Asia Water Forum 2022
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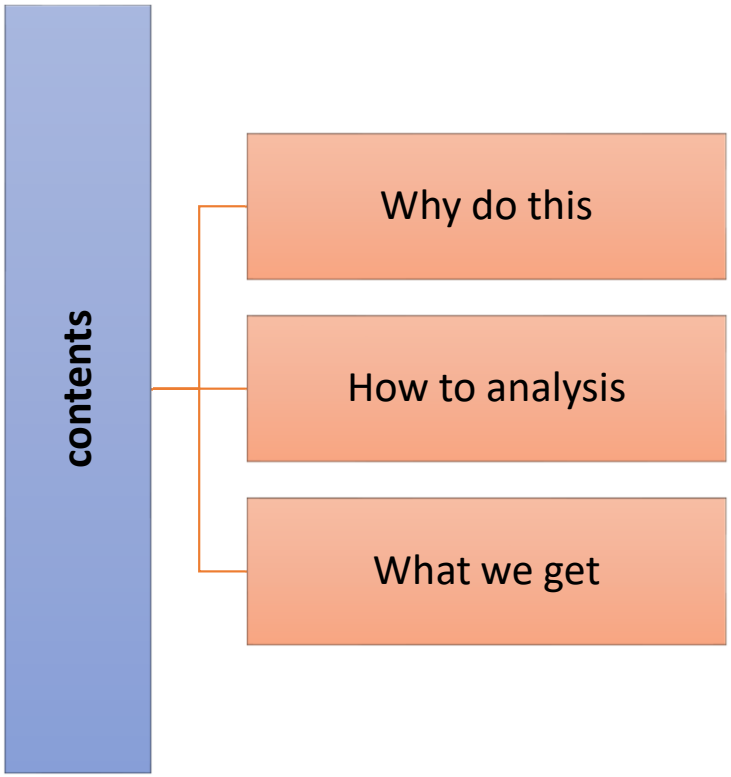
Focus Area: Water as a sustainable resource

Session Title: Decision support for efficient water utilization

Schedule: [Date | Time]: 9 August 2022 (Tue), 11:00 a.m. - 12:30 p.m. (GMT+08)

Analysis of the water resources utilization in the Yellow River Basin based on water resources ecological footprint model

Lu Rui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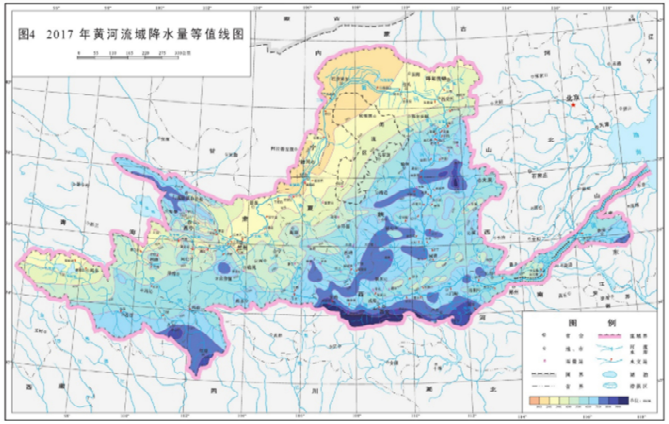
Why do this

The Yellow River basin locates in the northern China. And in general, it is lack of water and has sharp contradiction between water supply and demand.



- Mother River
- Sharp Contradiction between Water Supply and Demand （2%,12%,15%,14%,25%）
- uneven distribution of water resources
- different levels of socioeconomic development

Total amount of water resources	Water resources per capita	Water resources per drainage area
• 64.70 billion cubic meters • 2% of China’s total	• 530.8 cubic meters • 26% of China’s average	• 90,000 cubic meters • 1/3 of China’s average

How to analysis

$$EF_w = EF_{CS} + EF_{IP} + EF_{LE} + EF_{EC}$$
$$= [\sum_j Q_j \times [(10 \cdot K_j \cdot ET_0)/Y_j] + \sum_j O_j \times \frac{\int_{birth}^{slaughter} (water_d + water_a + water_{server} + \sum_j VW_j \times C_j)dt}{weight_a}]/p_w$$
$$+ (Q_{MI} \cdot P_{IO} + VWT_l - VWT_o)/p_w + K_i \cdot P_i / p_w + A \cdot \eta \cdot EP / p_w$$

$$EC_W = 0.4 \cdot \psi \cdot \gamma_W \cdot Q_W / p_w$$

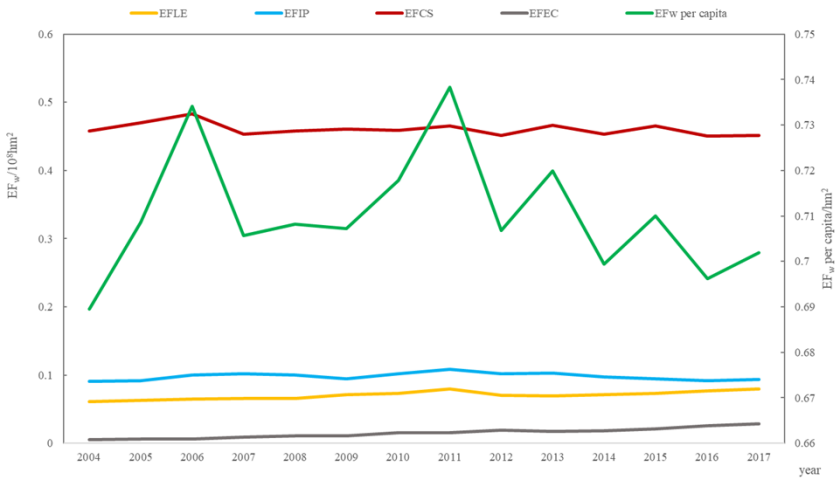
$$T = \frac{\Delta EF_W}{\Delta GDP} = \frac{(EF_{W,t} - EF_{W,t-1})/EF_{W,t-1}}{(GDP_t - GDP_{t-1})/GDP_{t-1}}$$

$$EPI_W = \frac{EF_W}{EC_W}$$

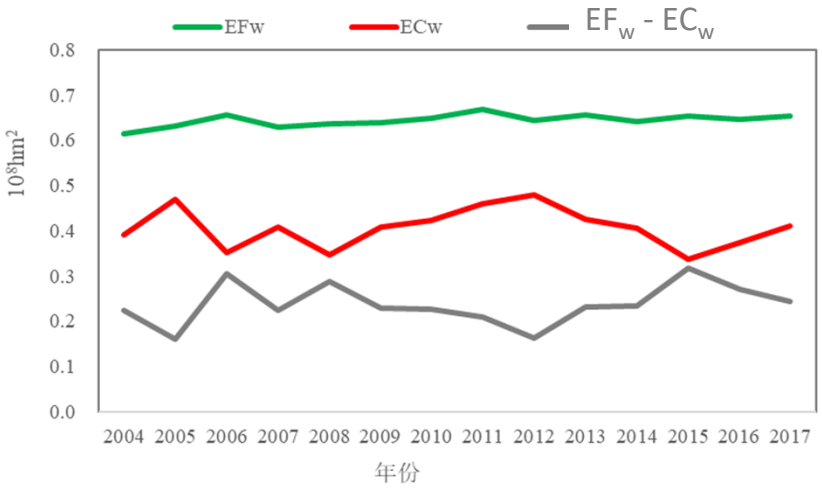
EF_w: water resource ecological footprint
EF_{CS}: Water Ecological Footprint of Agriculture (including Planting and Livestock and Poultry Breeding)
EF_{IP}: Industrial Water Ecological Footprint
EF_{LE}: Living Water Ecological Footprint
EF_{EC}: Ecological Water Ecological Footprint
EC_w: water ecological carrying capacity
EP_{IW}: water resources ecological stress index
T:Decoupling Index, to evaluate the degree of decoupling between the water resource ecological footprint and economic development

strong negative decoupling	Expansive negative decoupling	transition weak negative decoupling	weak decoupling	strong decoupling	recessionary decoupling	Transition strong negative decoupling	strong negative decoupling
ΔEF_W>0	ΔEF_W>0	ΔEF_W>0	ΔEF_W>0	ΔEF_W<0	ΔEF_W<0	ΔEF_W<0	ΔEF_W<0
ΔGDP<0	ΔGDP>0	ΔGDP>0	ΔGDP>0	ΔGDP>0	ΔGDP<0	ΔGDP<0	ΔGDP<0
T<0	T>1.2	1≤T≤1.2	0≤T < 1	T<0	T>1.2	1≤T≤1.2	0≤T < 1

What we get



- EFw shows a fluctuating upward trend, indicating that with the development of society and economy, the total consumption of water resources increasing.
- EF_{cs} dominates(67.5% ~ 74.5%).
- EF_{EC} increased fastest, reflecting more and more attention to ecological environmental protection.
- After 2012, EF_{IP} showed a slow decrease trend, indicating that the industry has gradually shifted from extensive growth to efficient and intensive.



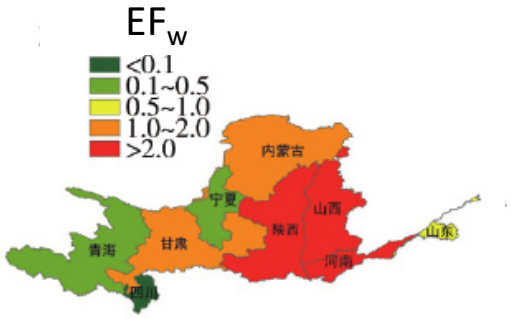
- ✓ EC_W is significantly smaller than EF_w, and it has been in a state of ecological deficit for a long time.
- ✓ After 2015, with the implementation of the "Water Pollution Prevention and Control Action Plan", the water environment, water resources and water ecological conditions of the Yellow River Basin have been greatly improved, EC_W has increased significantly, and the water ecological deficit has decreased significantly.

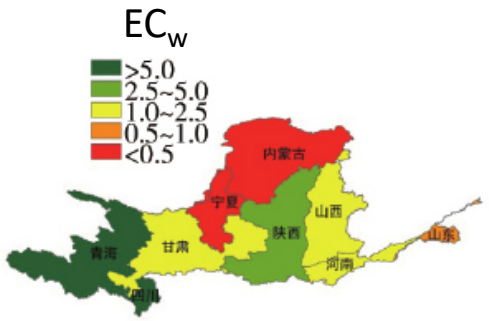
What we get

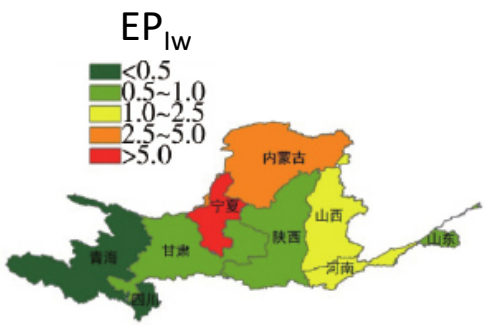
Year	T	Result
2005	0.100	weak decoupling
2006	0.203	weak decoupling
2007	-0.171	weak decoupling
2008	0.033	weak decoupling
2009	0.034	weak decoupling
2010	0.088	weak decoupling
2011	0.153	weak decoupling
2012	-0.341	strong decoupling
2013	0.250	weak decoupling
2014	-0.384	strong decoupling
2015	-2.278	strong negative decoupling
2016	-0.152	strong decoupling
2017	0.125	weak decoupling

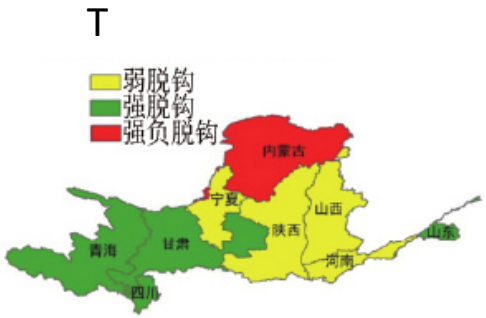
- The coordinated relationship between EFw and GDP has improved, but it has not yet reached the best state.
- Before 2012, the socio-economic development had a strong dependence on water resources, and the water resources utilization efficiency was low.
- After 2012, the economic development of the basin moderately slowed down, shifted to high-quality development, and gradually improved the efficiency of water resources utilization.

What we get









- **EF$_w$** varies greatly among different provinces. the largest is Inner Mongolia， the smallest is Sichuan.
- The main contributors to **EF$_w$** in each province are agricultural water and industrial water, specifically, the middle reaches(Henan, Shaanxi, Shanxi, Inner Mongolia which It is a major producer of **water-intensive crops and industrial products** such as wheat, corn, cotton, coal, steel, and electricity.)
- EC$_w$ varies greatly among different provinces. the largest is Qinghai,the smallest is Ningxia.
- **upstream**:water resources **surplus**;the **midstream and downstream:** overloading.Ningxia and Inner Mongolia especially serious.
- Gansu,Sichuan,Qinghai and Shangdong are strong decoupling, while others are weak decoupling.

What we should focus on

sector

- agriculture
- industry

irrigation areas, Fenwei Plain: Optimize planting structure

coal chemical industry: wastewater resource utilization

region

- upstream
- mid-downstream

water conservation

Improve water use efficiency, conserve water

provinces

- Ningxia, Inner Mongolia……

control the total amount of water used

ECO development

Thanks for Listening!