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THE ENVIRONMENT AND THE UTILIZATION THE STATUSOF THE SUBSIDENCE AREA THE IN XU ZHOU, YAN ZHOU AND HUAINAN AND HUAIBEI REGION OF CHINA

1. Introduction

The coal mining subsidence land in East China was mainly distributed in Huanghuaihai Plain such as Kailuan, Huainan, Huaibei, Xuzhou, Pingdingshan, Yanzhou and other coal mining area. At present, the surface subsidence caused by underground mining area could reach 13000 km^2, and over half of which was concentrated in the plains, especially Xu Yan, Huainan and Huaibei region. Surface collapse of coal field is one kind of geological disaster with great hazard, which may result from distortion and breakout of overlying strata that lose their support after underground coal beds are excavated in a large area. Due to the little dip angle coal seam, thick sediment loose layer, high phreatic water level on the flat XUYAN, Huainan and Huaibei Plain, and the the collapse land was lower than surface, the different depth and different size of subsidence water ponds were formed. On the influence of precipitation and surface water, XUYAN, Huainan and Huaibei coal mine subsidence showed with the appearance of water-logged area or marshland. With the change of precipitation, topography and geological condition of coal seam, the depth and dimension of the subsidence water area increased gradually, and the arid and seasonal water-logged area were decreasing gradually, and on the contrary, the subsidence flat marshland and the perennial shallow and deep water-logged area was increasing gradually.

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2. The actual state of coal mine subsidence water area of XUYAN, Huainan and Huaibei region

2.1. General information of coal mine subsidence area of XUYAN, Huainan and Huaibei region

2.1.1. Huaibei coal mine subsidence

Huaibei coal mine area is located in Huaibei city north of the Anhui province, which has rich coal resources, widely distributed coal fields of 9600 km^2, 8047 million tons accumulative proved reserves, 3–5 m average mineable coal seam, 5.5–13 m mineable depth [2], and it is one of important energy cities and five coal bases of China, with the raw coal exploitation of 3.4×10^8 t, 1800×10^4 t/a, since 1958.

The subsidence water area in Huaibei City includes five water areas, According to the investigation of the Bureau of Land Resource Huaibe on 2006, with the exploitation of coal mine, the size of subsidence area kept increasing at the annual speed of 670 hm^2 [3], there were 212 subsidence water ponds with the surface water square meter exceeding 1 hm^2, which distributed 14 coal mine area, the total surface water area was about 31 km^2, and the corresponding storage water capacity could reach 7.320×10^7 m^3.

2.1.2. Huainan coal mine subsidence area

Huainan city is an energy city mainly based on coal resource which is located in mid-north of Anhui province, the coal mine resource of Huainan coal mine is rich with the prospective reserves of 4440 million tons and proved reserves of 1536 million tons, and the total square meter of Huainan coal mine is 7250 km^2, the total mineral coal seam is 25–33 m [7]. Now the annual production of coal of Huainan coal mine could reach 8×10^7 t until 2010, the subsidence area reached 17300 km^2 and water-logged area was about 70% of it, about 12000 km^2.

Subsidence area of south of Huaihe River

Subsidence area of south of Huaihe River includes Kongji, Liyingzi-Lizuizi, Datong-Jiulonggang, Xieli subsidence. The total subsidence area was about 34.734 km^2, and the depth of the subsidence water area was about 8–10 m.

Subsidence area of north of Huaihe River

This area includes Panji, Xinji, Zhangji,and Xieqiao subsidence water areas. The surface water area square meter was about 697.33 km^2, the water depth was about 2–6 m [5].

2.1.3. Subsidence area of Xuzhou

Xuzhou city is located in the north of Jiangsu province with rich coal reserves of 250 million tons, the annual production of Xuzhou Coal mine was about 2.5×10^7 t, until 2008, the subsidence area reached 2.16×10^8 m^2, and the perennial water-logged area was about 1.38×10^8, the water depth was 2–6 m [9].

2.1.4. Subsidence area of Yanzhou

Yanzhou coal mine is one of important coal basins which located south of Shangdong province, with the coal reserve of 408 million ton. the annual production of it was about 3×10^7 t, the subsidence area was about 23.901 km^2, the perennial water-logged area was about 6.6 km^2, the water depth was 2–6 m, average depth was 4 m.

2.2. Pollution sources

Pollution sources of subsidence water area Xu Yan, Huainan and Huaibei region include point sources and non-point source, and some pollution sources were shown in following pictures (Fig. 1 and 2).

a)

b)

Fig. 1. Some non-point sources of subsidence area:
a) coal gangue road of the subsidencewater pond; b) waste of the subsidence water pond

a)

b)

Fig. 2. Some point sources of subsidence area:
a) chimney of kiln plant; b) sewage of residents around the subsidence area

Point-sources around subsidence water area include the industry pollution which are domestic waste water effluent from sewage treatment plant in the coal mine, the coal washing waste water, mine drainage, and other coal industry [8–10].

Non-point sources include industrial and agricultural non-point source, industrial non-point source is mainly leachate water of coal gangue slagheap, the ash place of power plants, surface runoff formed by precipitation, etc. Agricultural non-point source is the surface runoff formed by precipitation including fertilizer, agricultural chemicals and pesticides.

2.3. The research of utilization of subsidence water area in Xu Yan, Huainan and Huaibei region

At present, many researches have been done and doing about subsidence water area, which were shown as following directions [21–28]:

1) Water quality and quantity investigation and monitoring has been done to study the variation or change regularity of water quality indexes such as trace metal, nutrient salts, microbes, etc.
2) Different evaluation methods and models have been studied to evaluate and predicate the water quality change.
3) The relationship between aquatic organisms, and subsidence water to study ecological environment.
4) Different utilization modes and methods according to the characteristic of them including eco-fishery, eco-engineering or landscape design, has been done to find a more effective way to protect and sustainably utilize the subsidence water areas.

2.4. Environmental function of subsidence water area identified by environmental protection department

Environmental function of most of the subsidence water area has not been identified except few cities, for example in Huaibei city, the subsidence water areas were divided into different environmental function zones to guide the use of the water or protect them. The functions of Huaibei subsidence water mostly were fishery or agriculture use when the water reached III, IV grade in Environmental Quality Standard for Surface Water (GB 3838–2002).

In the other subsidence water area which the environmental function has not been identified, the water of them mostly has been used as fishery, irrigation, or kept wild. Some utilization methods were shown in following pictures (Fig. 3).

Now, with the development of local economy, water shortage appeared in many cites especially in coal mine city, especially in Huaibei and Huainan city, on the other hand, the abundant water resource in the subsidence area was more important, and how to protect and sustainably utilized these water were put on the agenda in many local government, and at the same time, mangy researches and new techniques have been done.

For example, in Huaibei government, a new development mode has been instructed named muti-layers aquiculture reclamation models of deep subsidence water area which was suitable for establishing cage, seining and block fishing ground [3, 10], and at the same time, eco-agriculture and ecotourism around subsidence water are gradually developing in many cities, for example, in Xintai city of Shandong province, the land structures of nourishment, plane and perpendicularity on subsidence area of coal extraction are differently designed. On nutritive structure green crops are mainly common crops, green vegetables, green forage crops and aquatic creatures. On plane structure the center of the subsidence land of coal extraction can be used as fish culture in net cage, the periphery can be established as fish

pool and economic crops in water, and the outmost layer can be used as high-yield field, vegetable shed, domestic animal breeding area and fruit-bearing forest. On vertical structure the deepwater area can be established as fish pool and economic water crops, and the uppermost layer can be developed as aquatic and semi-aquatic crops or dry farming crops.

The other use and plan to the subsidence water was to instruct plain reservoir, now in Huainan and Huaibei city, the subsidence plain reservoir are planning and instructing.

a)

b)

Fig. 3. Some utilization methods of subsidence water:
a) subsidence water was used as irrigation source; b) fishery breeding in subsidence

3. Conclusion

As stated previously, although some governments have make many utilization methods for the coal mine subsidence water area, and got much achievement, but there were also many problems remains in subsidence water area, there were concluded as follows:

1) Since most local governments have not define the environmental function zoning for subsidence water area, lack of the management to the subsidence water area cause the confusion of application, thus to establishment of scientific management to protect and utilize the subsidence water area to local government seems especially important.
2) The pollution sources around the subsidence water area still exist, and no amount control to the effluent of pollutant has been made.
3) More economic and effective engineering techniques need to be instructed to accommodate the changes of quantity and quality of subsidence water.

REFERENCES

[1] *Lingguo Kong*: Classification of Mining Subsidence Land and Its Characteristics Research, Coal Mining Technology, 2007, vol. 2.

[2] *Aiwu Luo*: The Land Restoration in the Sunk Areas of Coal Extraction in Huaibei City, Journal of Anhui Normal University (Natural Science), p. 287.

[3] *Fei Liu*: Evaluation on ecosystem services in Nanhu Wetland of Huaibei City, Journal of Natural Resources, 2009, vol. 10: p. 1819.

[4] *Wujiu Yan*: An analysis of overall environment rehabilitation for coal mine subsidence areas in Huainan, China Coal, 2007, vol. 6: p. 26.

[5] *Longqian Chen*: A study on state and comprehensive control ways of subsided land of Yanzhou coal mining area in China, Journal of Natural Resources, 2002, vol. 4: p. 505.

[6] *Yingchen Yuan*: Huainan Coal Mining Destroyed Land Resource and Comprehensive Treatment, Environmental Science and Management, 2008, vol. 2: p. 93.

[7] *Decheng Liu. Rongsui Zhang, Dongbin Liang*: The Reasons and Control Policies on Surface Collapse of Coal Field in Yanzhou City, Shandong Province, Research of Soil and Water Conservation, 2005, vol. 4: p. 68–69.

[8] *Chengui He, Liu Hui, Herong Gui*: Environment evaluation on typical water area resuling from coal-mine subsidence in Huainan, Journal of China Coal Society, 2005, vol. 6: p. 754–758.

[9] *Wu Y.B., Cui F.*: Analysis of water environment characters in mining subsidence corresponding to different evolution phase, 2008 Proceedings of Information Technology and Environmental System Sciences: ITESS 2008, vol. 2: p. 649–653.

[10] *Yao E.Q., Gui H.R.*: Four trace elements contents of water environment of mining subsidence in the Huainan diggings, China, Environmental Monitoring and Assessment, 2008, 146: p. 203–210.