Comparison of Coal Mining Reclamation Issues in the United States/Wyoming vs. Underground Coal Mining in Eastern China

Brenda K. Schladweiler

Wyoming Mining Association Annual Meeting

June 7, 2019

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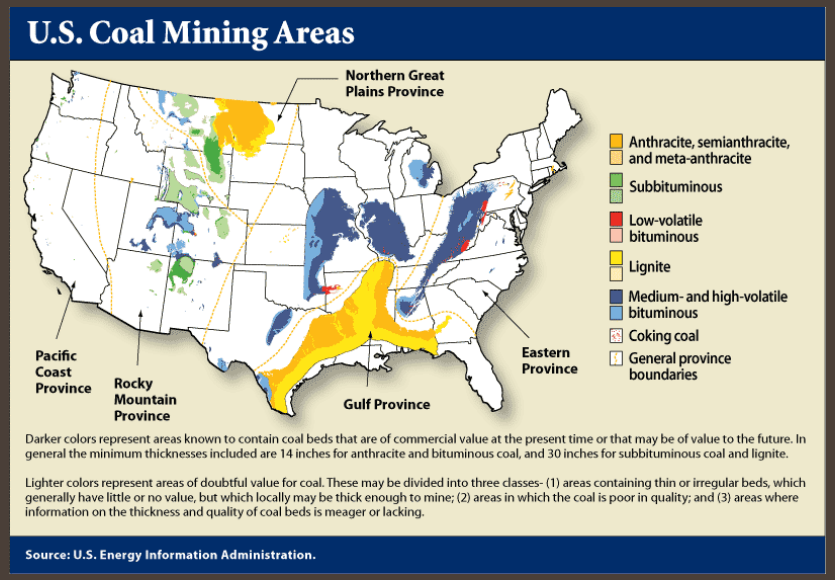
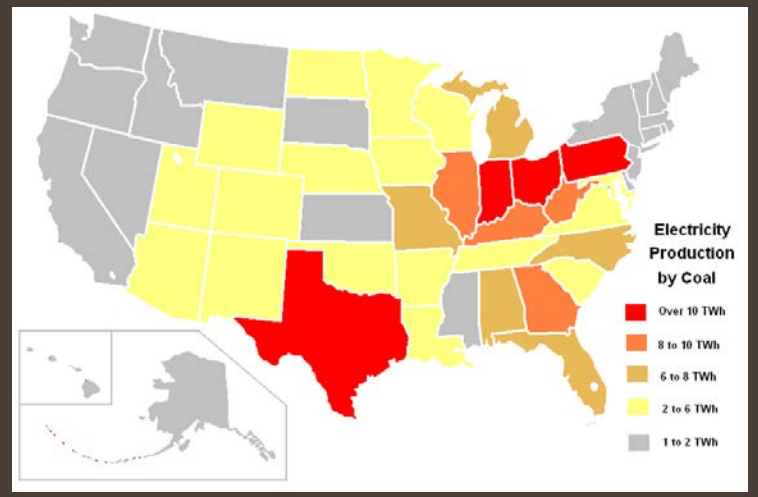
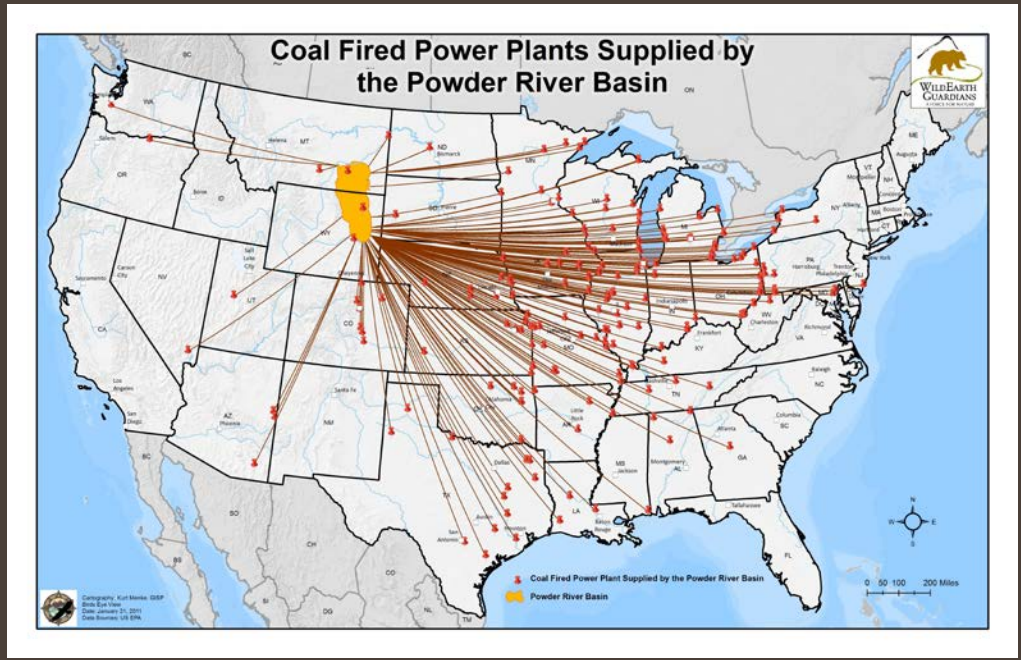
Review of Coal Mining in the United States and Wyoming

Coal Mining in the United States







Wyoming Coal Mining Areas

- Coal mining is historical in Wyoming
  - Use of coal to fire steam engines on railroads, especially along the Union Pacific line in southern Wyoming
- The oil embargo of the early 1970's and need for low sulfur coal to meet environmental regulations led to a large increase of coal mining in the western U.S.
- Coal mining is scattered throughout Wyoming but current mining is concentrated in the southwestern and northeastern corners
  - Much of the post-law coal mining in the south-central part of the state has been closed and reclaimed
- Different challenges based on location within the state
  - Example is shrub establishment

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Wyoming was ahead of federal regulations

- Open Cut Mining Law of 1969
- Environmental Quality Act of 1973
- Surface Coal Mining and Reclamation Act or SMCRA passed on the federal level in 1977.
  - SMCRA provided the overall framework for coal resource development, as well as environmental protection.
  - Wyoming obtained letter of conditional primacy in November 1980
- Wyoming's regulations were divided into "coal" and "con-coal".
- Abandoned Mine Land Program within WDEQ-LQD established in 1983.

SMCRA WAS 40 YEARS OLD IN 2017

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Reclamation 40 Years Ago

- Was considered an "add-on", not a field
- Much was agricultural based…just had to get something to grow to stabilize a site
  - Desired vegetation types vary based on geographic region
    - West – Rangeland/shrubland
    - Midwest – Prime Farmland
    - East - Forests

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Surface Coal Mining in Wyoming …what has changed in 40 years since the passage of SMCRA?

LOTS!!!!

- Seed mixes
- Topography and topsoil replacement
- Shrub establishment
- Weed control
- Seeding equipment
- Wildlife considerations
- Grazing
- Use of GIS
- Reclamation amendments

What haven't we learned yet under SMCRA?

- Regulations are written with broad brush implications but implemented on a site specific or region basis
  - Western vs. Eastern U.S. differences
  - Need to be flexible
- Wise use of a limited seed resource for shrubs and forbs
  - Strategic placement
- Stability vs. diversity – how can the two be balanced

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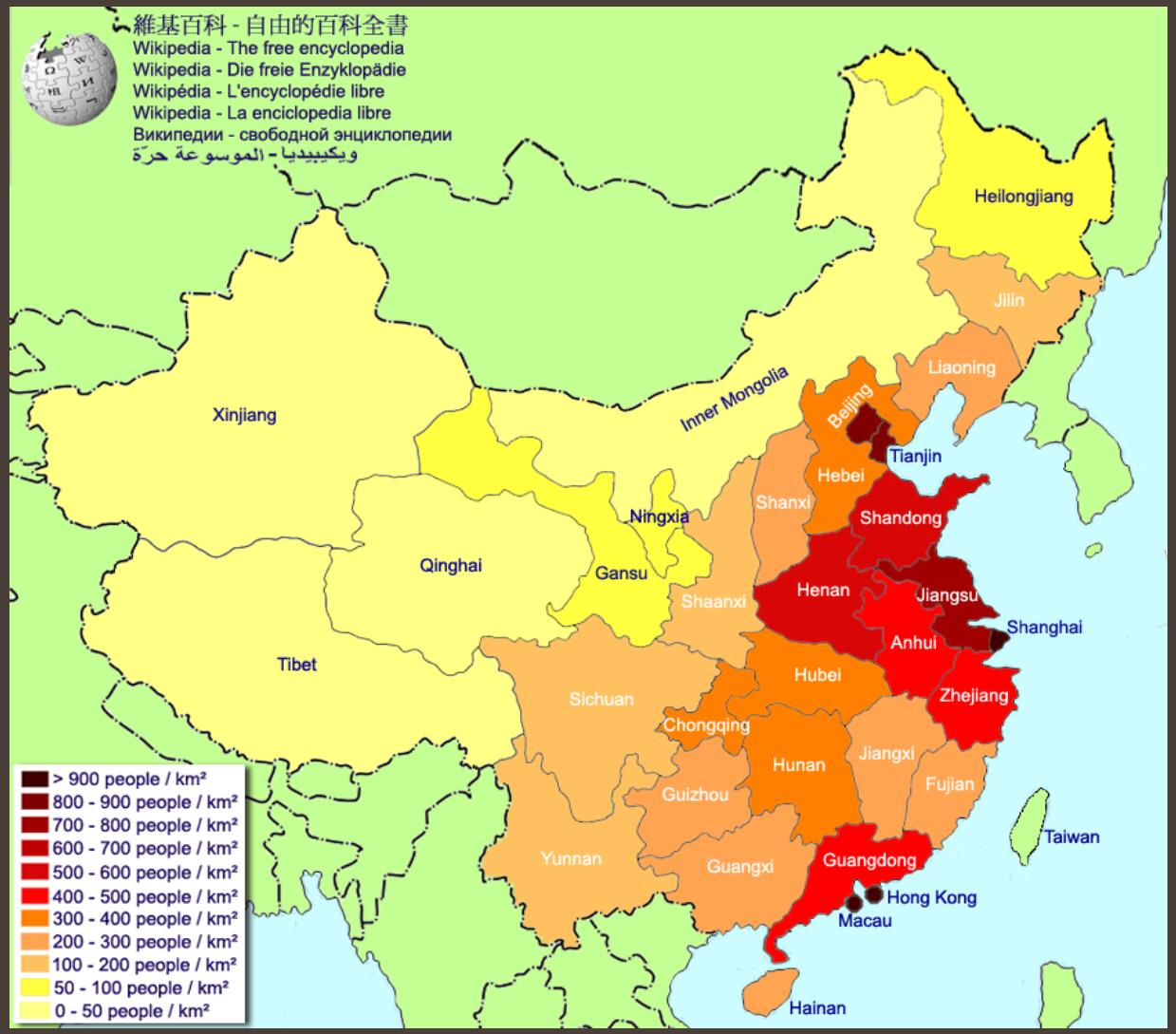
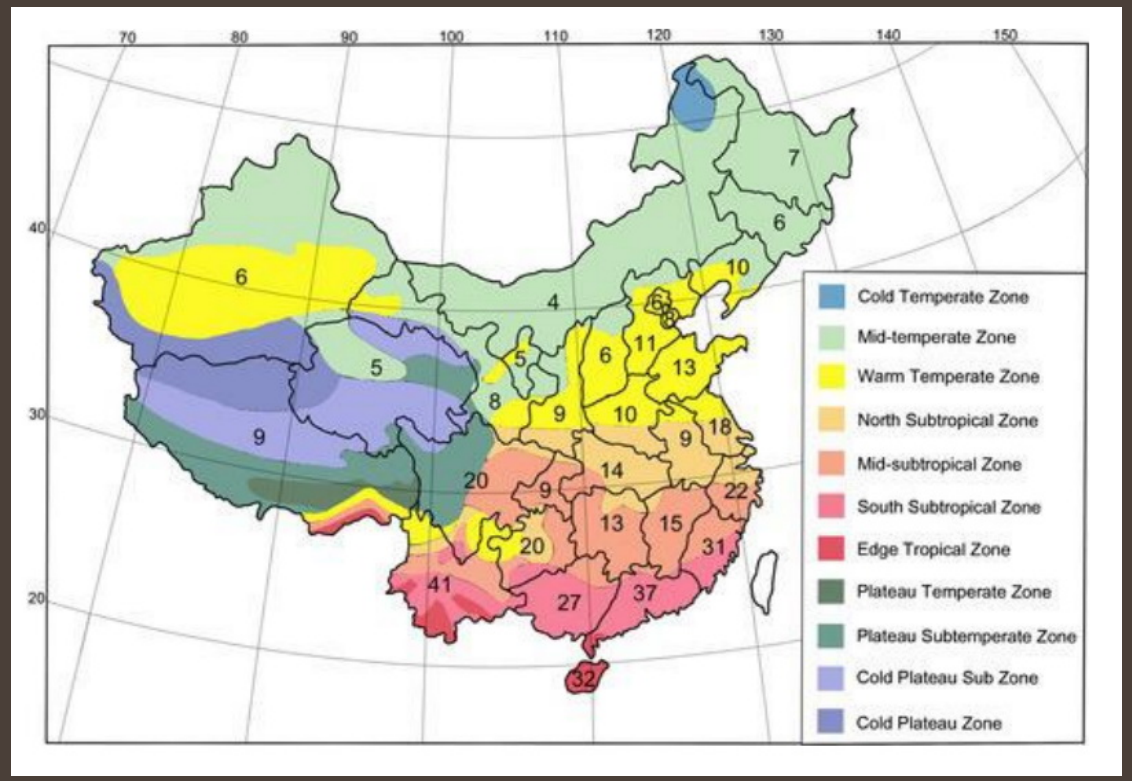
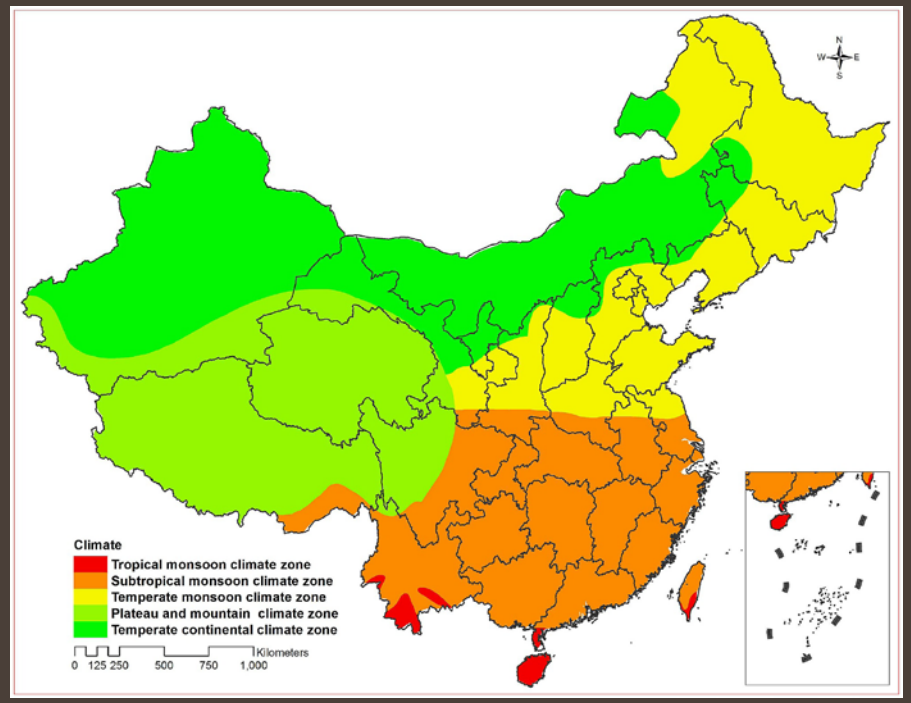
China Industrial Development

Population Density of China

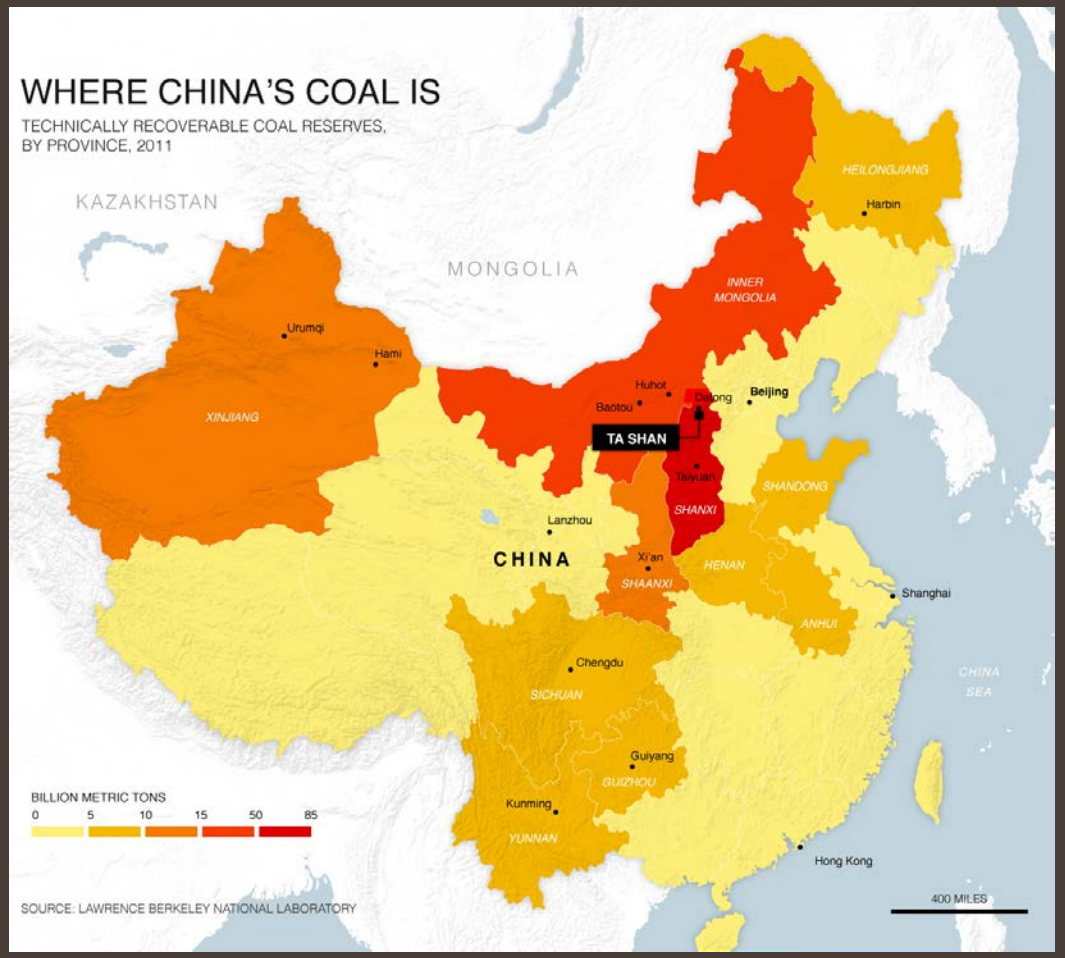


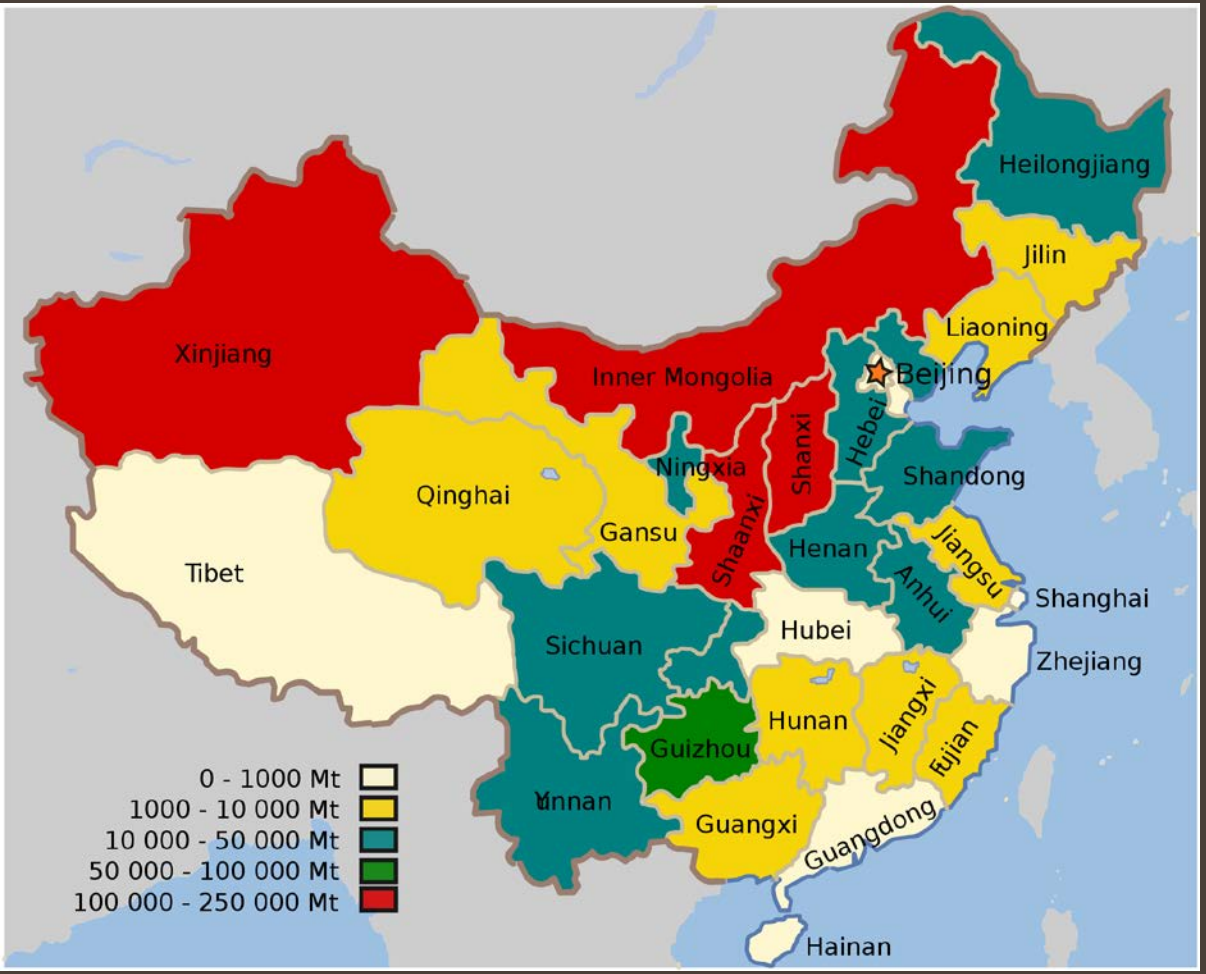




CHINA HAS WET AND ARID REGIONS

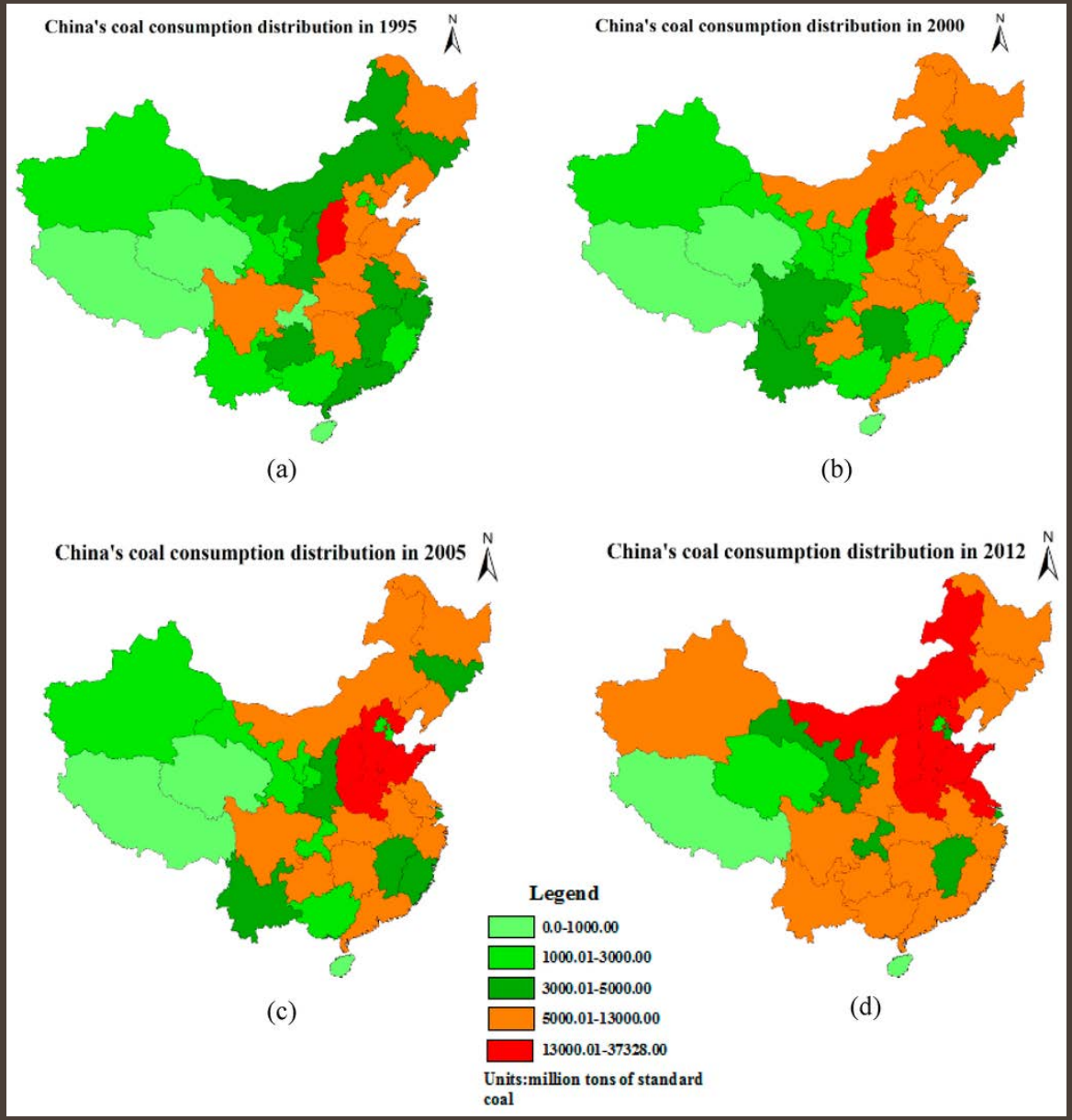
THREE MAIN RIVERS FLOW EAST TO WEST IN EASTERN CHINA



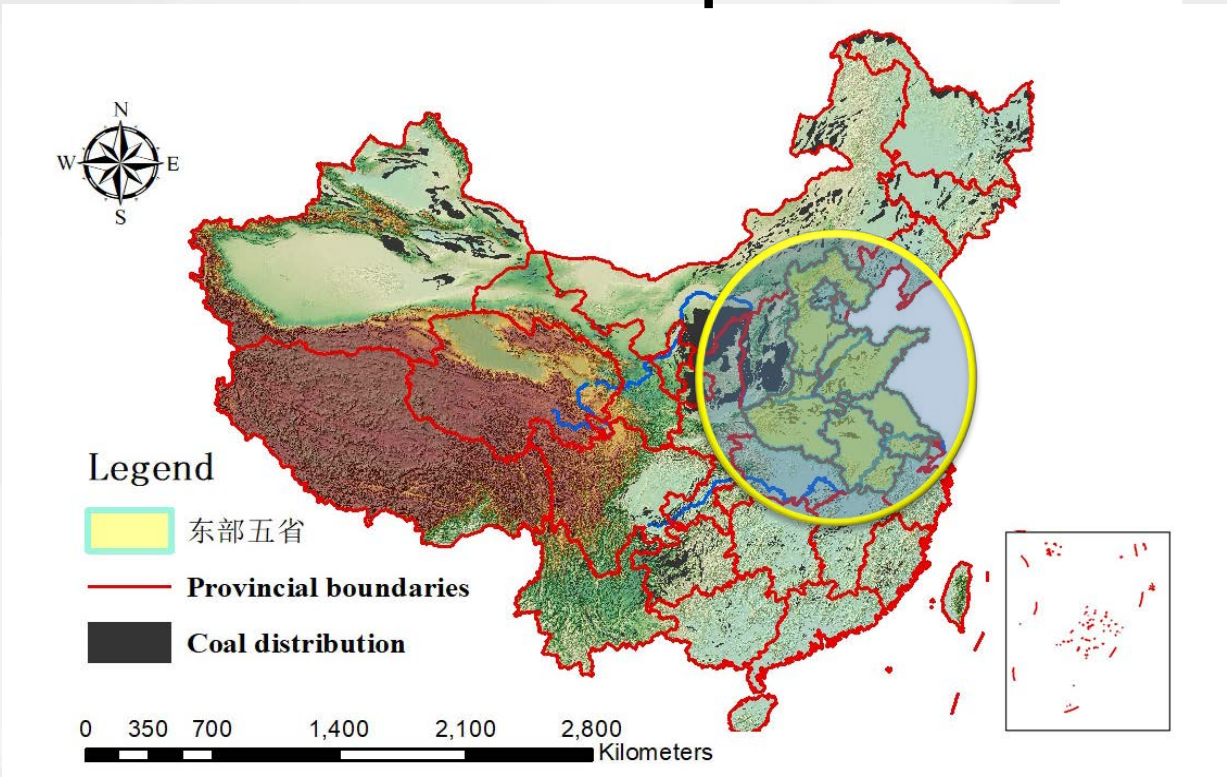


CHINA'S COAL RESOURCES

How has China's coal consumption distribution changed over time

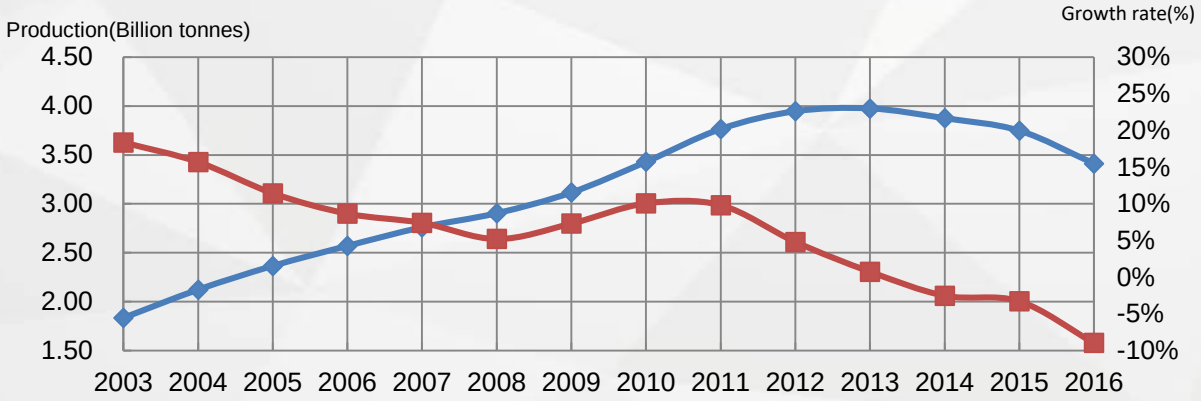


Coal production in China



China's coal production was 3.45 billion tons in 2017, 45.6% of global coal production

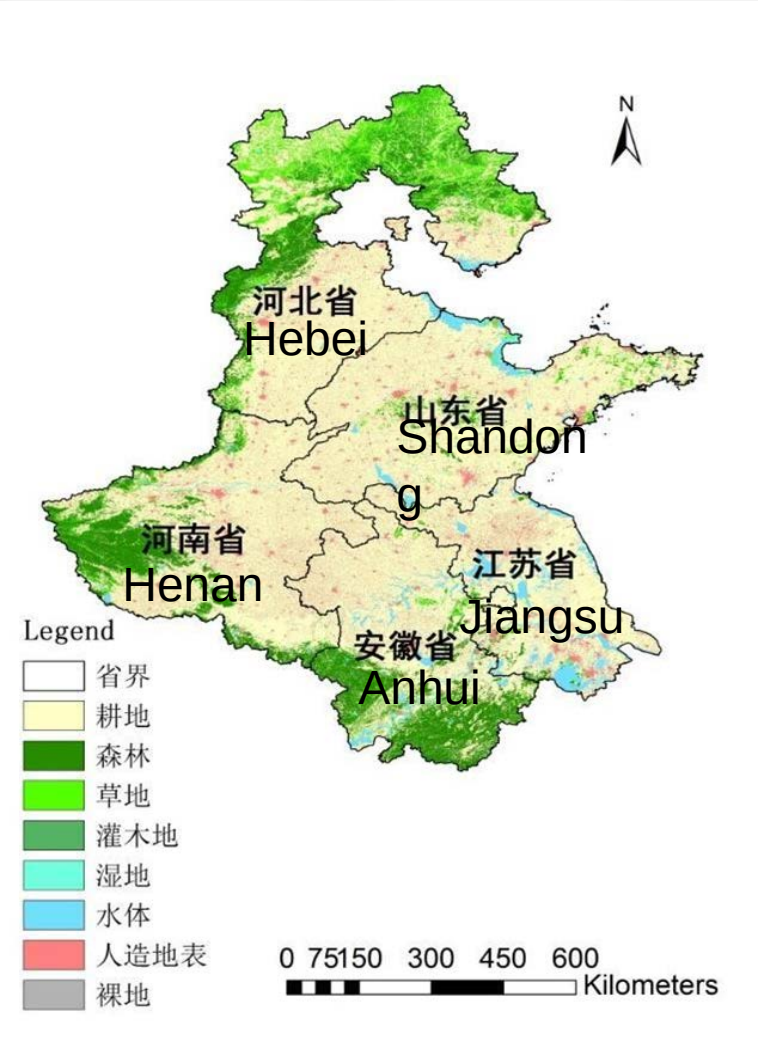
85%-90% comes from underground mining, coal mining induced land subsidence increased 45,000 hectares/Year

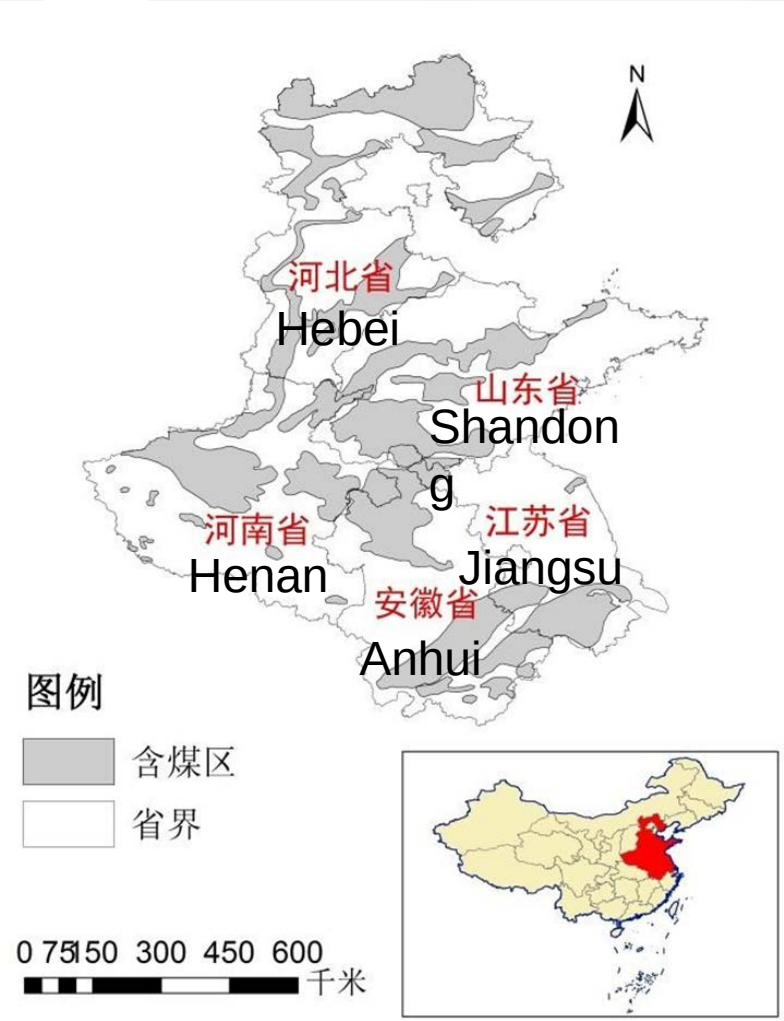


Coal yield and growth rate from 2003 to 2016 in China

W. Xiao, Z. Hu, J. Chen, ASMR 2019

Coal mining in China

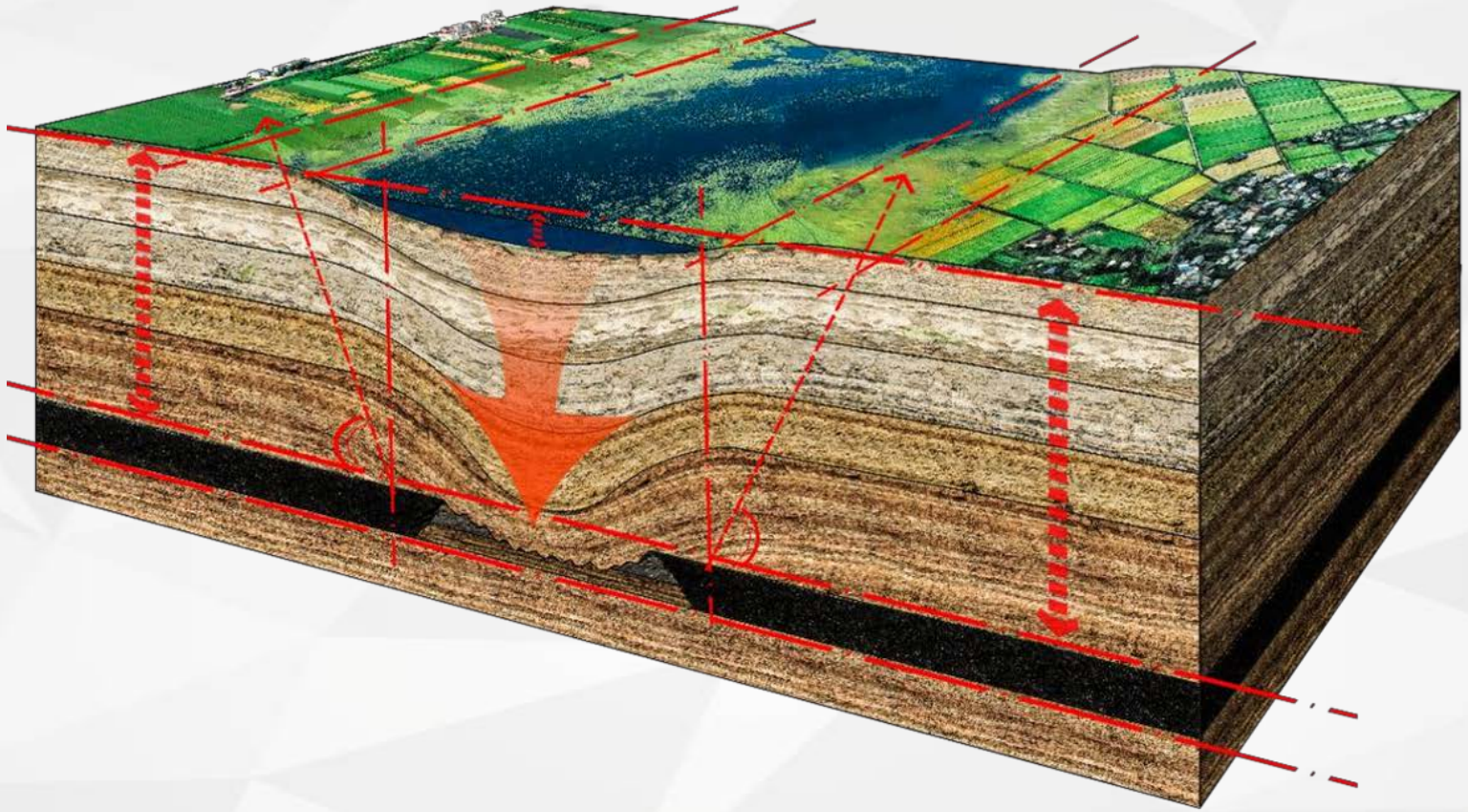




The five eastern provinces are not only important grain bases in China, but also occupy an important role in China's coal mining and utilization.

W. Xiao, Z. Hu, J. Chen, ASMR 2019

General Issues



Multi-coal mining, superimposed settlement, large subsidence area

Ecosystem transition

Soil erosion, deterioration of water quality, surface water system disorder

Prominent conflict between man and land

W. Xiao, Z. Hu, J. Chen, ASMR 2019

Coal mining in China

The mining areas in the five eastern provinces of China (Henan, Hebei, Shandong, Anhui, Jiangsu) are mostly high ground-water level mining areas. Due to the high ground-water level, the damage of cultivated land caused by coal mining subsidence is particularly serious.

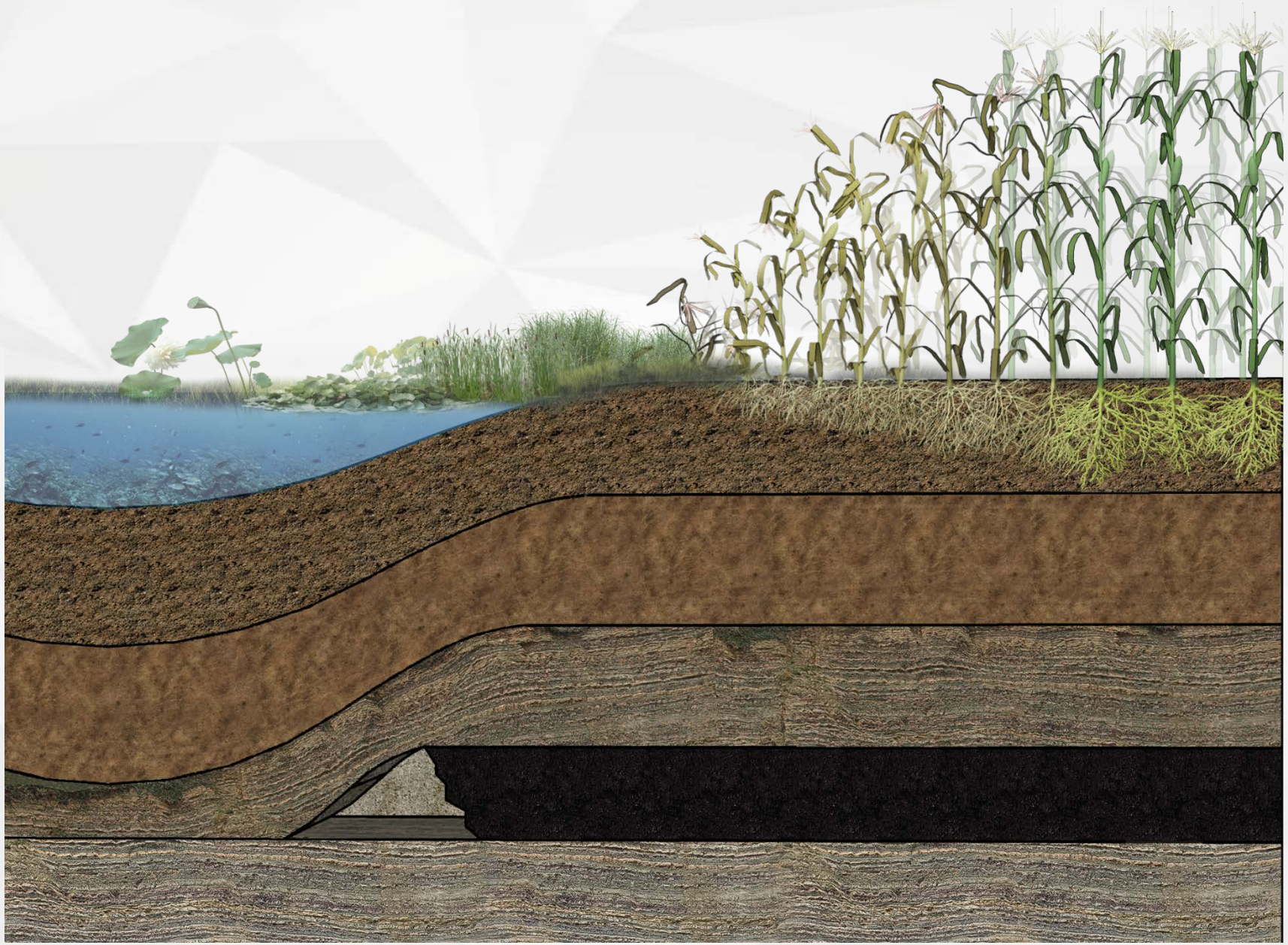
Cultivated land damage

Building damage

Ponding area

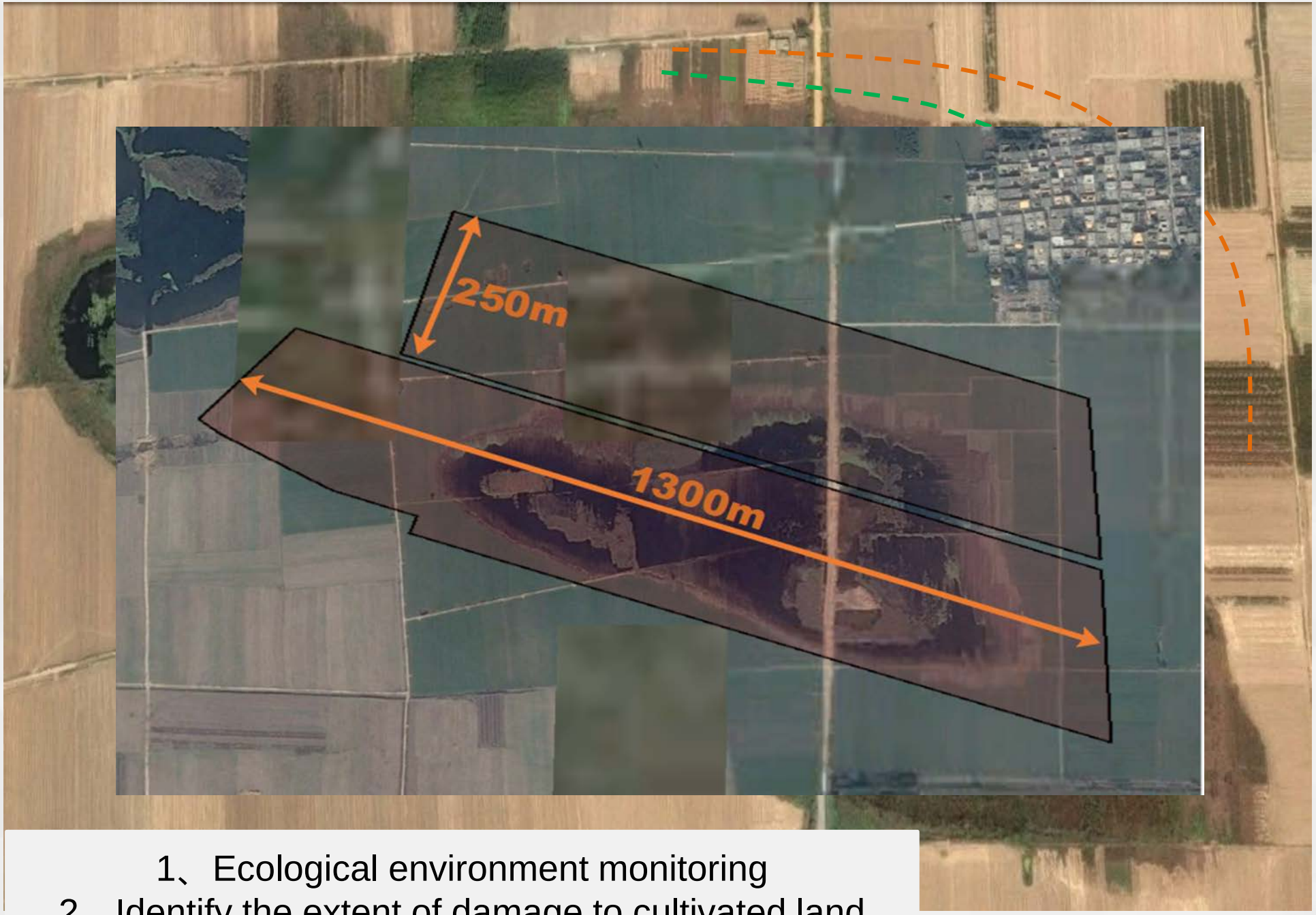
Road damage

W. Xiao, Z. Hu, J. Chen, ASMR 2019



W. Xiao, Z. Hu, J
Chen, ASMR 20

W. Xiao, Z. Hu
Chen, ASMR 2



1、Ecological environment monitoring
2、Identify the extent of damage to cultivated land

W. Xiao, Z. H
Chen, ASMR

March, 2013 March, 2014 September, 2016 February, 2017 September, 2017

W. Xiao, Z. H
Chen, ASMR

Subsidence Occurs Relatively Rapidly

- 80-90% in the first 3 to 6 months after mining
- Remaining 10-20% over the next two years

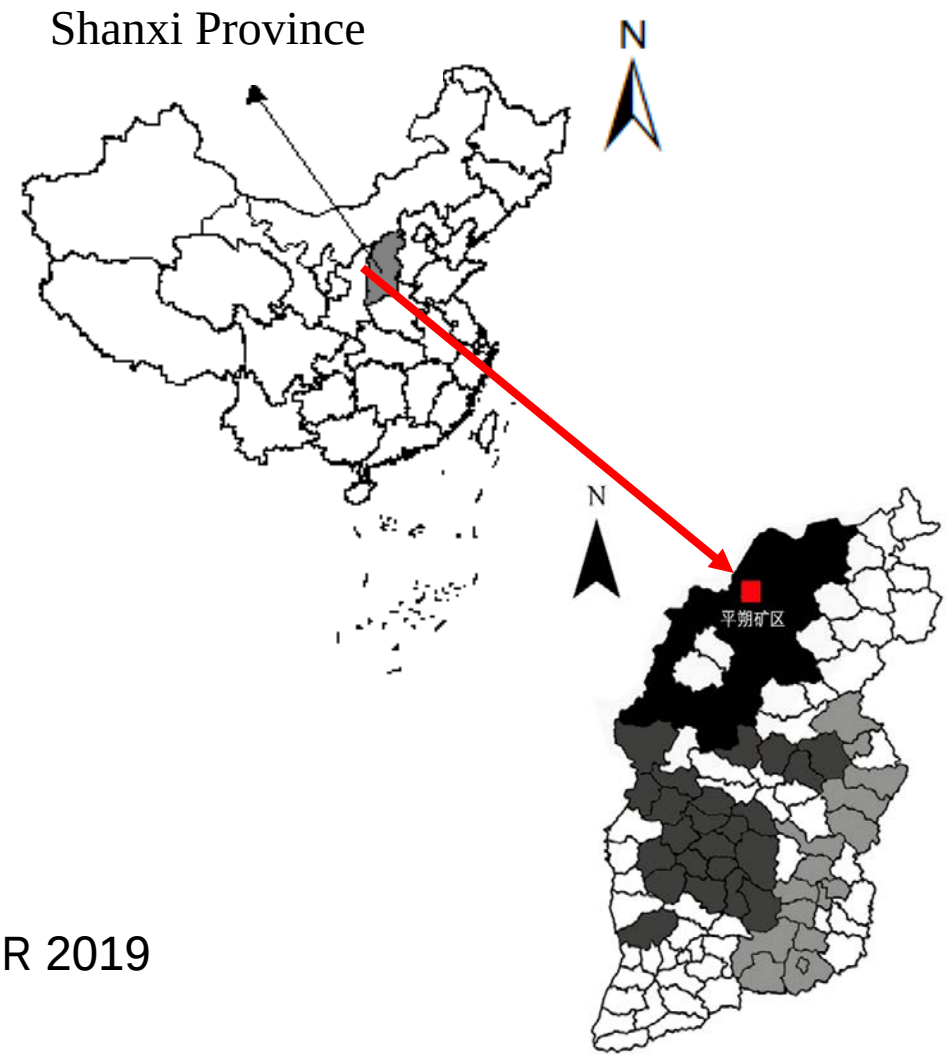
Background

National Energy Administration

Notice

No. 2 2019

According to China National Energy Administration's data on China's coal mine production capacity, by the end of December 2018, the state's new coal mine capacity was mainly concentrated in Shanxi, with an accumulated total of 180.02 million tons/year, of which opencast coal mine production is an important part.



Shu-fei Wang, Y. Cao, Z. Bai, ASMR 2019

Background

The Important Role and Significance of Pingshuo Opencast Coal Mine

Xiaoping Deng and Armand Hammer

Development of Pingshuo coal mining area from 1984 to 2016 (point-line-area-net)

Antaibao Opencast Coal Mine in Pingshuo, Shanxi Province, is the largest open-pit coal mine in China, which was constructed in 1984 by the cooperation between China and America. It is deeply imprinted with China's reform and opening, and is a milestone in the development history of China's coal industry.

Currently, Pingshuo coal mining area is the largest one that combined opencast mines with underground mines in China. The land and environment damage present the trend of point-line-area-net from 1984 to 2016.

Background

New Era, New Requirements

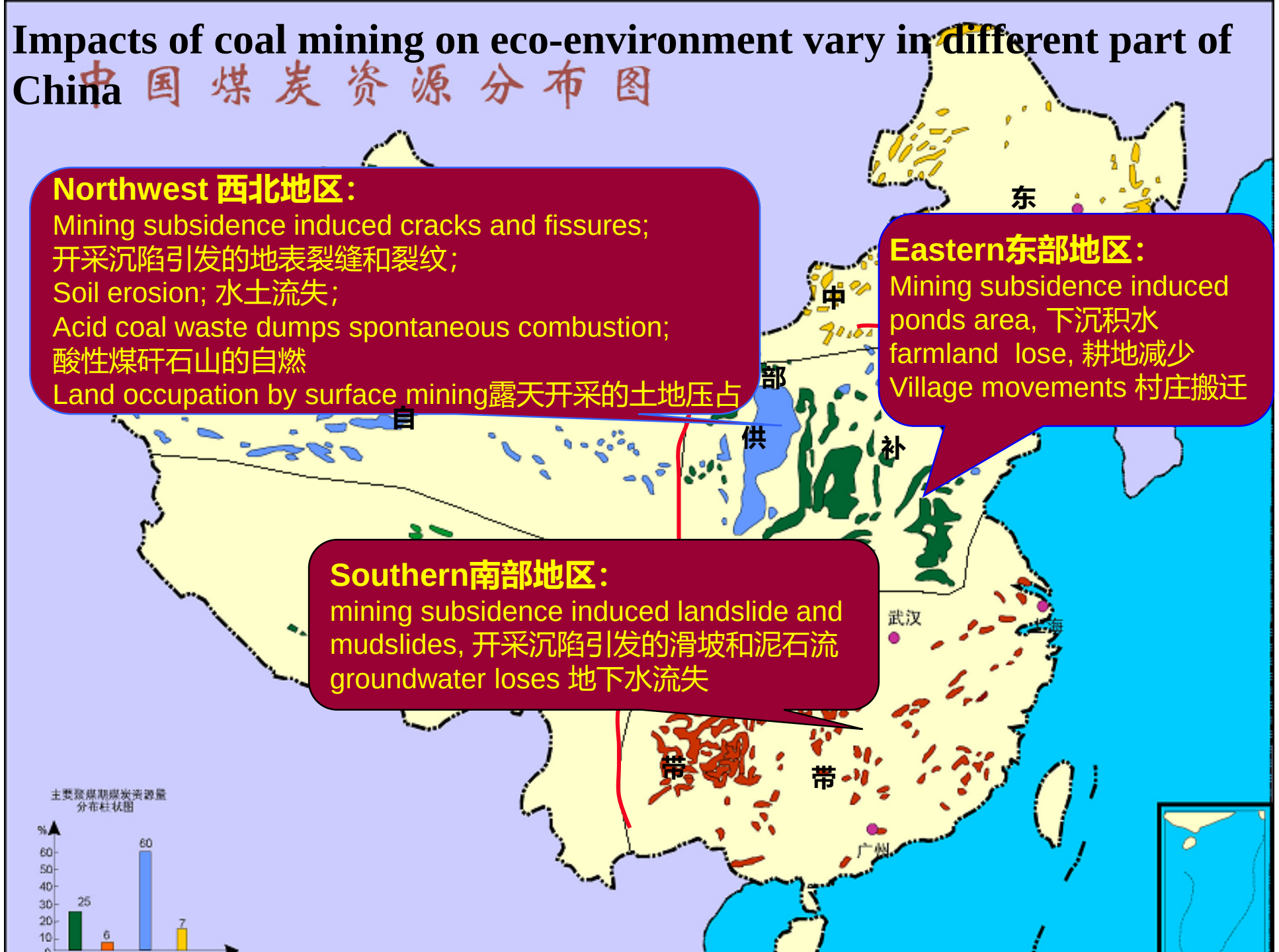
Lucid waters and lush mountains are invaluable assets.

GreenMine

Shu-fei Wang, Y. Cao, Z. Bai, ASMR 2019

In the new era, opencast coal mining has many new features, such as intelligent, large-scale, and rapid, so the intensity of mining continue to increase, bringing convenience and benefits, but also bringing a series of severe environmental issue. With the concept of “lucid waters and lush mountains are invaluable assets” and “Green Mine” put forward, more emphasis is placed on land reclamation and ecological reconstruction in the opencast coal mining area, and soil reconstruction is the core of land reclamation.

Impacts of coal mining on eco-environment vary in different part of China



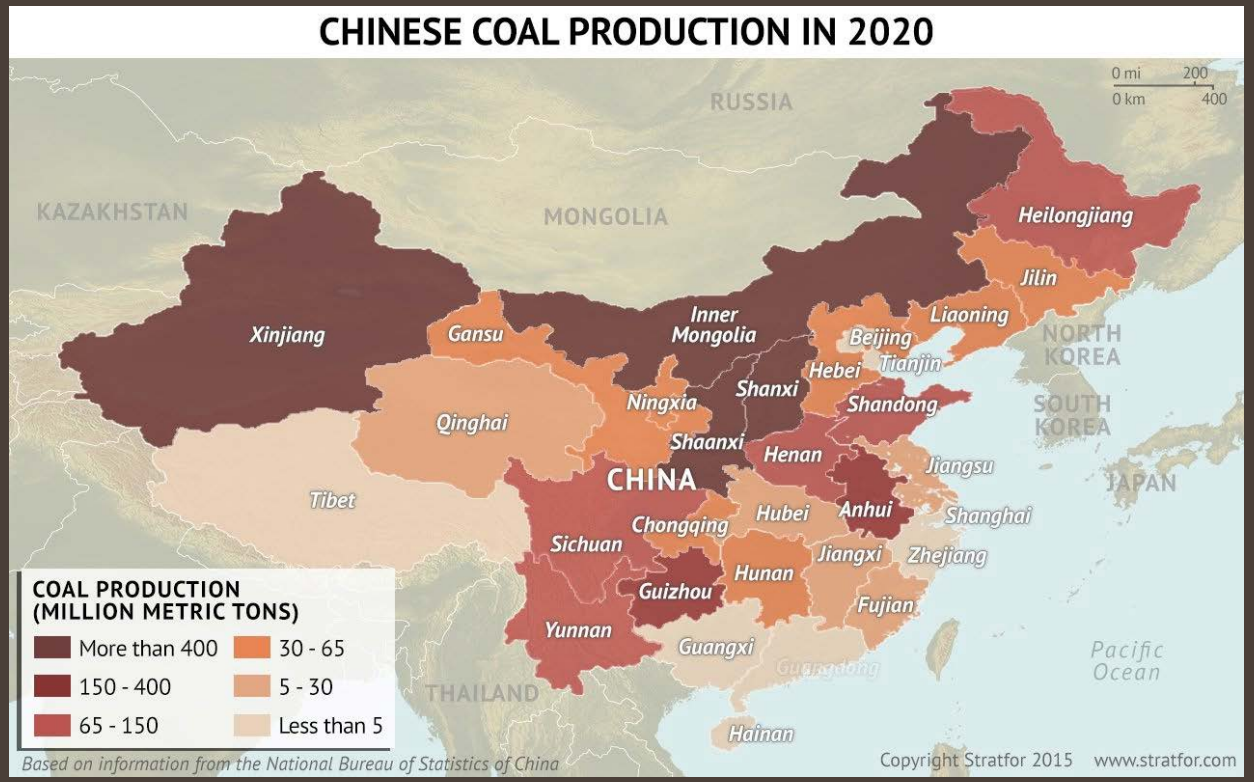
Northwest 西北地区：
Mining subsidence induced cracks and fissures;
开采沉陷引发的地表裂缝和裂纹；
Soil erosion; 水土流失；
Acid coal waste dumps spontaneous combustion;
酸性煤矸石山的自燃
Land occupation by surface mining露天开采的土地压占

Eastern东部地区：
Mining subsidence induced ponds area, 下沉积水
farmland lose, 耕地减少
Village movements 村庄搬迁

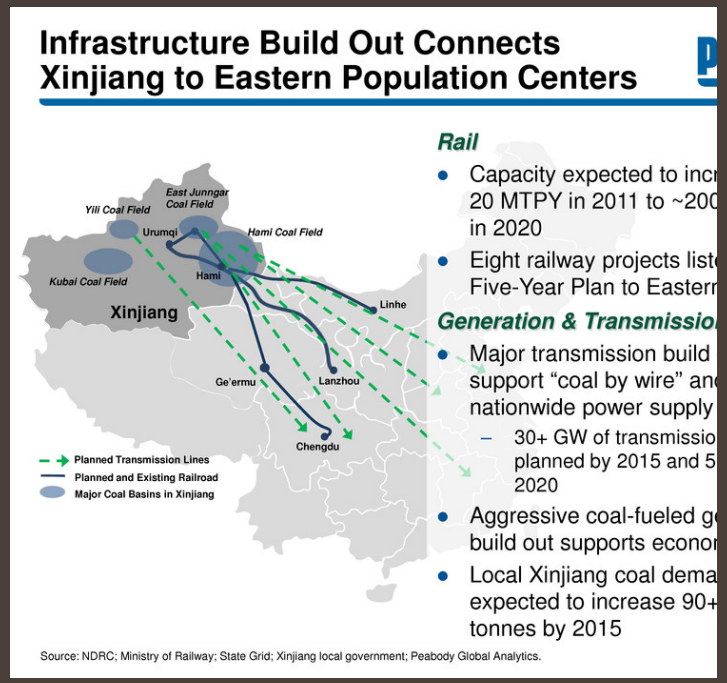
Southern南部地区：
mining subsidence induced landslide and mudslides, 开采沉陷引发的滑坡和泥石流
groundwater loses 地下水流失

Zhenqi Hu, A
2019

Potential future production



Potential Infrastructure Needs



Increased coal fired power plants to fuel industrial development and residential needs

High Rise “mushrooms” on the landscape

Chinese transportation needs

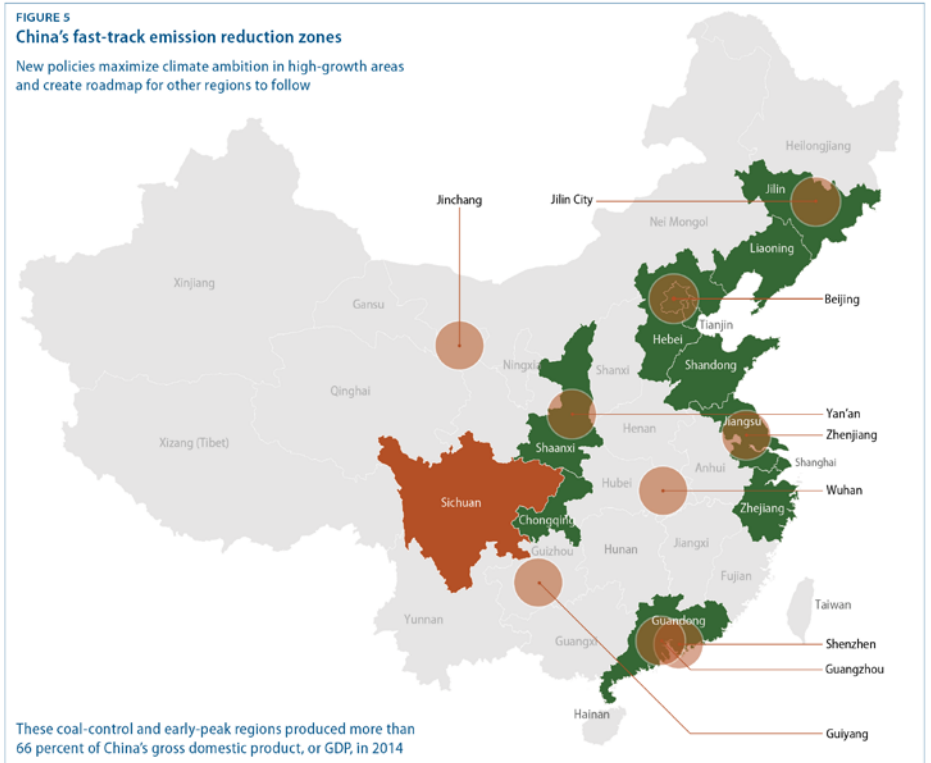
New Cities and Universities, e.g., Anhui University of Science and Technology

China's efforts to provide sustainable development given environmental impacts

FIGURE 5

China's fast-track emission reduction zones

New policies maximize climate ambition in high-growth areas and create roadmap for other regions to follow



These coal-control and early-peak regions produced more than 66 percent of China's gross domestic product, or GDP, in 2014

2017 regional coal-control targets

- **Beijing:** Cap annual coal consumption at 10 million tons to make a 56 percent cut from 2012 levels
- **Tianjin:** Cap annual coal consumption at around 43 million tons to make a 19 percent cut from 2012 levels
- **Hebei:** Cap annual coal consumption at 271 million tons to make a 15 percent cut from 2012 levels
- **Shandong:** Reduce coal consumption to 20 million tons below 2012 levels
- **Jiangsu:** Reduce coal consumption to no more than 65 percent of the energy mix
- **Shanghai:** Transition from growing to declining coal consumption
- **Zhejiang:** Cap consumption at 2012 levels and 50 percent of the energy mix
- **Guangdong:** Reduce coal use to no more than 36 percent of overall energy mix
- **Liaoning:** Limit growth to around 2 percent per year and cap total consumption at 201 million tons
- **Shaanxi:** Cap coal consumption at 138 million tons and 67 percent of the energy mix
- **Chongqing:** Cap coal consumption at 53 million tons and 65 percent of the energy mix
- **Jilin:** Cap coal consumption at 120 million tons and 65 percent of the energy mix

Pre-2030 CO2 emission peak commitments

- **2020**
  Beijing, by around 2020
  Guangzhou, by the end of 2020
  Zhenjiang, in 2020
- **2022**
  Wuhan, around 2022
  Shenzhen, by 2022
- **2025**
  Guiyang, in 2025
  Jilin City, before 2025
  Jinchang, before 2025
- **2029/pre-2030**
  Yan'an, before 2029
  Sichuan Province, before 2030

For the full list of source information, see Appendix.

Underground Coal Regions in China – Tour October 2017

Xi'an, Shaanxi
Xuzhou, Jiangsu
Huainan, Anhui
Jinan, Shandong
Yangquan, Shanxi
Beijing

Overview of October 2017 Activities

- Reclamation conference in Xi'an, Shaanxi Province
- Xi'an Canba National Wetland Park
- Xi'an to Xuzhou, Jiangsu Province, Pan'an Lake National Wetland Park
- Xuzhou to Huainan, Anhui Province
  - New university
  - Laolongyan reservoir – subsidence
  - Dongchen ecological park - subsidence/topsoil salvage ahead of subsidence
- Huainan to Jinan, Shandong Province
  - Yellow River sediment backfilling reclamation
- Jinan to Yangquan, Shanxi Province
  - Coal waste pile restoration
- Beijing, China University of Mining and Technology

Pan'an Lake Wetland Park

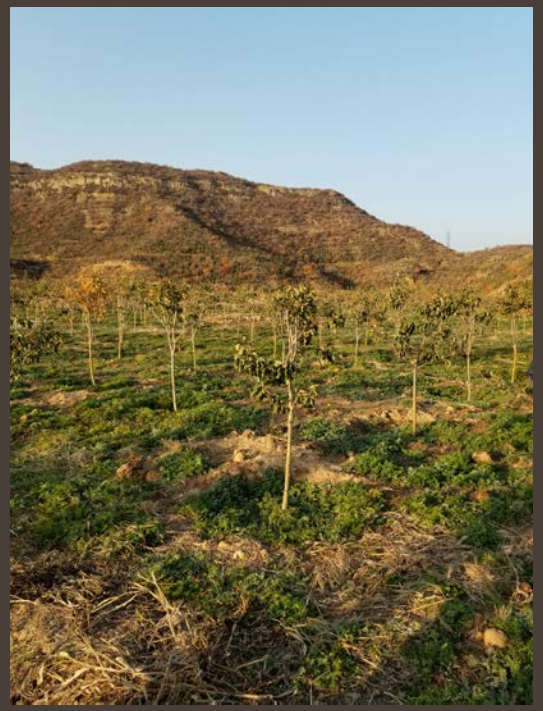
Mine Subsidence Areas

TOPSOIL SALVAGE STUDY AHEAD OF PLANNED SUBSIDENCE

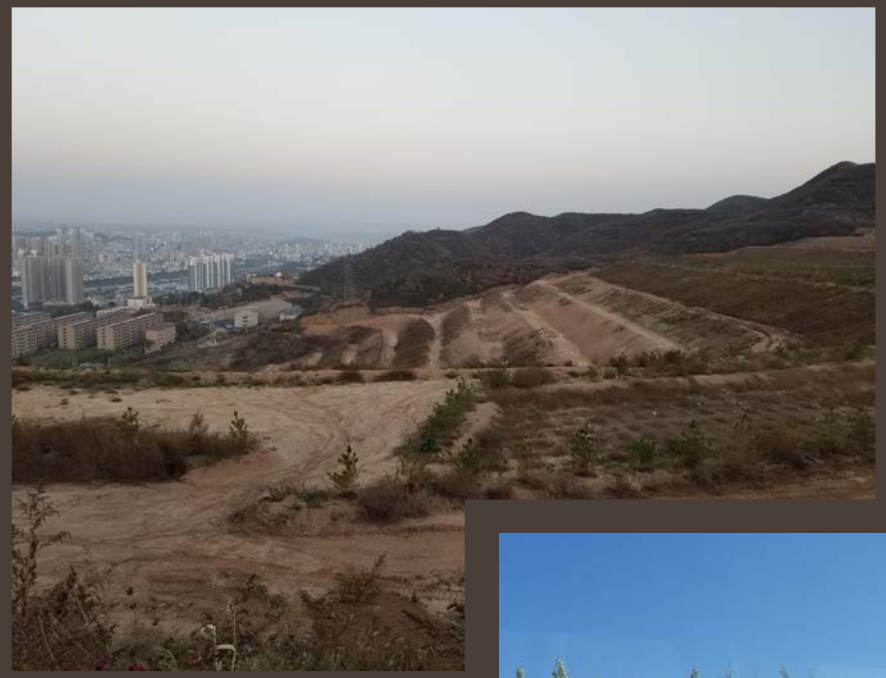
Xi’an Chanba National Wetland Park

Yellow River Sediment Reclamation

Spoil Pile Restoration in Yangquan



Erosion Control in Building Boom



Other Cases：Tangshan South Lake Park 其他案例：唐山南湖公园

Other Cases: Huaibei National Mining Park 其他案例：淮北国家矿山公园

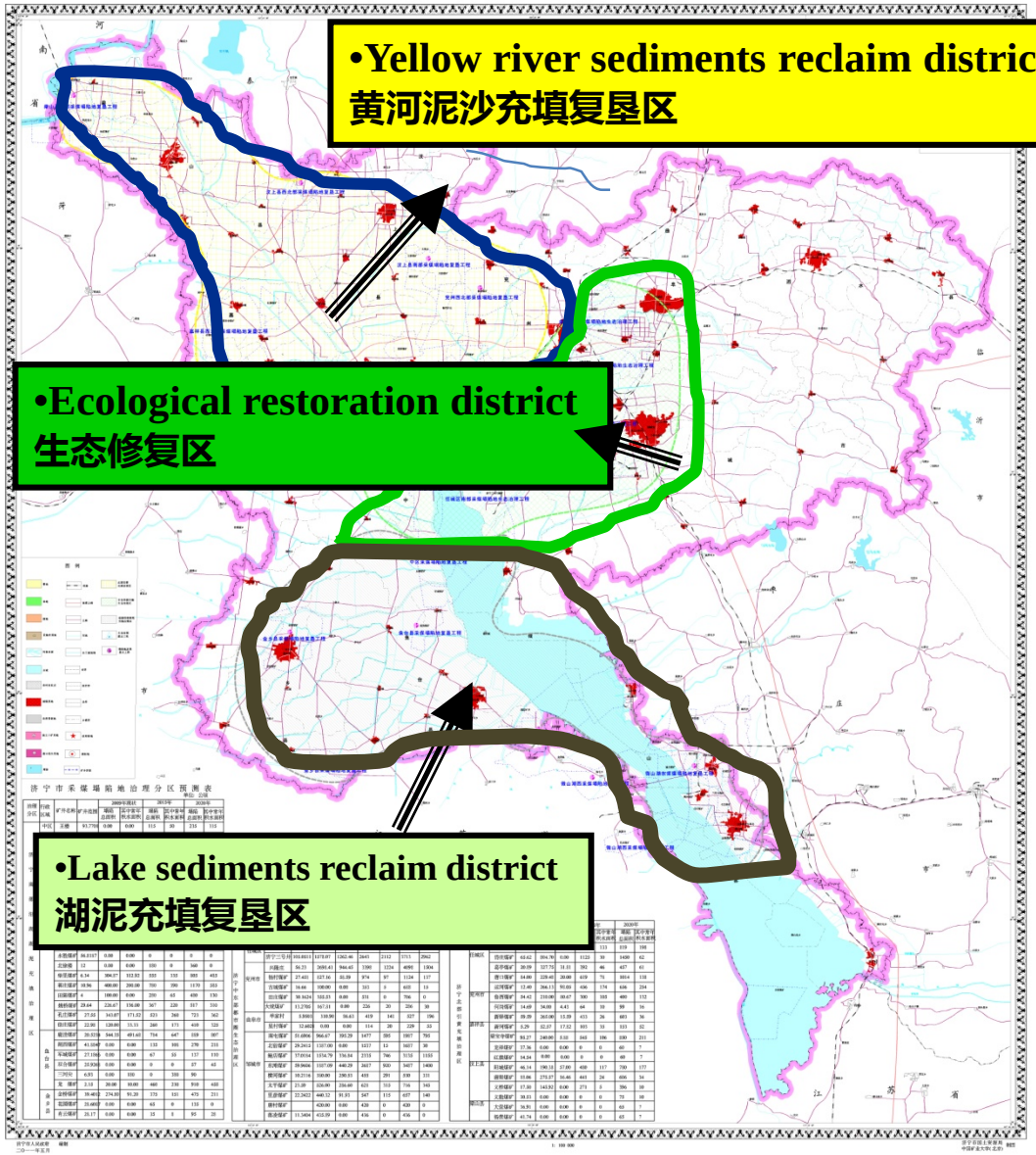
Other Cases: Subsidence land Restoration Plan in Jining
其他案例：济宁市采煤塌陷地治理

Jining City locates in Shandong province, close to Yellow river.
济宁位于山东省，黄河沿岸。

It is the one of biggest coal-bases in China, Yanzhou coal company is in this city.
中国最大的产煤基地之一，兖矿集团所在地。

Subsided land : 沉陷地面积 24575.79hm^2 (2009)
Predict: 预测塌陷面积
2015: 47199.34 hm^2
2020: 68100.53 hm^2

济宁市采煤塌陷地治理分区图



Other Cases: Subsidence land Restoration in Jining
其他案例：济宁市采煤塌陷地治理

Comparison

China

- High population centers in the eastern 1/3 of the nation
- Underground mines primarily in the eastern 1/3
- High historical use of the land over 5000 years
- No overriding reclamation law
- Focus of reclamation is safety and productive food sources
- University systems are separated by discipline

United States

- High population centers in the eastern 1/3 of the nation
- Underground mines primarily in the eastern 1/3
- Higher use in the eastern half of the nation; less public land
- SMCRA is the overriding reclamation law
- Focus of reclamation is safety and reestablished land uses such as forestry, cropping, grazing and wildlife habitat
- University systems are inclusive

Recent Chinese Regulation Review

- 2018 trip to China to discuss U.S. federal and state mining regulations with Chinese government officials.
- Newly established Ministry of Natural Resources of the People's Republic of China has combined various government agencies under the direction of the current Chinese President Xi Jinping.
- Sweeping changes to government structure announced in March 2018.
- Responsibilities of the new ministry include, in part, those previously divided amongst a host of other agencies.
- As best as can be described in agency terms found in the United States, this ministry would be a cross between the Department of Interior and the Department of Agriculture.
-

Random Take-away Thoughts from China

- Overriding mining rules and regulations limited
- Early stages of knowledge
- Working hand in hand with mining engineers is not as common
- University system limits collaborative
- Catch up vs. planning
- Drier parts of China tour to come

Questions

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