矿山生态安全教育部工程研究中心
Engineering Research Center of Mining Environment & Ecological Safety, Ministry of Education

土地复垦与生态重建研究所
Institute of Land Reclamation and Ecological Restoration

Subsidence wetland formation and transition in the coal mining areas with high ground water table

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China University of Mining and Technology, Beijing

What's next for reclamation? ASMR Joint Conference
April 9-13, 2017, Morgantown, WV

Underground coal mining in China

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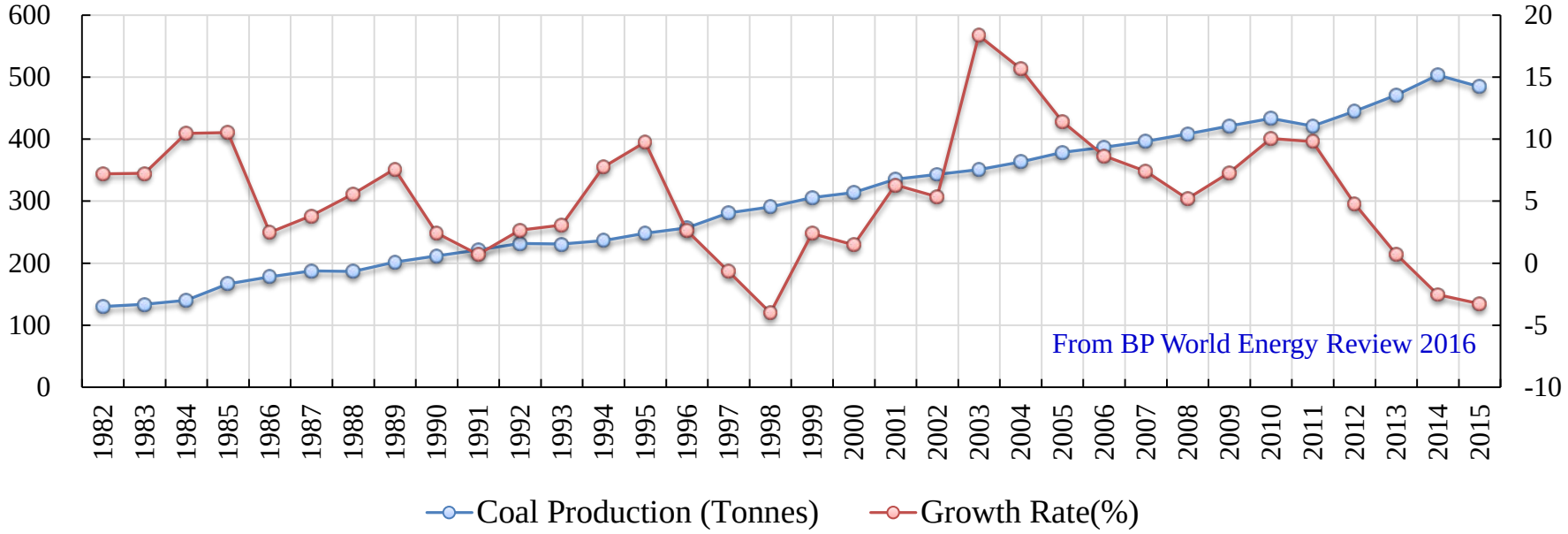
Coal production in China



Underground coal mining

About 90% of coal in China produced by underground coal mining.

Damaged land due to mining subsidence

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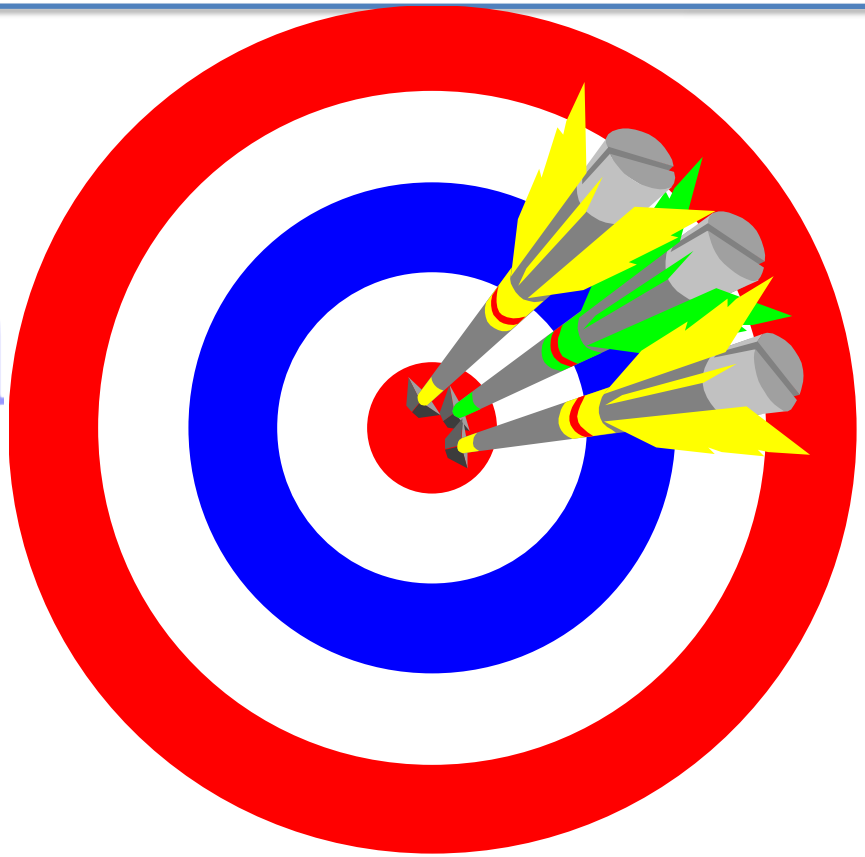
longwall mining

- **Subsidence: over 1 million hectare of subsided land; 70 thousands ha of land is subsided every year (estimated in 2011)**

Subsidence land Reclamation



has become an urgent task in China

Coal mining areas with high ground water table

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Including 5 of 14 main coal basin in China.

- High ground water table
- Thick Coal Seams
- Multiple coal seams
- Flat terrain

Most of them are
"overlap areas"

Coal mining areas with high ground water table

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Underground coal mining

Reclaiming subsided land for farmland

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Digging deep to fill shallow with hydraulic dredge pump

Filling reclamation with coal wastes, fly ash and river sediments

Reclaimed Farmland by non-filing reclamation Technology

Reclaimed land by filling reclamation technology

Reclaiming subsided land for “wetland”

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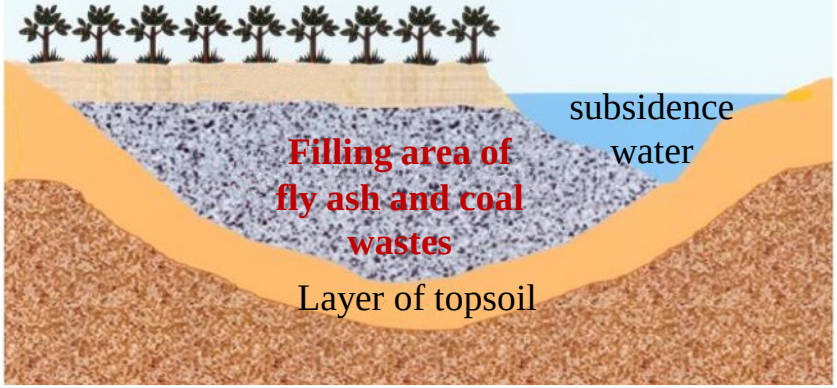
Land reclamation diagram in the coal mining subsidence area



Land Reclamation: restoring disturbed land to a useful state ---- water

Utilization of the water in subsided land is very important!

Huaibei, Anhui, Province

Tangshan,Hebei Province

Coal mining areas with high ground water table

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For better utilizing the water of subsidence land and best practice reclamation of subsided land for wetland

Some basic information needed

- **Are they wetland?**
- **What's the characteristics and changes with time and spatio?**
- **How to classify the subsidence wetland?**
- **Transition of the subsidence wetland?**

Subsidence wetland

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"Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres."

1971 Convention on Wetlands of International Importance especially as Waterfowl Habitat

They should be included in the wetland system!

Formation of subsidence wetland

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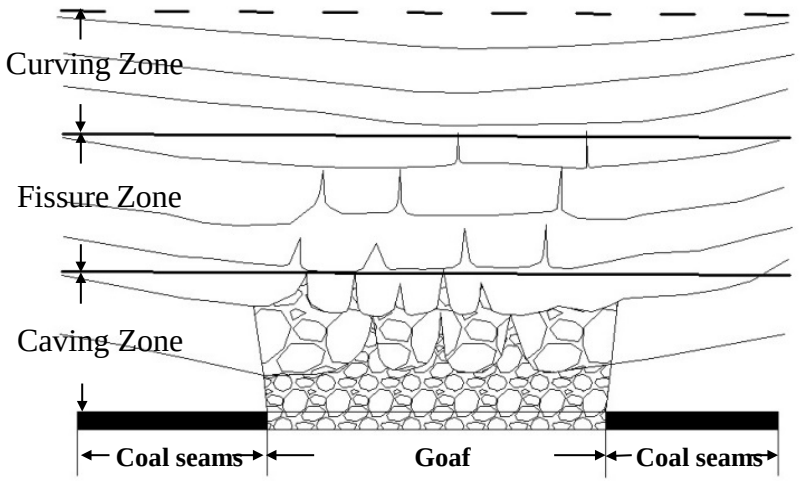
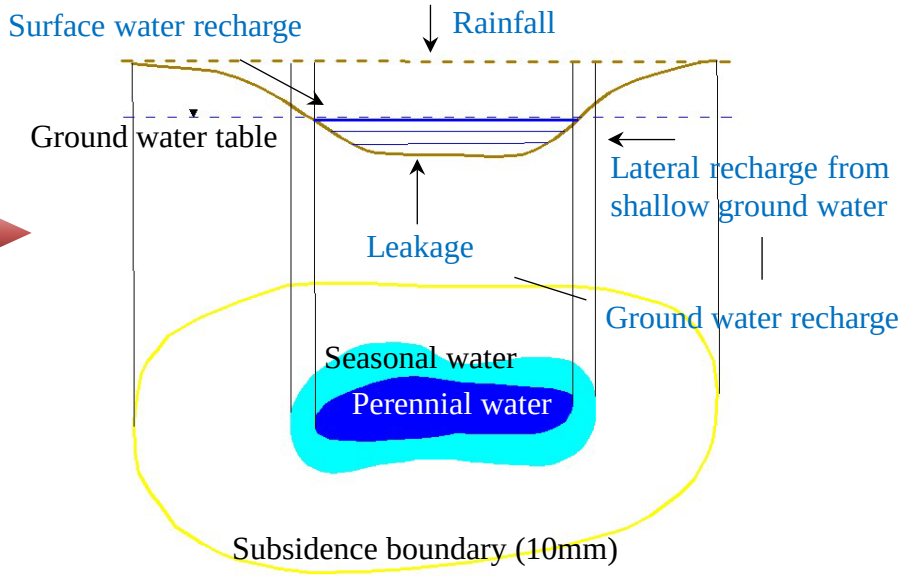
Formation of subsidence basin



Waterlogging in the subsidence basin



Formation of subsidence wetland

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Formation of subsidence wetland soil and vegetation –mining and subsidence process

Classification of subsidence wetland

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Subsidence wetland

The subsidence wetland could be classified according to the restoration process

Natural succession

Restoration mainly depend on the natural succession process

Construction wetland

Restoration process highly influenced by human interference

Classification of subsidence wetland

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Natural succession

Subsidence lake

Subsidence fen

Tangshan South Lake Park 唐山南湖公园

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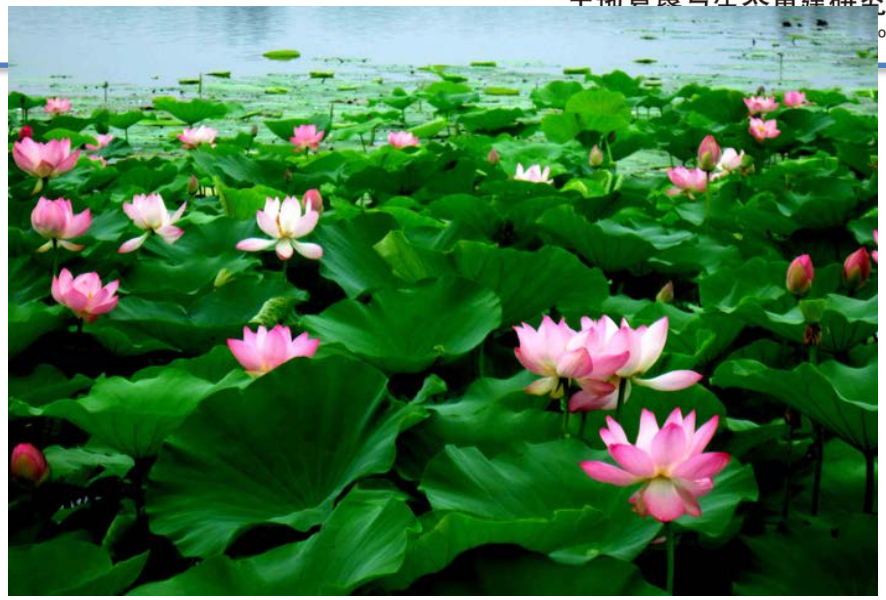
Industrial Square Restoration
工业广场修复


Shaft Restoration
原井口修复


Wetland Restoration
湿地修复


Wetland Restoration
湿地修复

Huaibei National Mining Park 淮北国家矿山公园



Classification of subsidence wetland

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Construction wetland

Aquaculture

Recreation/waste water treatment

Water reservoir

Transition of Subsidence wetland

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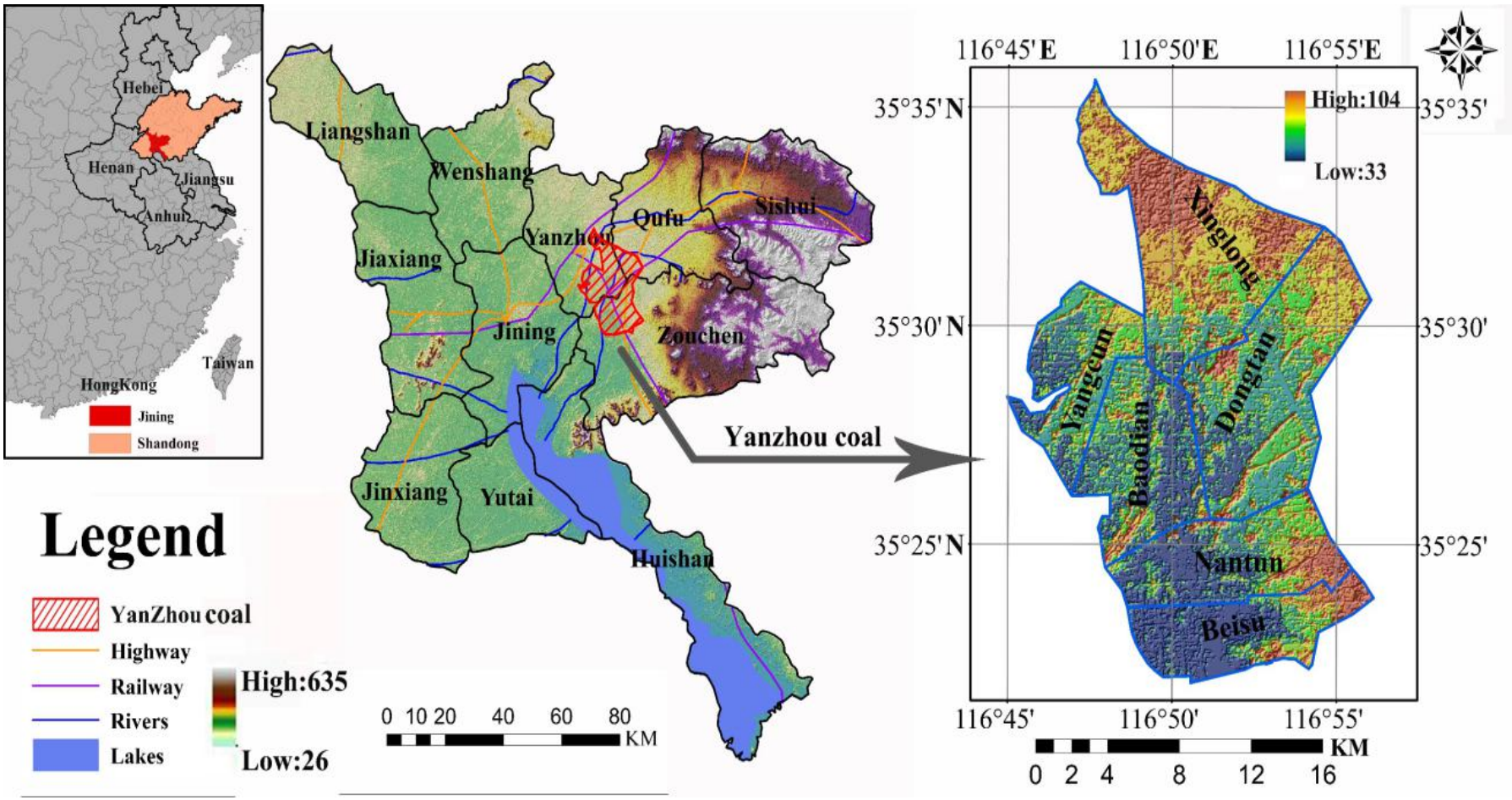

Land use and wetland types

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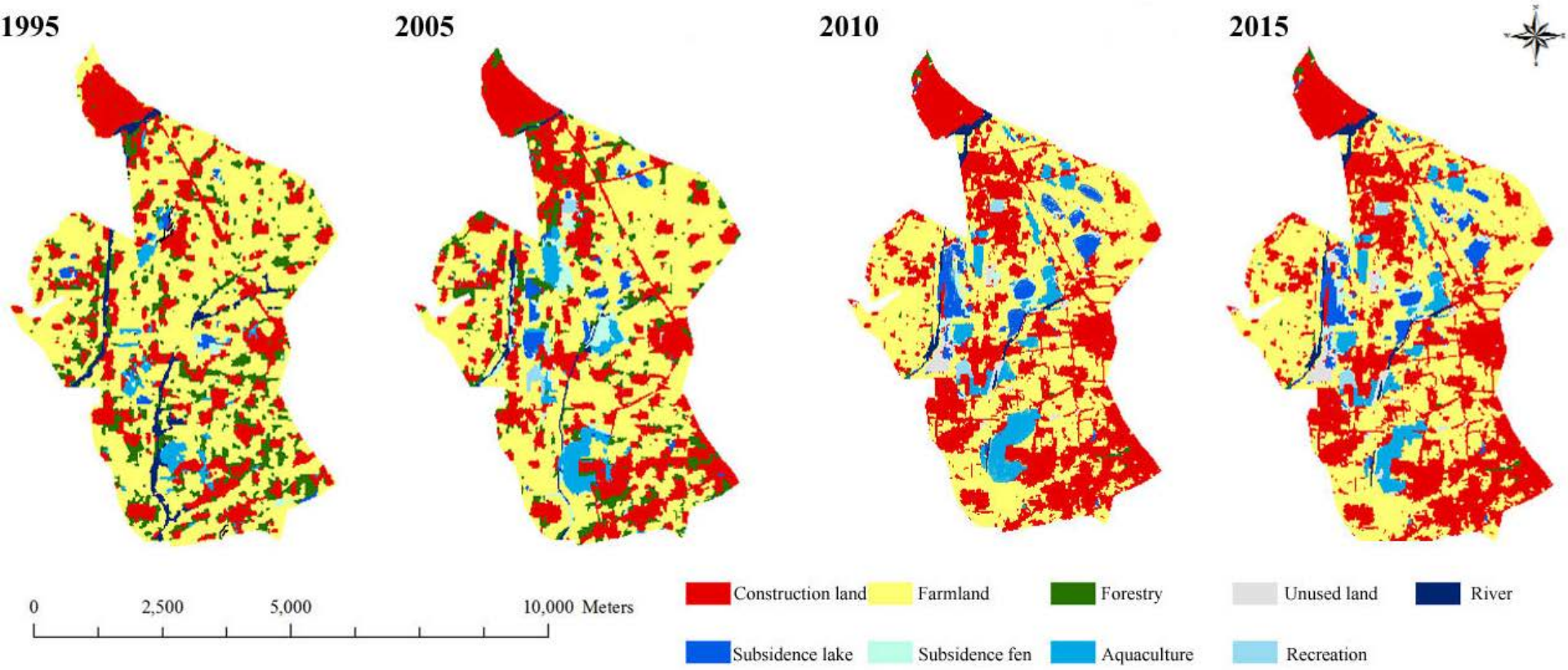
Land use and wetland types in 1995, 2005, 2010 and 2015



Land use and wetland types

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Land use and wetland types in 1995, 2005, 2010 and 2015

Type	1995	2005	2010	2015
Construction land	4662	4771.08	6153.21	9476.6
Farmland	16773.39	16128.54	14742.18	12042.67
Forested land	1896.48	1654.83	945.09	785.12
Unused land	181	187.4 ↑	439.75 ↑	385.5 ↓
River	235.24	243.54 ↑	228.73 ↓	211.12 ↓
Subsidence lake	369.49	507.24 ↑	751.25 ↑	484.62 ↓
Subsidence fen	156.86	439.34 ↑	645.61 ↑	575.97 ↓
Recreation	0	135.18 ↑	135.18 –	133.66 ↓
Aquaculture	86.66	293.97 ↑	320.12 ↑	265.86 ↓

Wetland transition in the study areas

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1995	2015									
	Construction land	Farmland	Forested land	Unused land	River	Subsidence lake	Subsidence fen	Leisure	Aquaculture	Total
Construction land	3700.84	679.13	53.57	88.54	7.14	67.92	54.44	3.53	6.89	4662
Farmland	4963.45	11011.36	93.11	118.57	33.63	191.74	303.83	7.37	50.33	16773.39
Forested land	705.44	227.92	579.34	94.87	16.31	105.75	135.56	5.07	26.22	1896.48
Unused land	55.38	42.07	24.62	24.46	13.31	8.03	1.98	8.22	2.93	181
River	6.41	10.29	18.34	23.87	132.32	17.05	23.07	3.89	0	235.24
Subsidence lake	12.73	37.73	5.59	31.88	6.09	81.61	34.22	100.48	59.16	369.49
Subsidence fen	32.35	34.17	10.55	3.31	2.32	12.52	22.87	5.1	33.67	156.86
Leisure	0	0	0	0	0	0	0	0	0	0
Aquaculture	0	0	0	0	0	0	0	0	86.66	86.66
Total	9476.6	12042.67	785.12	385.5	211.12	484.62	575.97	133.66	265.86	9476.6

Conclusion

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- The subsided land logging water is the wetland, which has huge areas in the coal mining areas with high ground water. The subsidence wetland increase consistently in these areas, and this trend will continue in the near future.
- It can be classified as natural process and construction wetland.
- The ecological situation of subsidence wetland should be focused. The wetland transition among different types and with other land use is complicated, therefore, its ecological situation vary considerably.
- More restoration and management measures should be taken to enhance the ecological function of the subsidence wetland. Most of the subsidence wetland is under natural succession with spontaneous human interrupt and without restoration and management.

Welcome to XI'AN to attend our conference

The 2nd International Symposium on Land Reclamation and Ecological Restoration

October 20-23, 2017, Holiday Inn Xi'an Big Wild Goose Pagoda

Theme: Land Reclamation in Ecological Fragile Areas

Host

China Coal Society

China University of Mining and Technology (Beijing)

Organizers

Committee of Land Reclamation and Ecological Restoration, China Coal Society

Xi'an University of Science and Technology

Chinese Ecological Restoration Network (www.ER-CHINA.com)

Co-Organizers

International Affiliation of Land Reclamationists

American Society of Mining and Reclamation

International Journal of Mining, Reclamation and Environment

International Journal of Coal Science & Technology

China Industry Alliance of Mine Environment Restoration

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Honorary Chair：
Suping Peng, China University of Mining and Technology-Beijing

Chair:
Zhenqi Hu, China University of Mining and Technology-Beijing

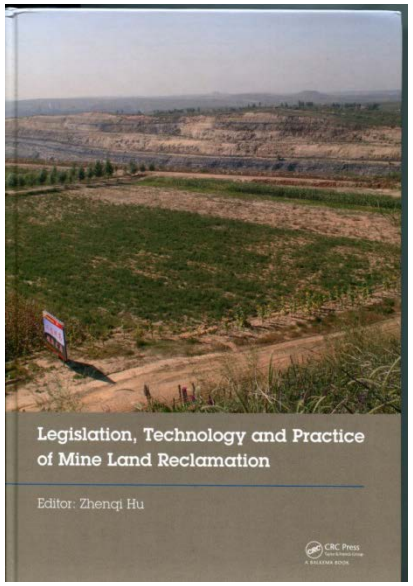
Co-Chair：
Robert G. Darmody, American Society of Mining and Reclamation, USA W. Lee Daniels, International Affiliation of Land Reclamationists, USA
Raj Singhal, International Journal of Mining, Reclamation and Environment, Canada

http://islrer2.er-china.com/index.php?m=content&c=index&a=lists&catid=13

Welcome to XI'AN to attend our conference

The symposium on land reclamation and ecological rehabilitation is a series of international conference, held every three years. The first symposium was held successfully on 16th - 19th October, 2014 in Beijing, China. Nearly 60 foreign scholars from 15 countries and more than 300 domestic scholars to participate the symposium. The deep discussion and communication of mine restoration and land reclamation in China including legislation and practice, technology and theory and so on, promote the development of the mining area ecological environment and land reclamation.

16- 19 October, 2014, Beijing, China



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Major topics covered by the Conference, but not limited, are as follows:

Mining impact on environment
Monitoring, prediction and assessment of mining impact on land environment
Mining methods and measurements to minimize the land and environment impact
Mining and reclamation policies, regulations and standard
AMD treatment
Soil and landscape reconstruction
Revegetation and biodiversity protection
Subsidence land reclamation and ecological restoration
Surface mined land reclamation and ecological restoration
Solid wastes management, waste dump and tailings pond restoration
Case study
Abandoned mine land reclamation and ecological restoration
Contaminated land remediation
Reclaimed land monitoring and evaluation
Land reclamation supervision
Products and industrialization
Education, technology transfer and international cooperation of mine land reclamation
"The Belt and Road Initiative" and mine land Restoration

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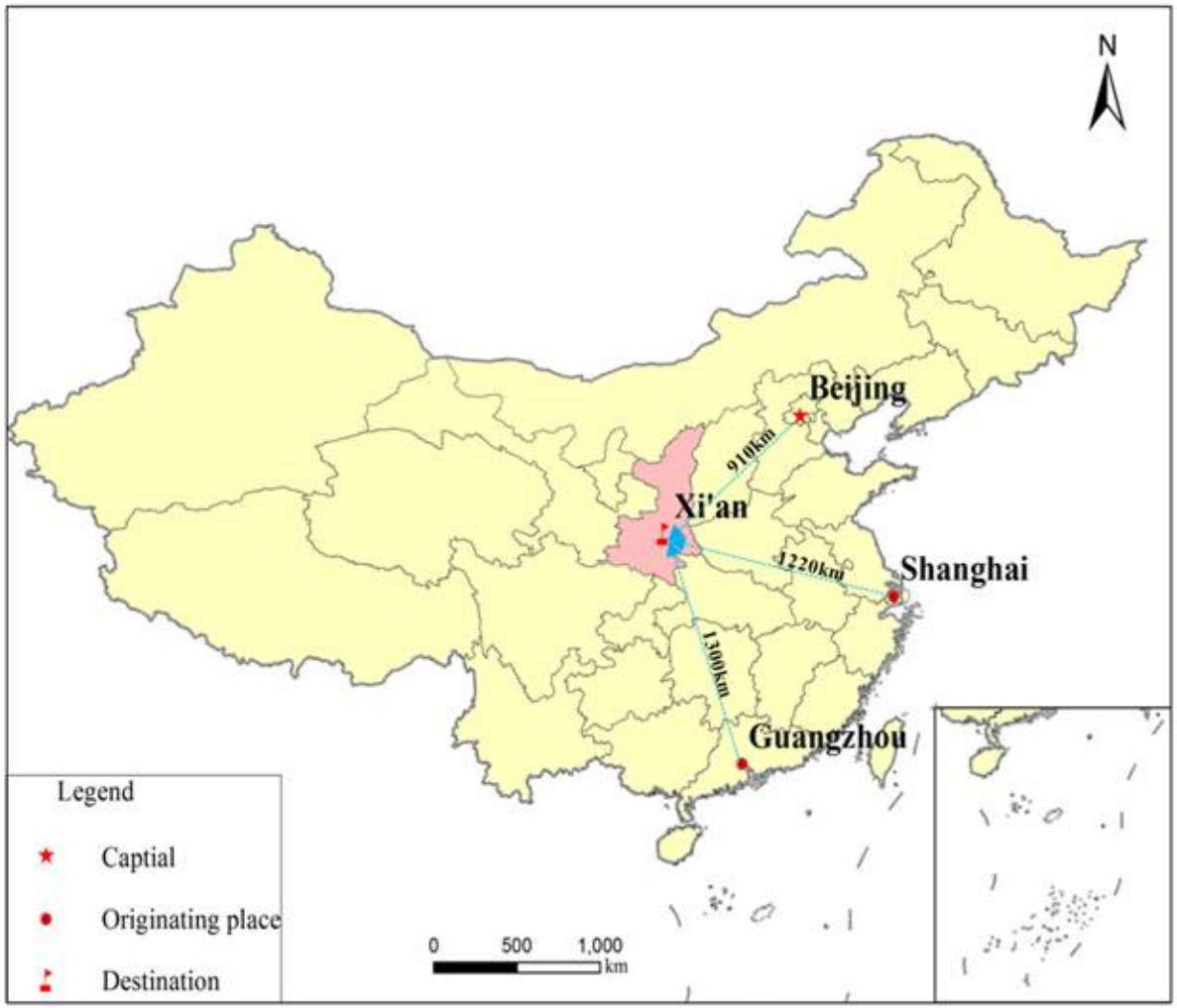
Welcome to XI'AN to attend our conference



Emperor Qin's Terra Cotta Warriors

The famous historic and cultural city

Interesting places and good food

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Thank you!

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