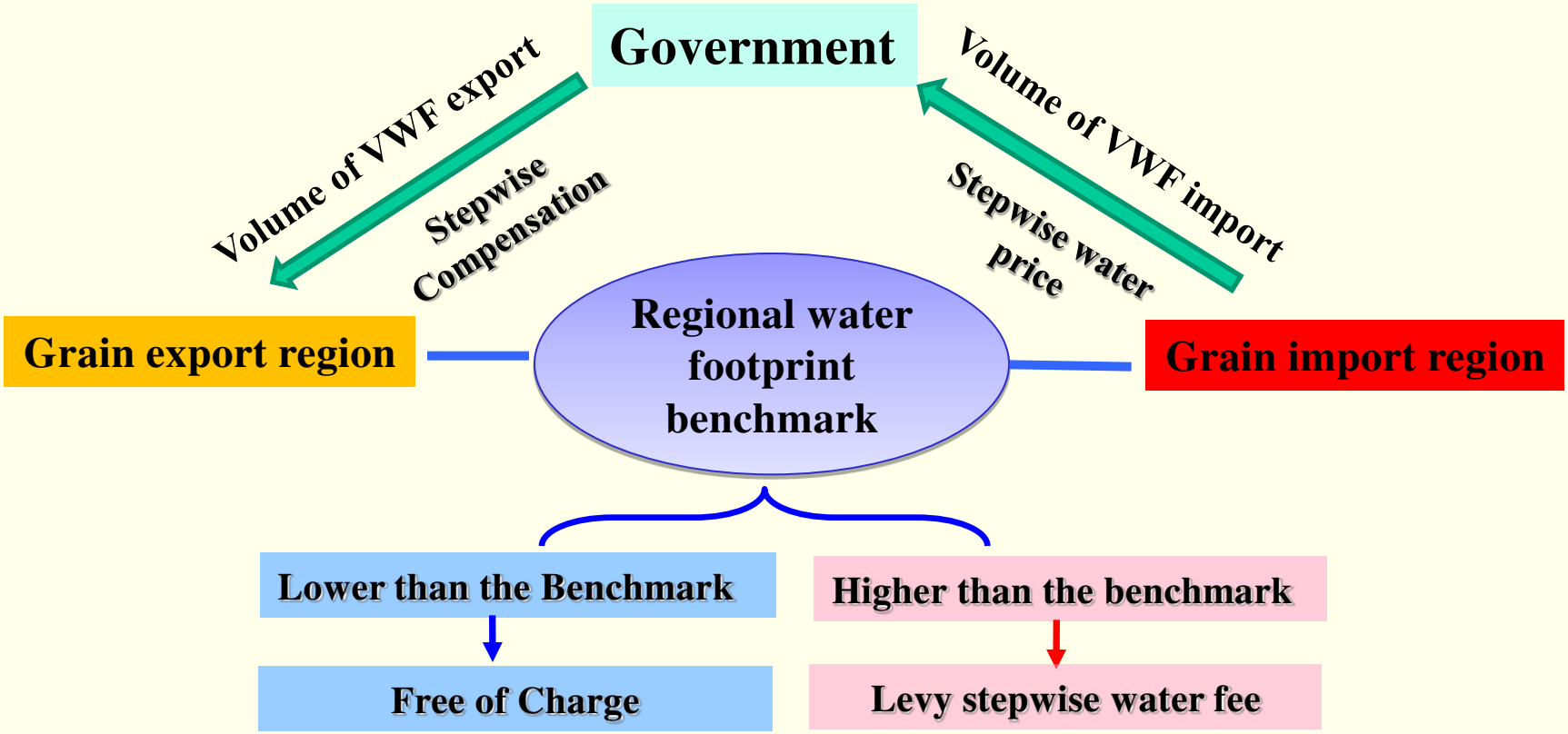


Spatial and temporal evolution of WFGP

Countermeasure 1 :
strengthen management, control agricultural water use



Countermeasure 2: compensation for water use in grain production



Purpose: To stimulate the grain production and narrow the economic gaps between the northern and southern region.

Thanks for attention!