Land, water, energy, and food systems in the Ili-Balkhash basin of Central Asia

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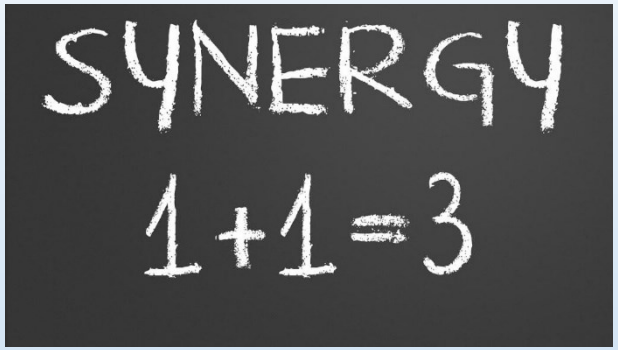
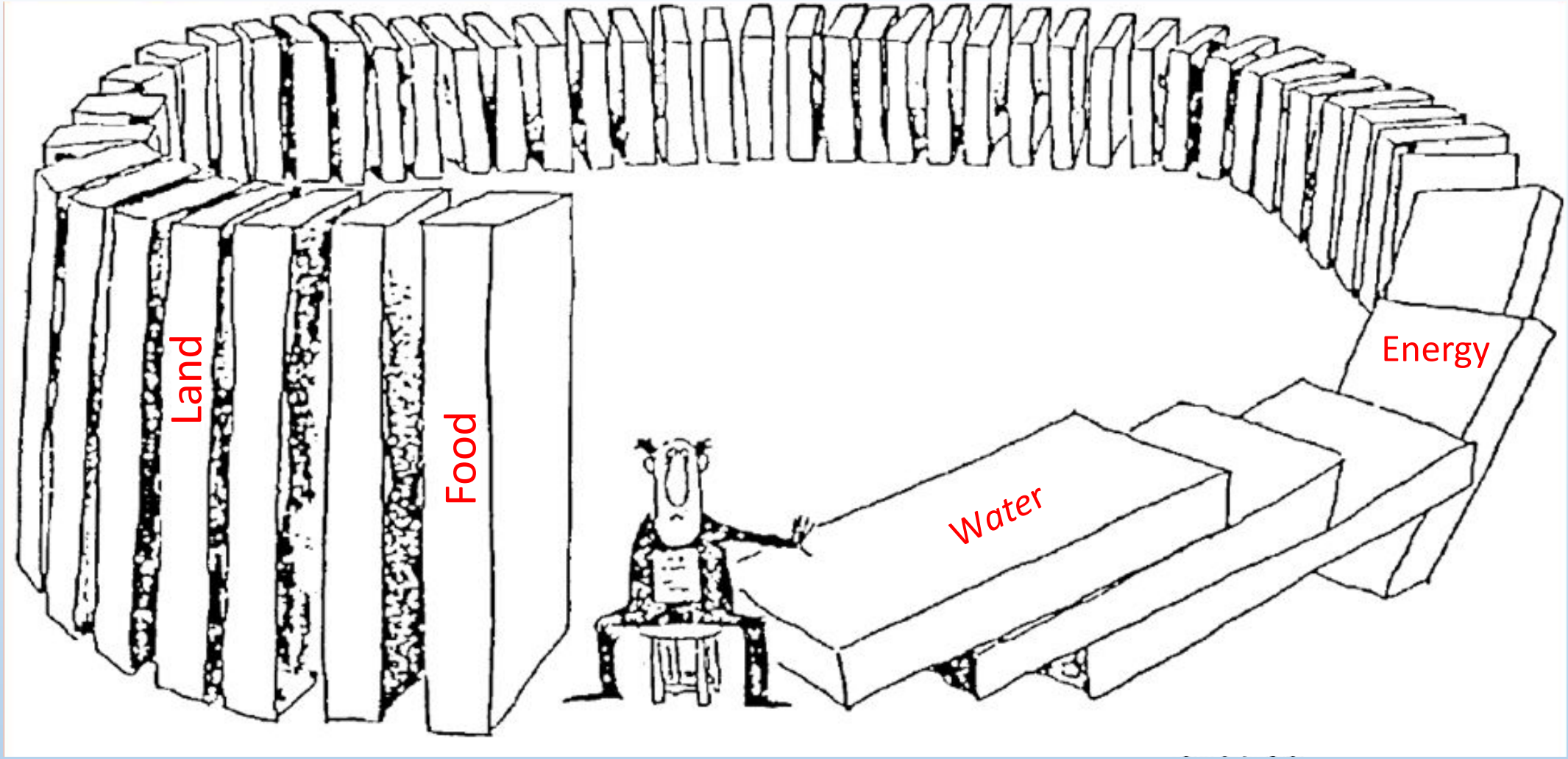


Each essential for human well-being and development

Each increasingly subject to planetary limits

Interconnected and inseparable: a single system



We are especially interested in the interrelationships between the L-W-E-F components of the system (these are complicated, often ignored)

415,000 km^2, 86% KZ

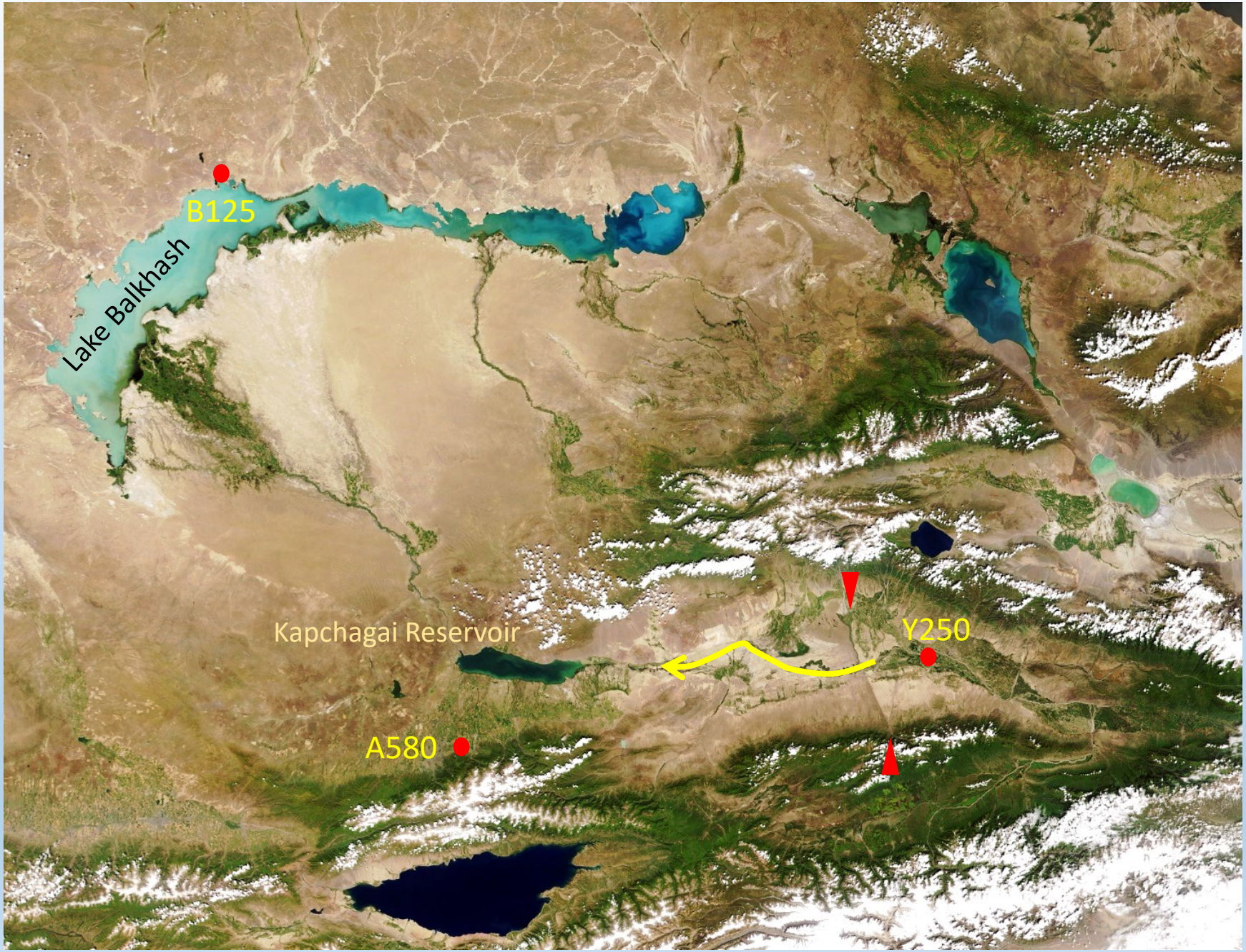
Closed and arid, near the Pole of Inaccesibility

Threatened by climate change

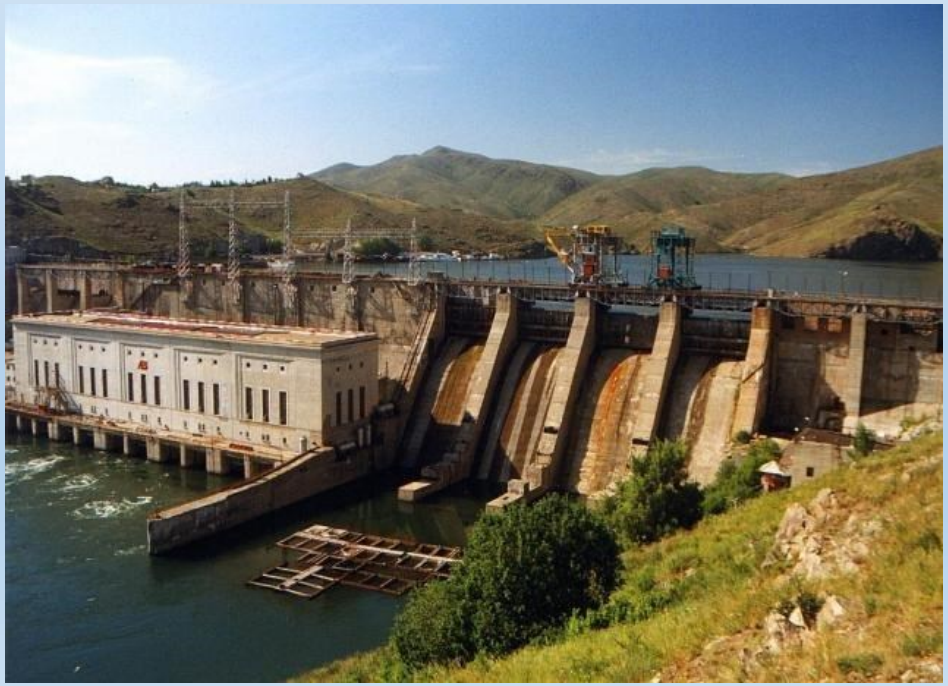
Transboundary complexity

Geopolitical developments (more later)

History of land-water-energy-food tradeoffs


B125
Lake Balkhash
Kapchagai Reservoir
Y250
A580

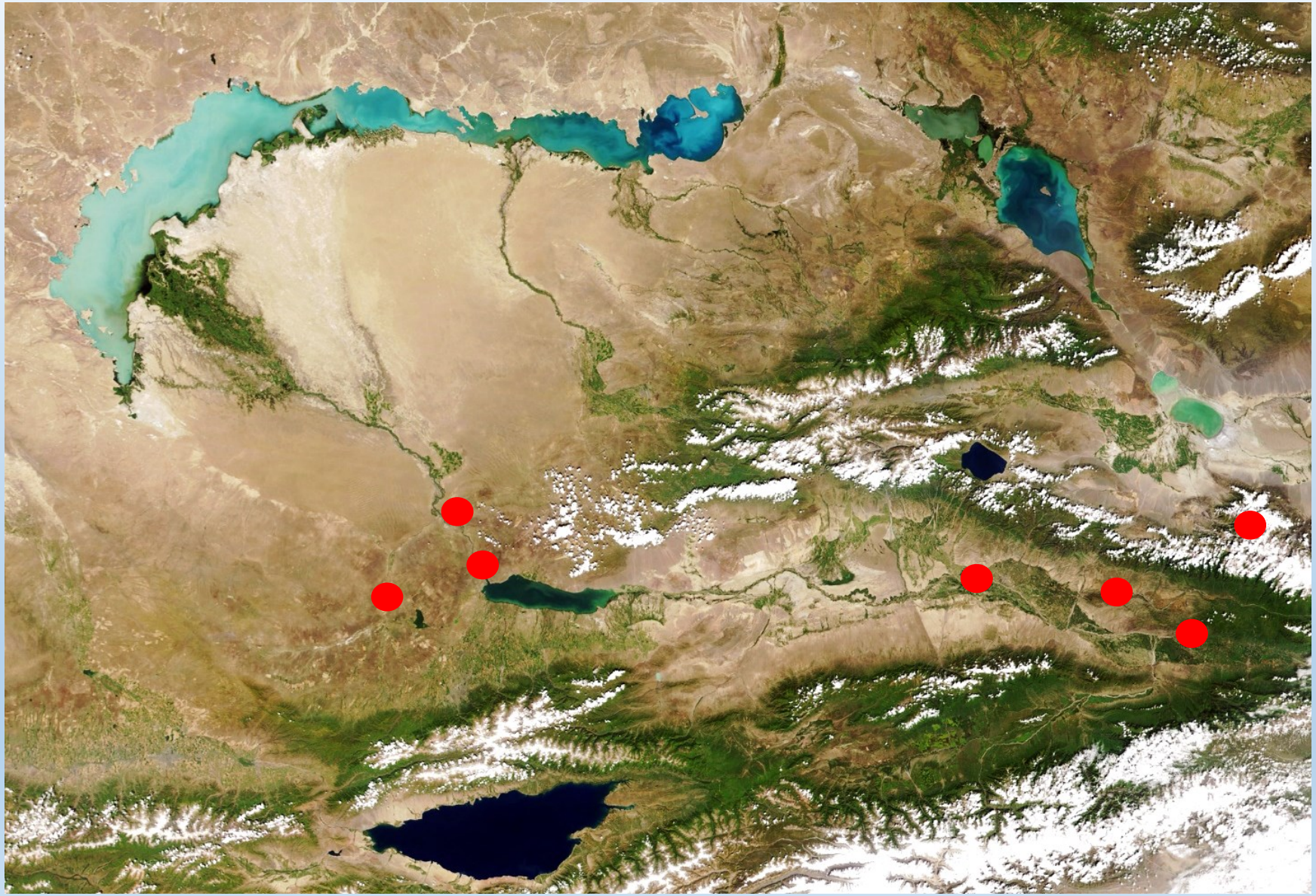
LWEF
On the ground

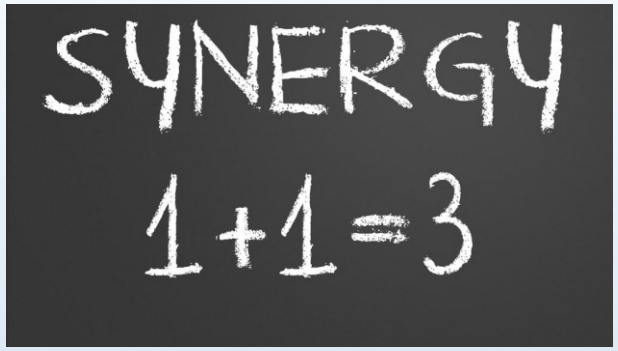


LWEF
On the ground

Everything is interacting with everything else over time and distance

1,000 km





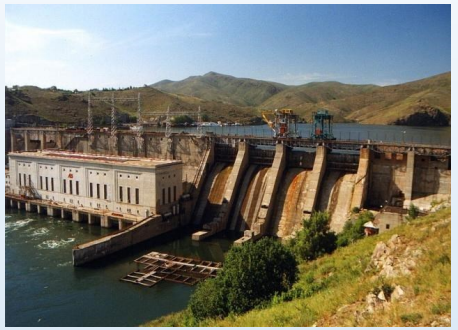
Over Time

Over space

Overlooked

Food from fish/cattle

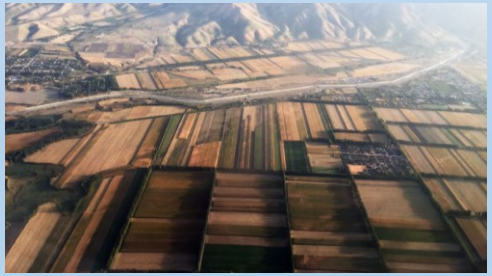
Hydroelectric energy



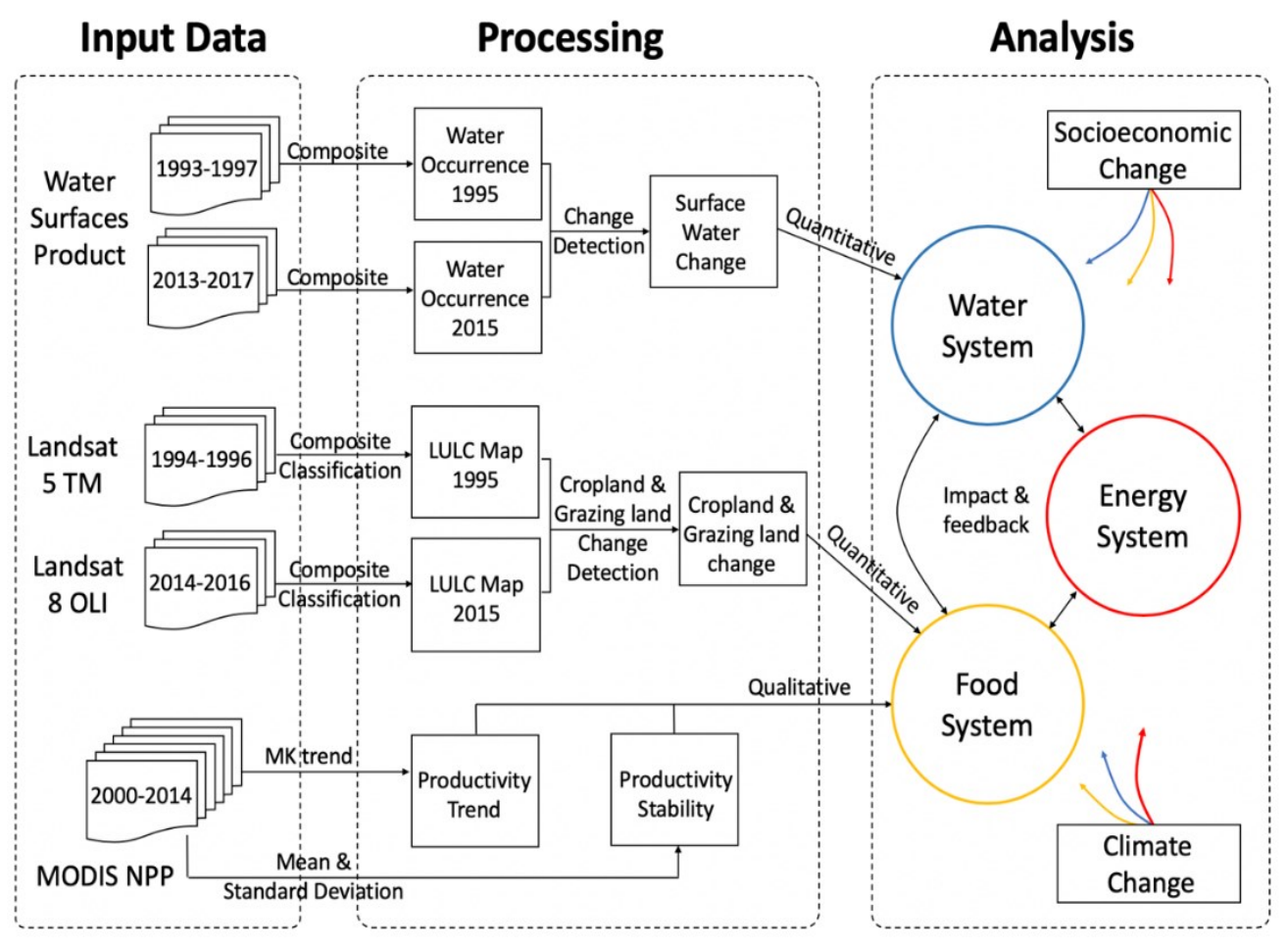
Water

Food from crops

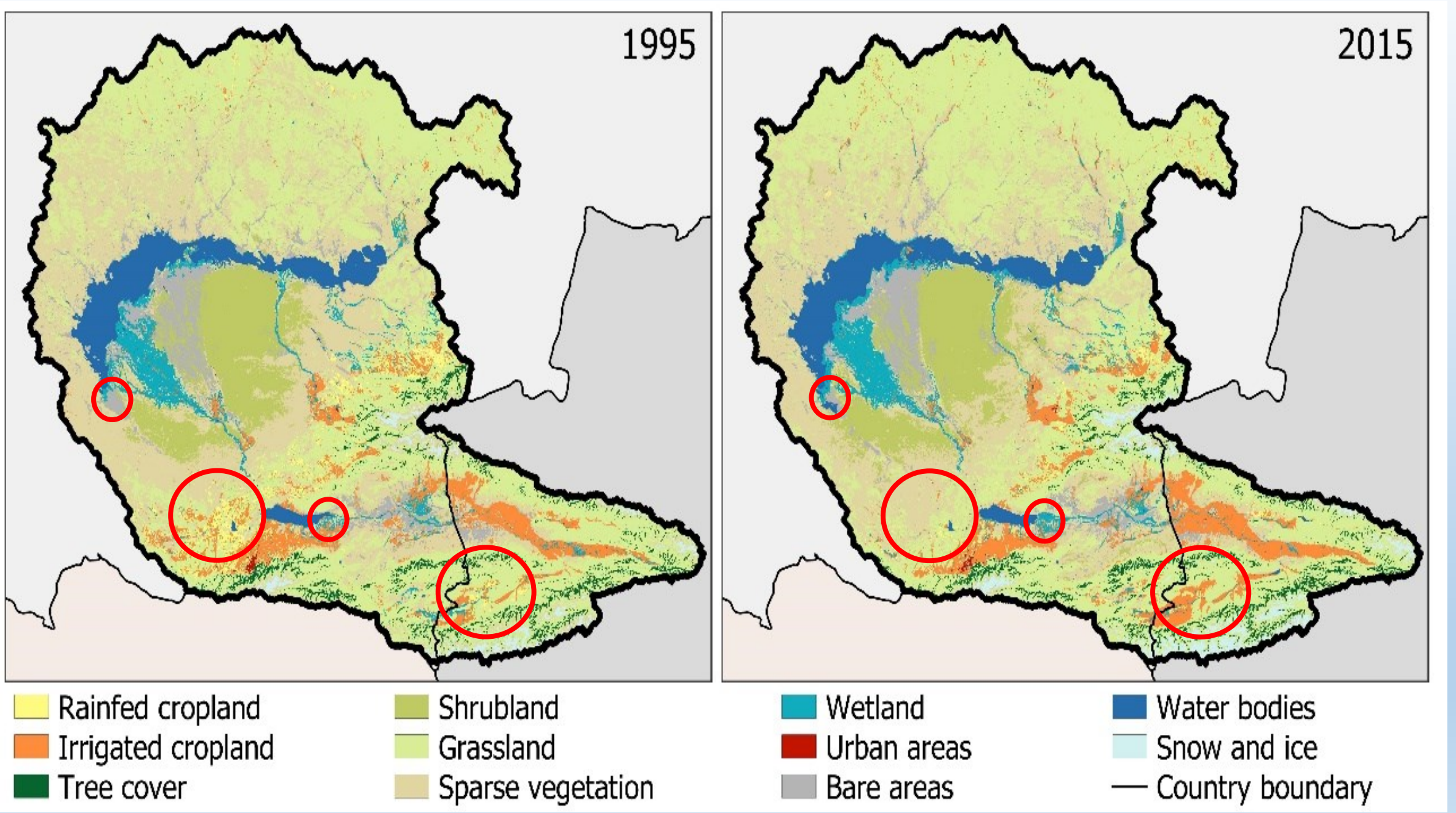
Food from animals



Land cover/land use change, 1995-2015

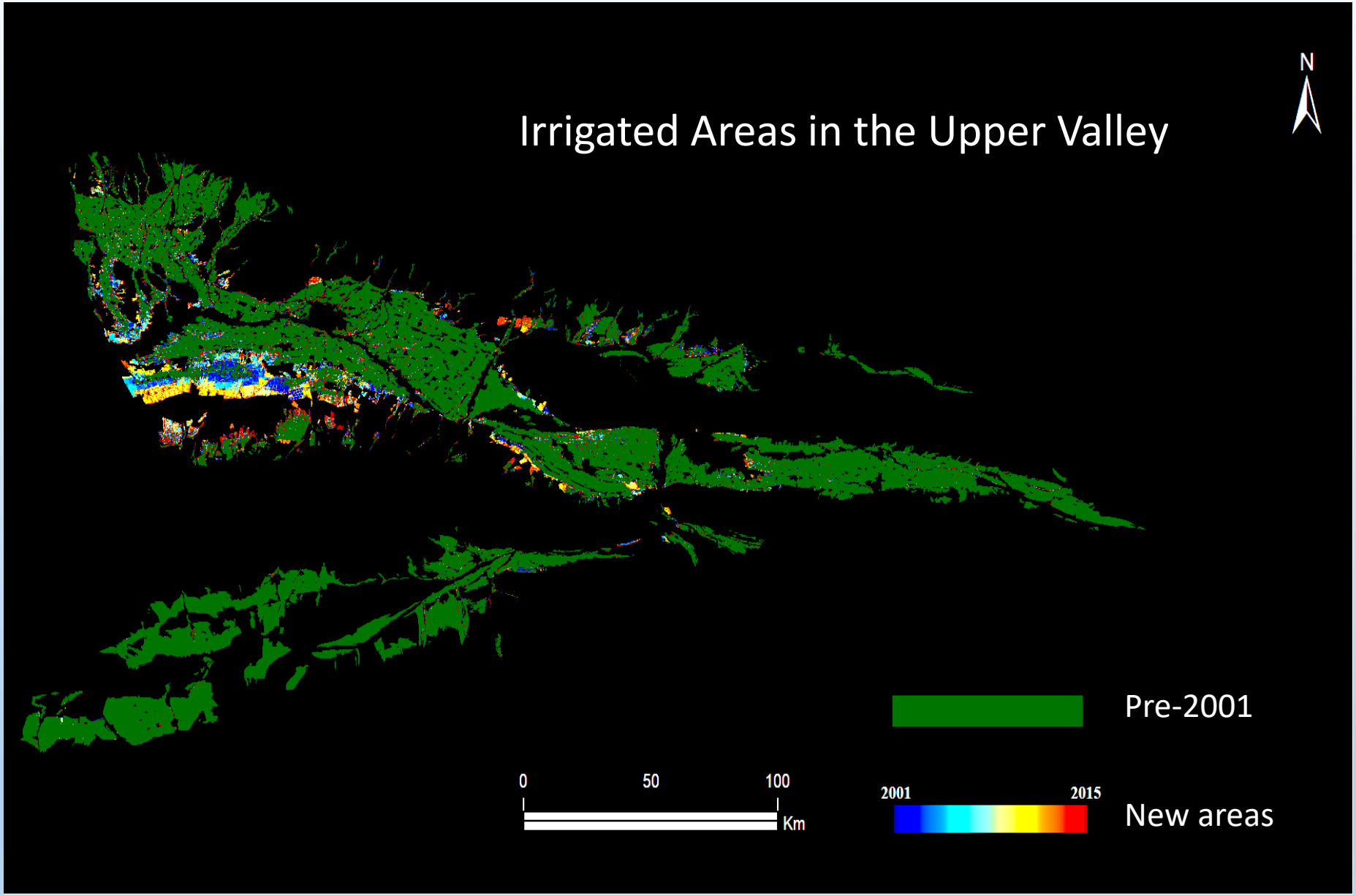


--Remote Sensing Work: J. Qi, S. Tao, S. Pueppke, T. Espolov, M. Beksultanov, X. Chen, X. Cai, submitted for publication


1995
2015
Rainfed cropland
Irrigated cropland
Tree cover
Shrubland
Grassland
Sparse vegetation
Wetland
Urban areas
Bare areas
Water bodies
Snow and ice
Country boundary

Tradeoff between grasslands and irrigated cropland but only in the upper valley

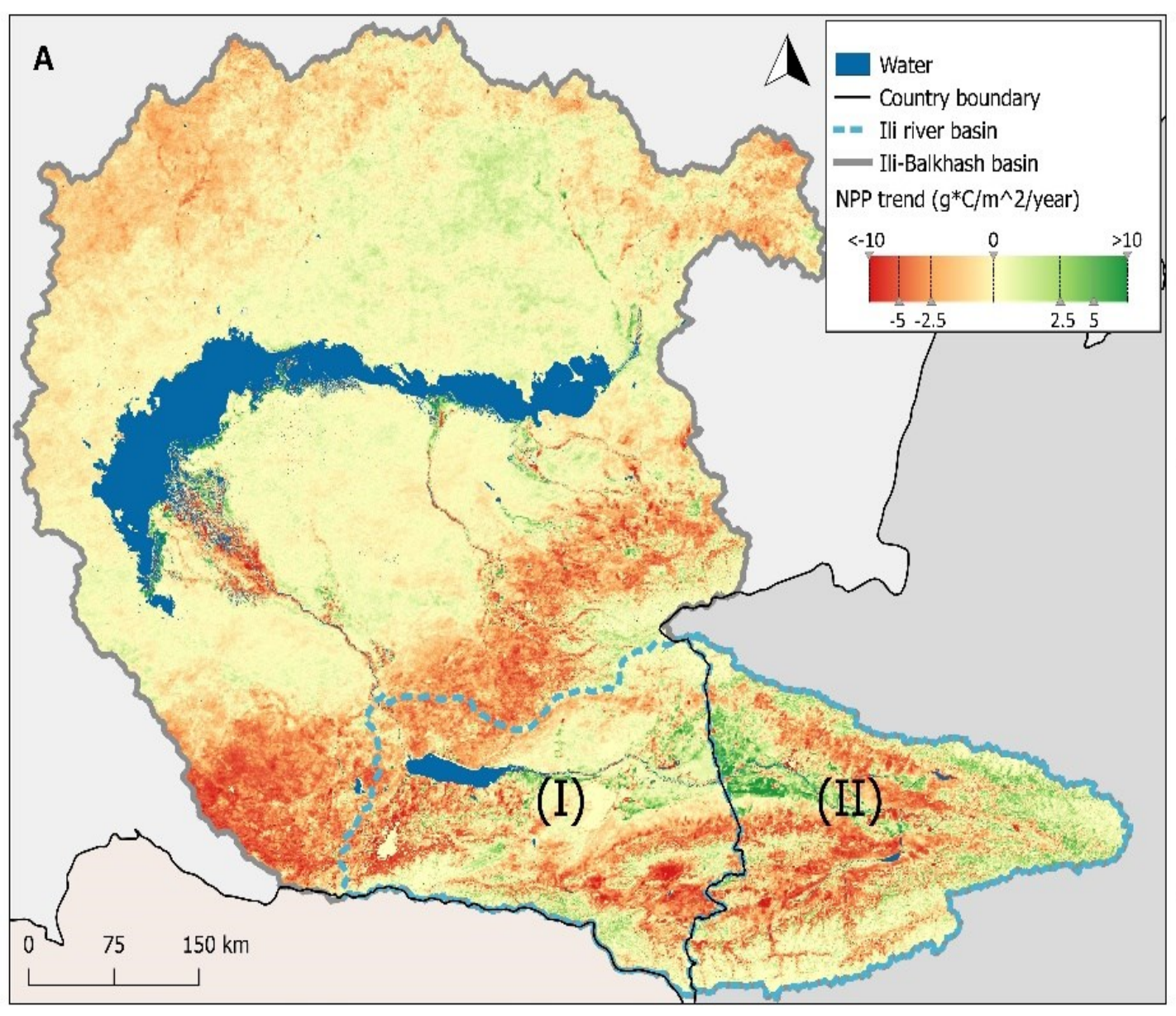
Land Use & Land Cover	Percentage of Land Use and Land Cover					
	Entire Basin		Chinese Portion		Kazakhstan Portion	
	1995	2015	1995	2015	1995	2015
Rainfed cropland	0.7	0.6	0.3	0.8	0.8	0.6
Irrigated cropland	2.8	3.2	10.2*	13.1*	1.6*	1.6*
Tree cover	1.6	1.7	6.1	6.5	0.9	0.9
Grazing land	82.4	81.8	73.9	70.6	83.8	83.5
Wetland	2.1	2.9	1.8	2	2.1	3
Urban	0.2	0.3	0.1	0.6	0.2	0.3
Bare areas	4.3	3.6	1.8	0.6	4.7	4.1
Water bodies	4.6	4.7	0.2	0.4	5.3	5.4
Snow and ice	1.3	1.2	5.6	5.4	0.6	0.6



--Pueppke, Zhang and Nurtazin, 2018

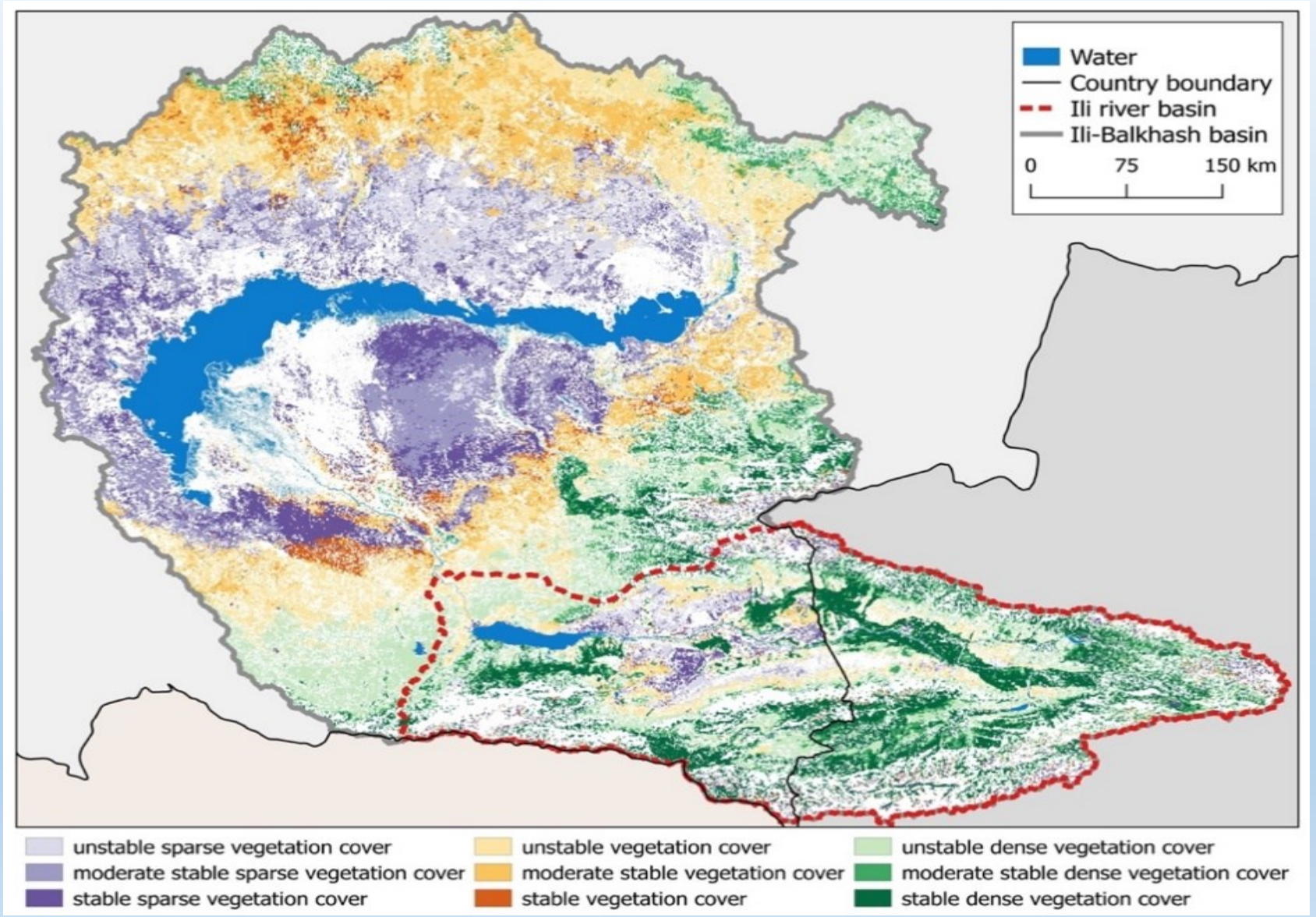
Location and Description	Dam Coordinates	Construction	Volume (million cubic m)
Ili River, Kazakhstan			
Kapchagai Reservoir in Almaty Oblast, near Kapchagai[1]	43°55’19”N,77°5’51”E	1969	18,300
Kash River, China[2]			
Reservoir in Nilka County, near Dunmazhazan	43°49’15”N,81°56’38”E	<1990	120-150
Zharyntaysky Reservoir in Nilka County, near Jilintai[3]	43°51’42”N,82°50’55”E	2004	650-800
Reservoir in Nilka County, near Jilintai	43°51’14”N,82°48’8”E	2009	25-30
Reservoir in Nilka County, near Dunmazhazan	43°50’11”N,82°1’11”E	2010	65-70
Tekes River, China[2]			
Kapchagaysky Reservoir in Tekes County, near Ji’ergalangxiang[4]	43°18’13”N,82°29’5”E	2005	1,650-1,800
Reservoir in Gongliu and Xinyuan Counties, near Toudaowancon	43°23’41”N,82°29’23”E	2009	35-26
Reservoir in Tekes County, near Kuokesuxiang	43°6’39”N,81°53’20”E	2012	55-60
Reservoir in Zhaosu County, near Kaxiajia’erxiang	42°45’37”N,81°3’49”E	2014	

NPP trends are divergent



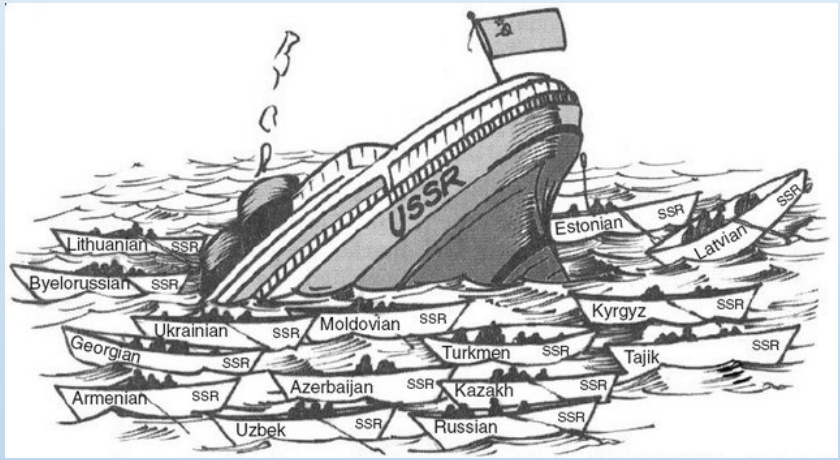
Density of vegetation cover declines generally from east to west

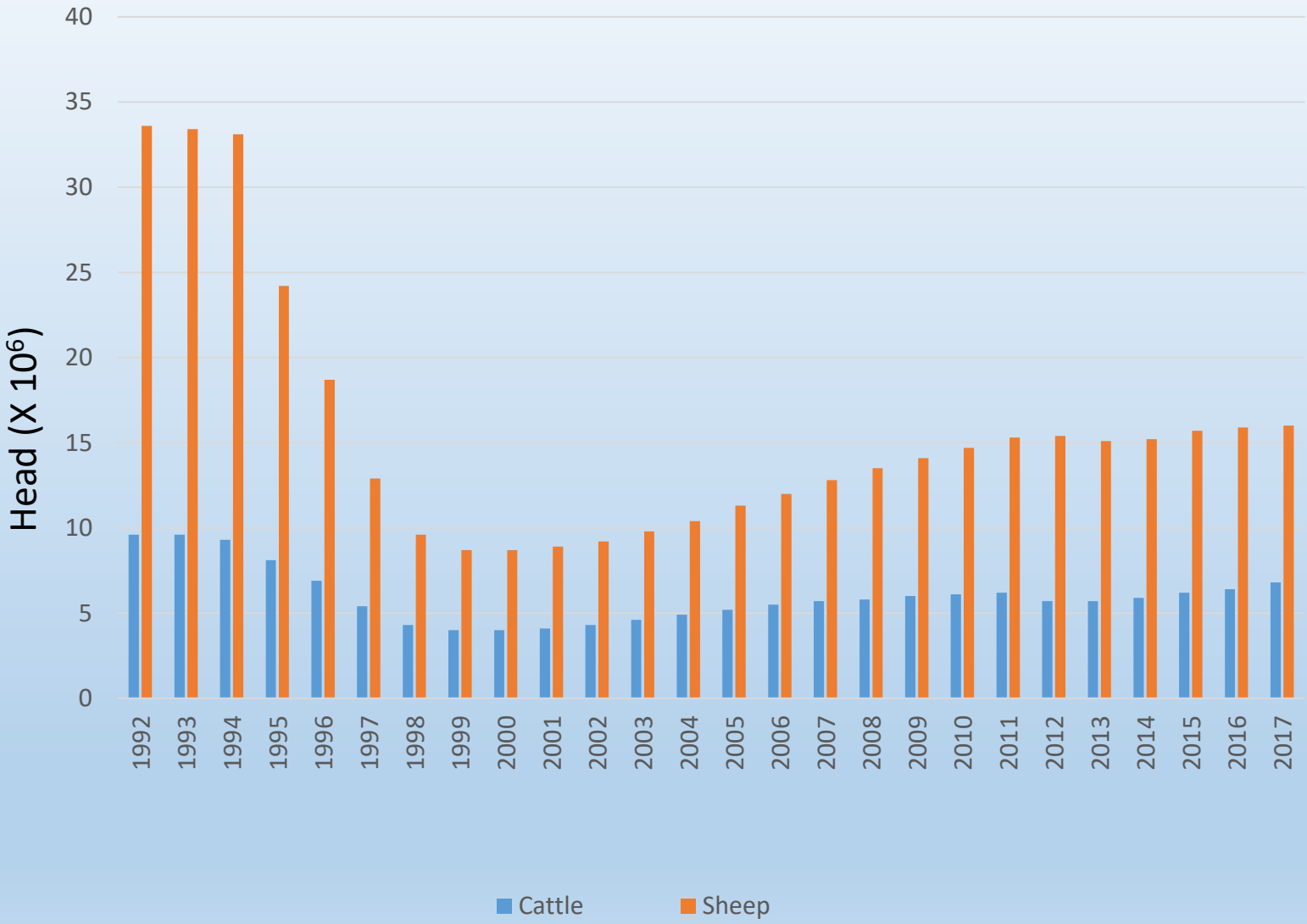
Stable dense vegetation cover mostly in the east



What's the future of land, water, energy and food systems in the Ili Balkhash basin?

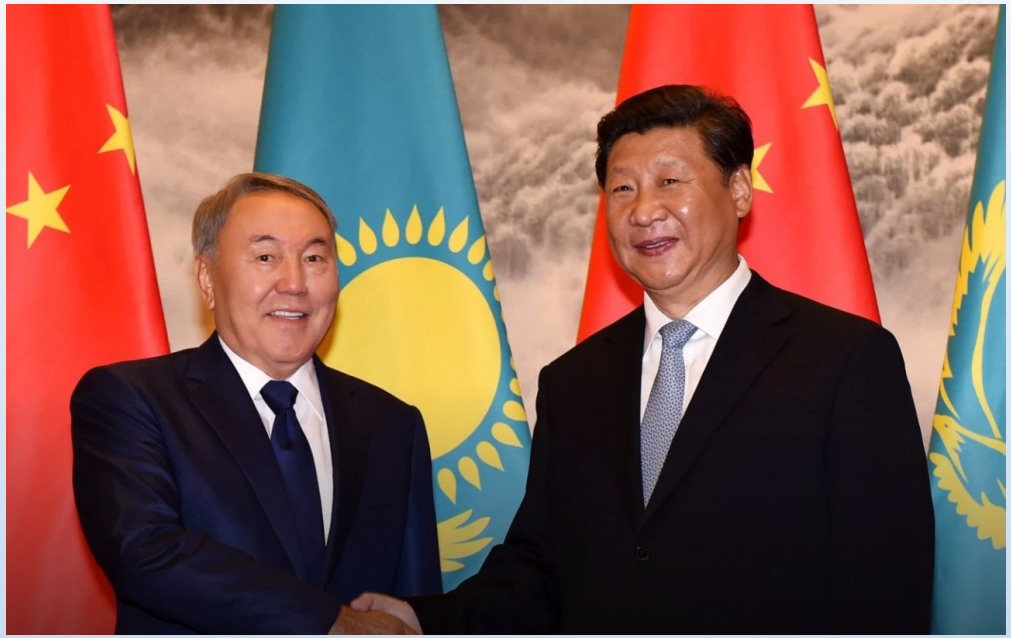
20th century geopolitical developments: cattle and sheep in KZ





--Source: FAOSTAT

21st Century 西部大開發



Transportation infrastructure stimulating agricultural production and trade

BELT, ROAD HELPS FRUIT EXPORTS THRIVE

Business expands rapidly in western provinces

By CHEN YINGQUN
chenyingqun@chinadaily.com.cn

indepth

Dozens of trucks with Kazakhstan license plates line up as Chinese workers load them with tangerines, apples and other fruit and vegetables.

The next morning, this produce will appear in supermarkets before reaching dinner tables across Central Asia.

This is an everyday scene at Horgos Jinyi International Trade Co in Horgos, a border city in the Xinjiang Uygur autonomous region.

More than half of Xinjiang's fruit and vegetables are exported via Horgos' port.

Yu Chengzhong, chairman of the company, which is the biggest agricultural products trading business in Xinjiang, said overseas demand for fruit and vegetables, especially in Central Asia and Europe, has grown rapidly in recent years, mainly due to the China-proposed Belt and Road Initiative.

In the first nine months of this year, the city's port handled 98,800 metric tons of fruit and vegetables worth 945 million yuan ($136 million), an increase in volume of 50 percent and a rise in value of 70 percent year-on-year, according to Horgos Customs. Of this, 97,000 tons consisted of fruit, including grapes, apples and peaches.

See Fruit, page 2

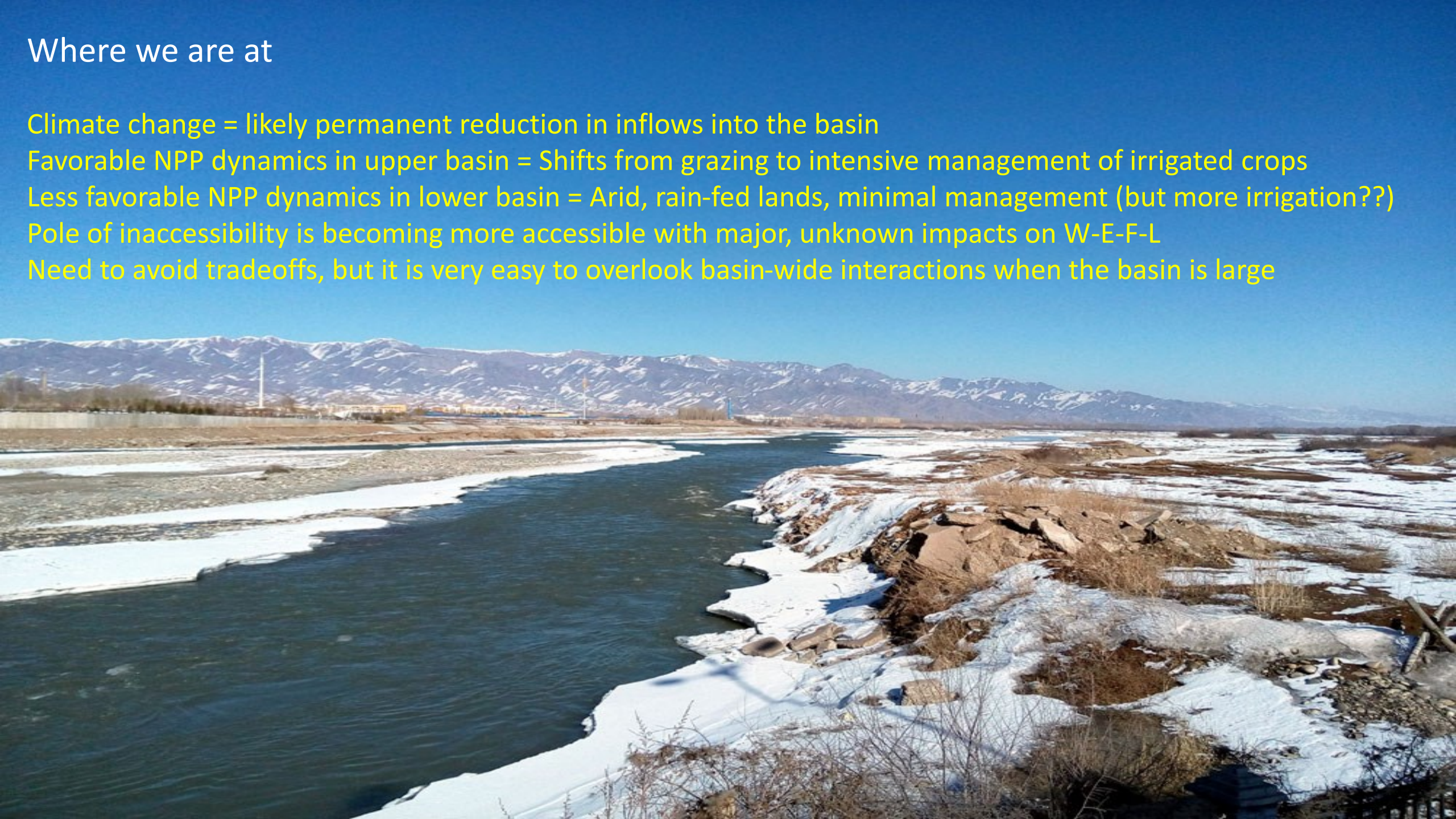
--China Daily, 27 Nov 2018

Since 2016, KZ

- Four large new cattle production and slaughterhouse operations
- USDA commits to help KZ double annual sheep and cattle production
- Tyson Foods: 25 -- 37 / 12
- Land, water, energy, food impacts on KZ??

Where we are at

Climate change = likely permanent reduction in inflows into the basin
Favorable NPP dynamics in upper basin = Shifts from grazing to intensive management of irrigated crops
Less favorable NPP dynamics in lower basin = Arid, rain-fed lands, minimal management (but more irrigation??)
Pole of inaccessibility is becoming more accessible with major, unknown impacts on W-E-F-L
Need to avoid tradeoffs, but it is very easy to overlook basin-wide interactions when the basin is large



Systems approaches are needed

- W experts care about understanding hydrology, stream flows, and melting glaciers
- E experts want to maximize hydroelectric power production
- F experts care about productivity per ha, irrigation efficiency, agricultural technology
- L experts want to prevent erosion and preserve soil health

- Everything depends on everything else in ecosystems, especially arid ones
- No single scientific perspective provides all the answers
- Interrelationships pose the most difficult challenges
- The Ili-Balkhash basin is an excellent test bed to examine these interrelationships