



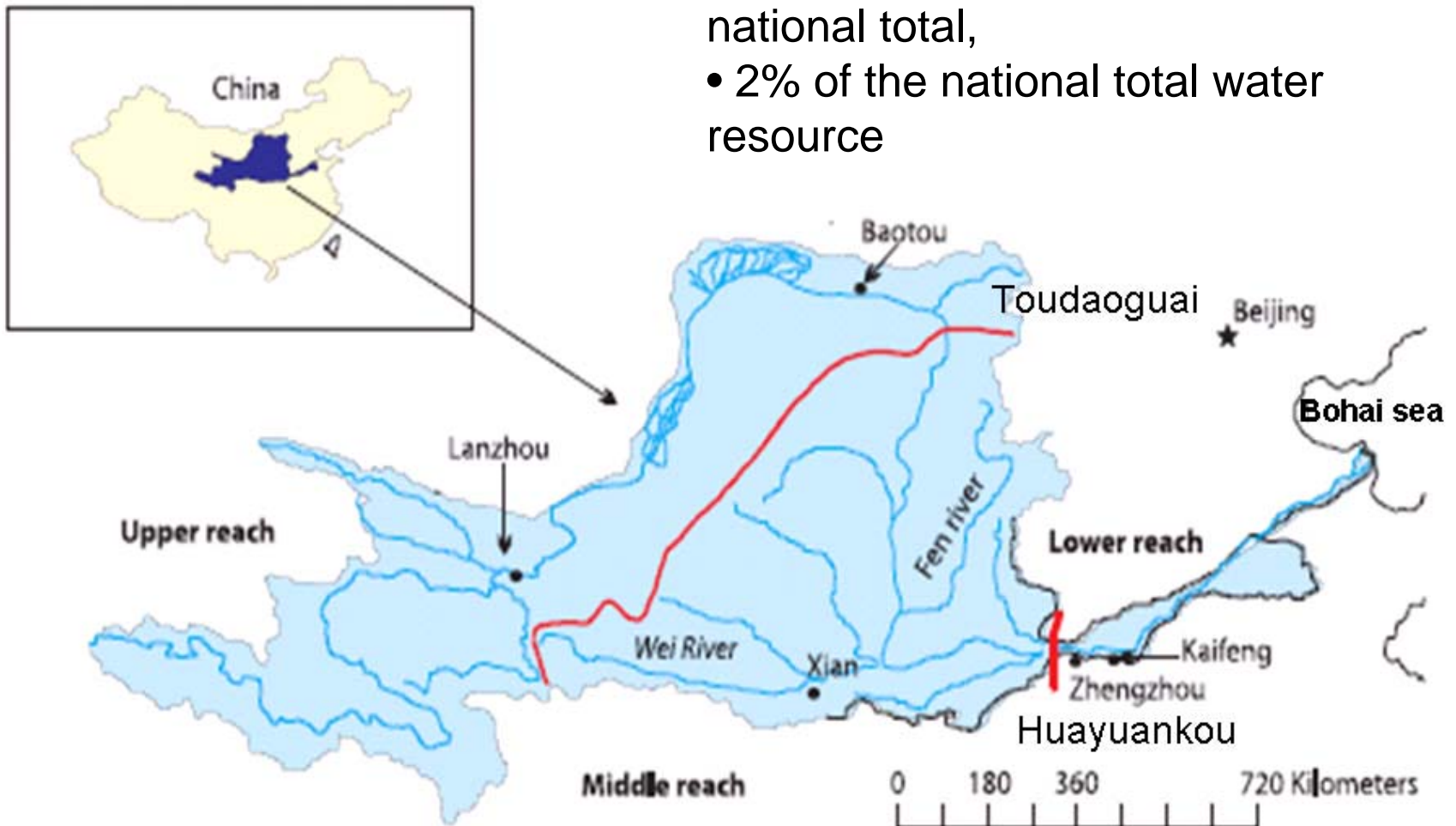
# Land and Water Use Changes in the Yellow River Basin and Their Driving Forces

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# The Yellow River Basin

- River length: 5464 km;
- Basin area: 795,000 km<sup>2</sup>; (Germany 348,672 km<sup>2</sup> )
- Population: 153 million, 12 % of the national total,
- 2% of the national total water resource





# Two questions

- 1) How do changes in climate, land cover/use, demography, institutions and consumption patterns and other internal and external factors affect the characteristics of the Yellow River?
- 2) What are the impacts of these changes on food production in the basin and virtual water trade across the basin boundary?

# 1. General features of the Yellow River

- Basin water resources: 44 - 71.9 billion m<sup>3</sup> (58-68 billion m<sup>3</sup>)
- Seasonal and yearly variation is substantial. 60 % of the discharge is concentrated between July and October.
- Currently, the river basin has about 3150 reservoirs with a total storage capacity of over 64 billion m<sup>3</sup>. Of which, 22 large reservoirs on the main river body have a storage capacity of 56.3 billion m<sup>3</sup>.
- Most of the water resources are from the upper reach. There is almost no intake in the lower reach.







## Riparian provinces in the Yellow River basin

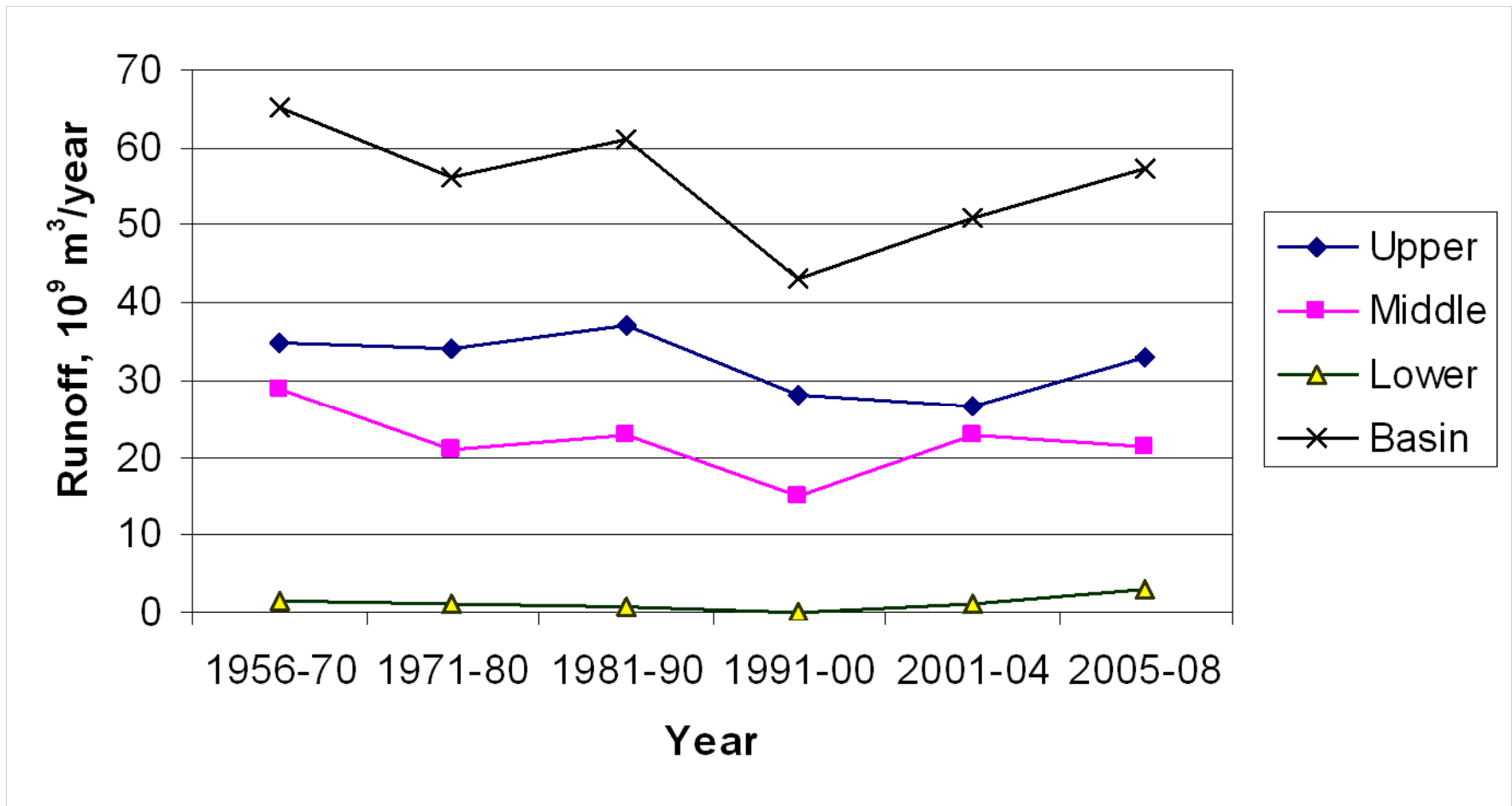
Provinces	Reach	Area in the basin (1000 km <sup>2</sup> )	Total area (1000 km <sup>2</sup> )	% of province	% of the basin
Qinghai	Upper	152.30	714.83	21.31	19.15
Sichuan	Upper	17.00	484.10	3.51	2.14
Gansu	Upper	143.20	404.12	35.43	18.01
Ningxia	Upper	51.40	51.56	99.69	6.46
Inner Mongolia	Upper	151.00	1131.07	13.35	18.99
Shanxi	Middle	97.10	156.68	61.97	12.21
Shaanxi	Middle	133.30	205.96	64.72	16.77
Henan	Middle (mostly)	36.20	165.24	21.91	4.55
Shandong	Lower	13.60	154.05	8.83	1.71

Inconsistency of the natural boundary of the river basin and sub-basins with the administrative boundary makes it difficult for studies on river basin scale due to the lack of data.



## 2. Water Resources Availability and Water Use

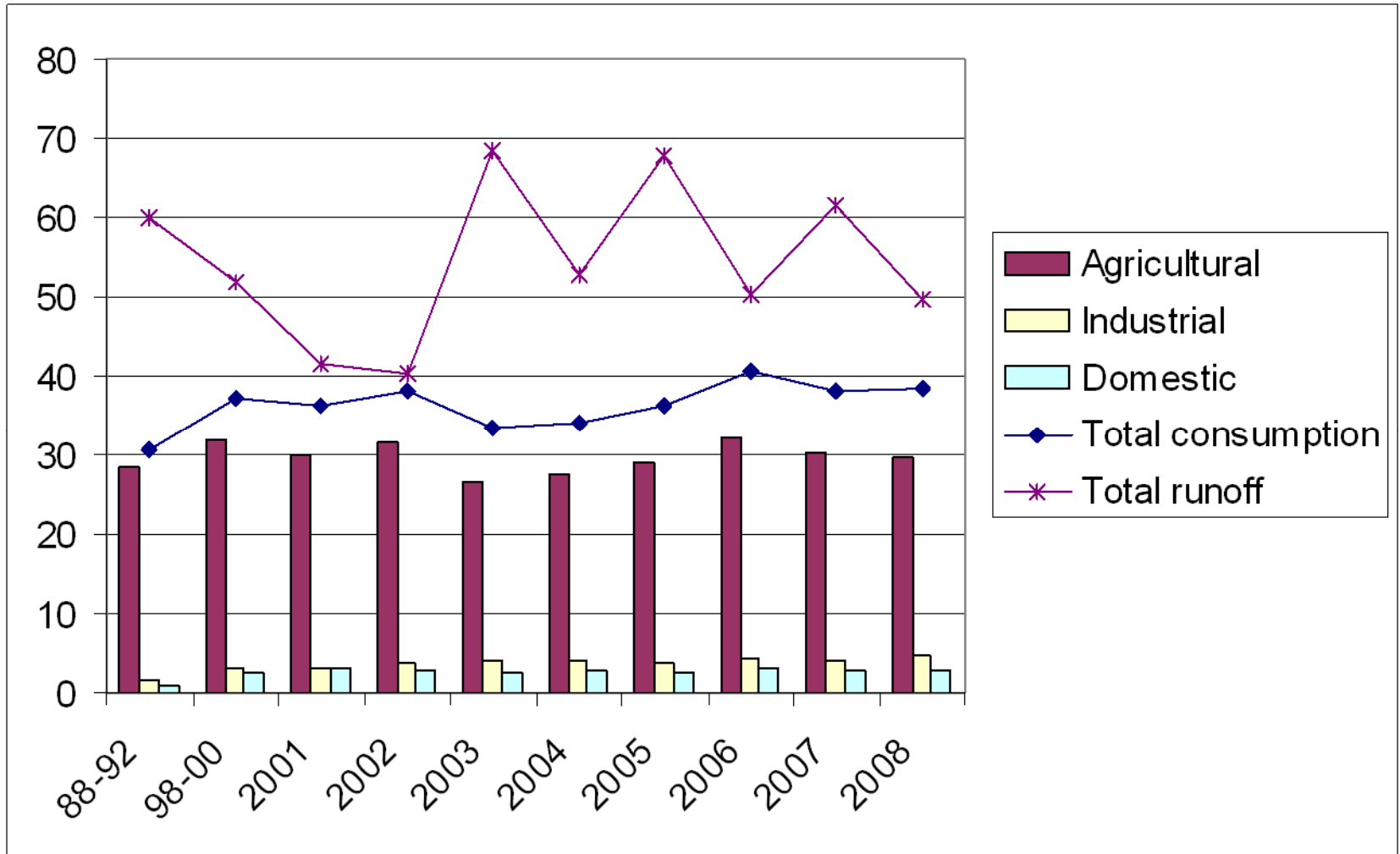
Estimated natural runoff in different sections of the Yellow River



## Yellow River Water Allocation Plan (1987), billion m<sup>3</sup>

Provinces	Water withdrawal		Province	Water withdrawal	
	quota billion m <sup>3</sup>	% of total		quota billion m <sup>3</sup>	% of total
Qinqhai	1.41	3.81	Shaanxi	3.86	10.43
Sichuan	0.04	0.11	Shanxi	4.31	11.65
Gansu	3.04	8.22	Henan	5.54	14.97
Ningxia	4.00	10.81	Shandong	7.00	18.92
Inner Mongolia	5.86	15.84	Hebei and Tianjin	2.00	5.41
Total				37.00	
As % of total water resources in 1987				63.90	

# Consumptive water use in different sectors



Water withdrawal and depletion by sectors and sections in the Yellow River, average of 2007-2008, billion m<sup>3</sup>

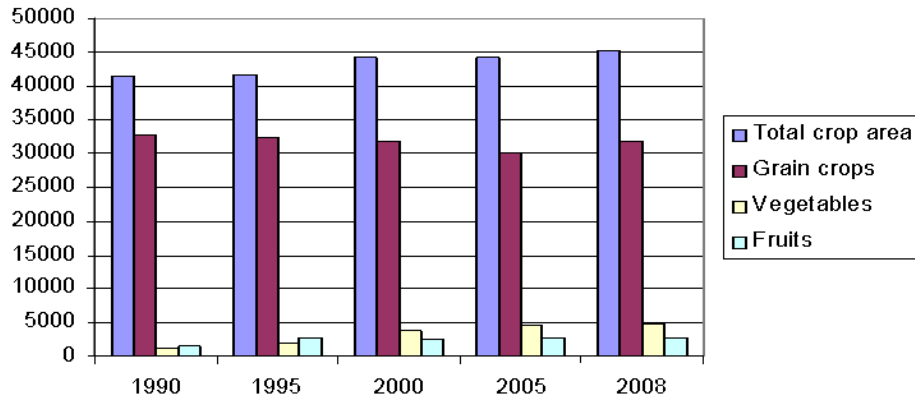
		Total	Agriculture	Industry	Domestic
Upper	withdrawal	21.03	17.06	2.01	1.96
	depletion	14.32	11.63	1.47	1.22
middle	withdrawal	14.35	8.78	2.34	3.23
	depletion	11.06	7.62	1.48	1.96
lower	withdrawal	10.32	8.47	0.90	0.95
	depletion	9.75	8.18	0.78	0.79
<b>Basin</b>	<b>withdrawal</b>	<b>45.70</b>	<b>34.31</b>	<b>5.25</b>	<b>6.13</b>
	<b>depletion</b>	<b>35.12</b>	<b>27.43</b>	<b>3.73</b>	<b>3.97</b>

The total allocated water is about 37 billion m<sup>3</sup>

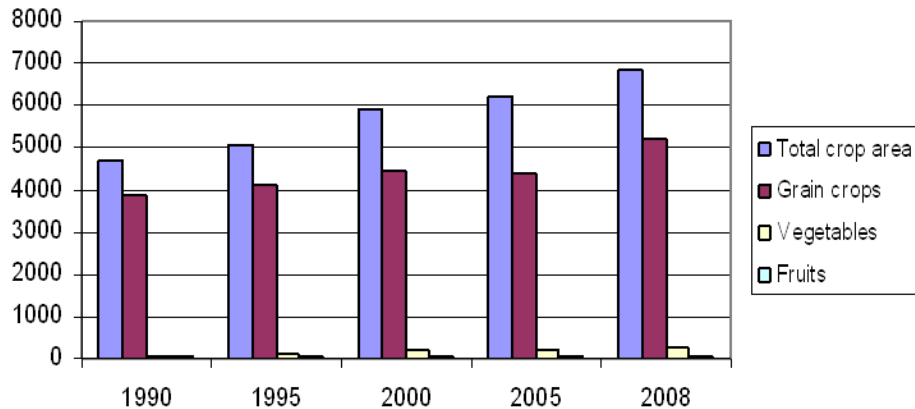
# 3. Land Use Changes

Crop structure and changes in the Yellow River basin, 1990-2008

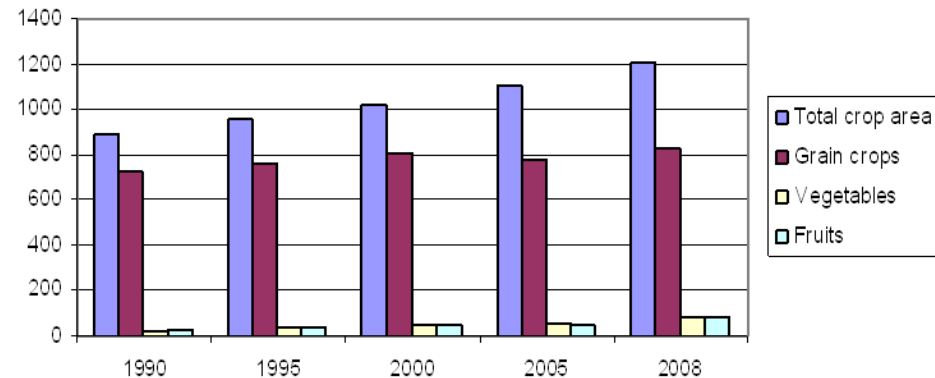
a. Basin



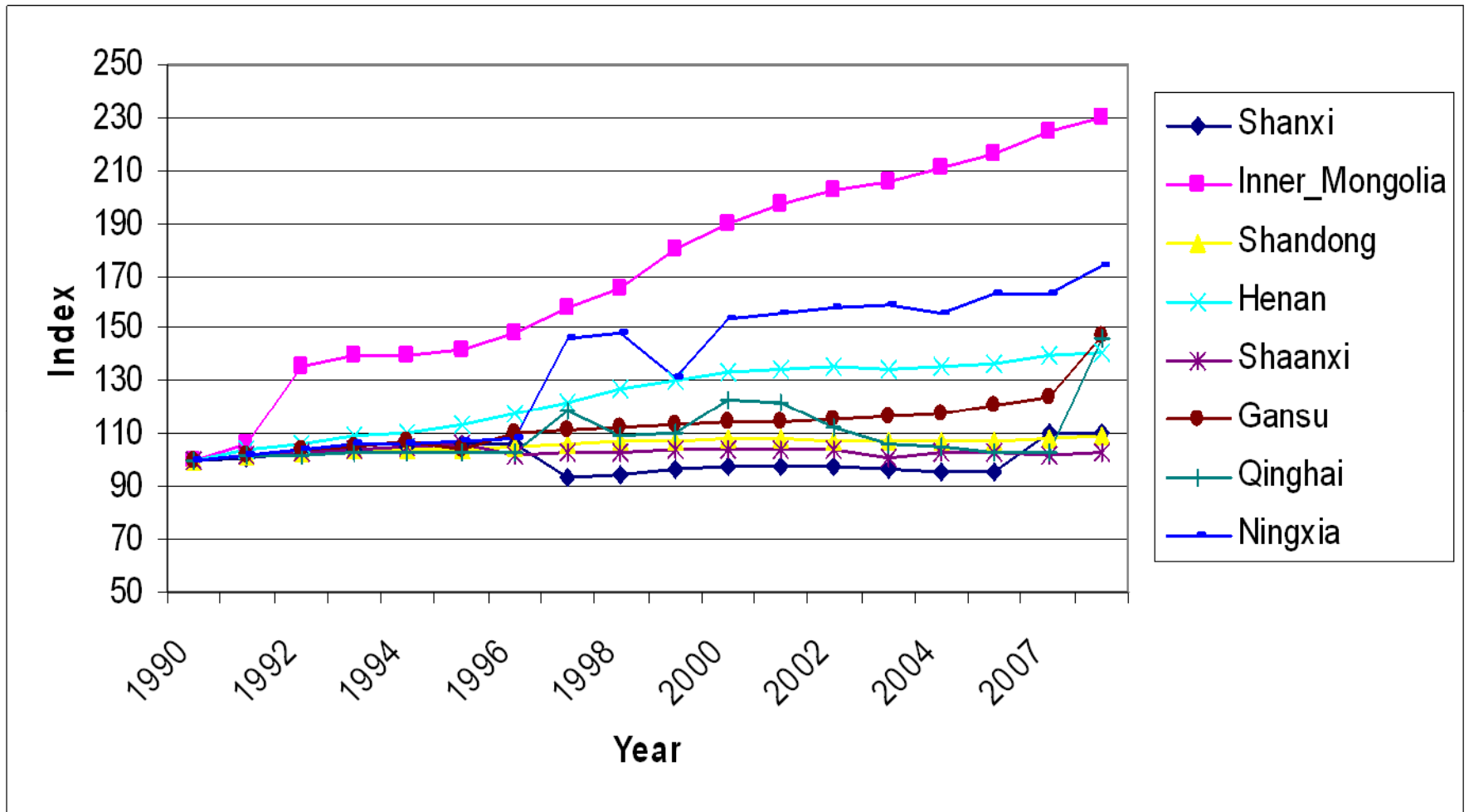
c. Inner Mongolia



b. Ningxia



# Changes in irrigated areas between 1990 and 2008



## 4. Changes in Food Production and the Role of the Basin in the Nation

Changes in food production between 1998 and 2008

		1998			2008			change in the basin
		total million ton	Basin million ton	%	Total million ton	Basin million ton	%	
Grain		512.30	135.30	26.41	528.71	152.16	28.78	12.46
Of which	Cereal	456.25	118.66	26.01	478.47	138.48	28.94	16.70
	Rice	198.71	7.43	3.74	191.90	7.77	4.05	4.66
	Wheat	109.73	57.92	52.79	112.46	62.58	55.64	8.04
	Maize	132.95	48.07	36.15	165.91	64.97	39.16	35.16
Fruits		54.53	19.12	35.06	192.20	72.39	37.66	278.63

## Changes in per capita food production between 1998 and 2008

		1998	2008	1998	2008
		nation	nation	basin	basin
		kg/capita	kg/capita	kg/capita	kg/capita
<b>Grain</b>		414.48	398.12	492.99	527.92
Of which	Cereal	369.13	360.30	432.36	480.46
	Rice	160.77	144.50	27.07	26.98
	Wheat	88.78	84.69	211.05	217.12
	Maize	107.57	124.94	175.14	225.41
<b>Fruit</b>		44.12	144.73	69.66	251.15

- The role of the Yellow River basin as a supplier of grain has strengthened.
- Water scarcity in the basin has not led to a significant shift of agricultural production to less water intensive commodities





## 5. Driving forces of land and water use changes

- Improvement in water use efficiency in irrigation
- Water rights transfer
- Holistic water management
- Other forces

Ratio of agricultural water use (withdrawal and consumption from the Yellow River)\* to provincial irrigated area, m<sup>3</sup>/ha

	1998 withdrawal	1998 consumption	2008 withdrawal	2008 consumption
Qinghai	7881.54	5448.24	5455.99	4581.76
Gansu	2405.85	1811.39	2215.62	1809.16
Ningxia	23081.89	9695.17	15232.11	8213.48
Inner_Mongolia	4153.01	3533.05	2796.33	2286.45
Shaanxi	2859.67	2362.97	3168.79	2707.76
Shanxi	2180.42	1885.64	1928.96	1649.98
Henan	940.87	817.70	835.81	768.86
Shandong	1858.92	1811.43	1355.85	1319.82
Basin	2652.70	2047.72	2111.56	1715.27



## Changes in water withdrawal and consumptive use in agriculture, 1998-2008

	withdrawal		withdrawal %	consumption		consumption %
	1998	2008		1998	2008	
Qinghai	1.48	1.37	92.96	1.02	1.15	112.93
Gansu	2.32	2.78	119.88	1.75	2.27	130.01
Ningxia	8.94	6.88	77.05	3.75	3.71	98.91
Inner Mong	8.59	8.03	93.49	7.31	6.57	89.86
Shaanxi	3.73	4.12	110.71	3.08	3.52	114.49
Shanxi	2.33	2.42	103.86	2.02	2.07	102.73
Henan	4.25	4.17	98.19	3.69	3.84	103.93
Shandong	8.89	6.59	74.12	8.66	6.41	74.04
Basin	40.51	36.39	89.82	31.27	29.56	94.52

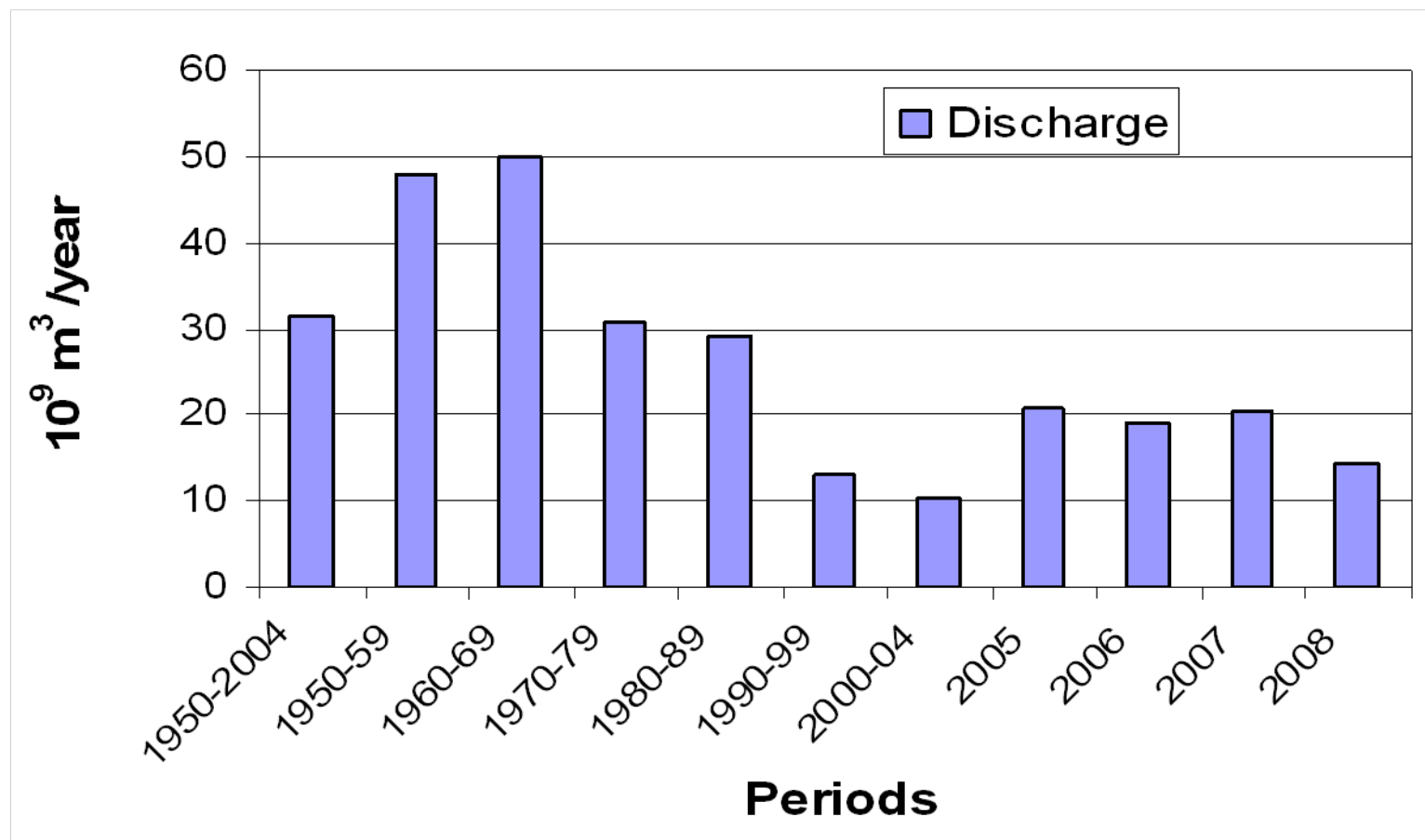
# Water right transfer and water saving

- In 2003, ‘Investment for water saving and water rights transfer’ was put forward.
- Industrial water users, especially the large enterprises, are encouraged to invest in the water saving projects in the existing irrigation schemes in exchange for the rights for use of the saved water.
- By the end 2009, 26 water right transfer projects have been approved. The total volume of the water under these projects are about 228 million m<sup>3</sup>.
- The second phase of the water rights transfer will focus on crop structural adjustment to increase farmers’ income.

# Holistic management by YRCC

- The current Yellow River water allocation is enforced with both the total quantity control and the cross-provincial boarder discharge control.
- Since the implementation of the holistic water management in 1999, the seasonal dry ups in the lower reach of the Yellow River have been halted,
- The water needs for ecosystem protection and sediment removal are far from being met (could even be reduced due to the reduced return flow in irrigation schemes.
- Maintaining the river flow to reach the sea during the peak water use seasons has been achieved mainly through administrative means.

# Changes in the Yellow River Discharge to the Bohai Sea (at the Lijin station)



# Other factors

- Subsidies to grain production,
- Increased demand for meat and fruits,
- Lack of employment opportunities outside of farming in the basin,
- Water pricing?





**Thank you**