

# Reclamation Plan for Subsided Land due to Coal Mining in Northeast China\*

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## **Abstract**

This paper is to explore an efficient technical model for land reclamation in northeast China. As a result of the hardworking and long-term developing by generations of agricultural soldiers, Beidahuang with the special fertile black soil in northeast China, where was the famous place for urban intellectual youth to reform their thought during the Great Cultural Revolution from 1966 to 1976, has become an important national comprehensive agricultural developing area. However, with the development of coal mining, a large amount of land were subsided or occupied by coal wastes, which destroyed the fertile farmland and damaged the regional ecological environment. Thus, reclamation of subsided land from coal mining in Beidahuang region has become an emergent task. Shuangyashan mining area is a famous coal-industry base in Northeast China, which locates in Beidahuang. This paper took this mining area as experimental site. Based on the investments, 2917.49hm<sup>2</sup> of subsided lands were produced by seven coalmines. Damage characteristics of the subsided land were introduced, and reclamation plan with benefit analysis were make in this paper.

**Keywords** □ reclamation, subsided land, coal mining

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## **1 Introduction**

Coal accounts for approximately 75% of the annual energy consumption of China. Underground mines in China account for 96% of the coal output. The underground coal mining has caused a large amount of land subsidence, which has led to farmland losses and caused severe conflicts between farming and mining. According to statistics, subsided land due to coal mining exceeds more than 400,000 hectares at present and is increasing at a rate of more than 20,000 hectares each year □Hu, 1999□.

As a result of the hardworking and long-term developing by generations of agricultural soldiers, Beidahuang (in North-East China) with the special fertile black soil in northeast China, where was the famous place for urban intellectual youth to work in countryside for

reeducation during the Great Cultural Revolution from 1966 to 1976, has become an important national comprehensive agricultural production base. With the activities of long-term coal mining, a large amount of subsided lands and wasted rock piles were produced, which damaged the fertile black land and regional ecological environment. Thus, subsided land reclamation in Beidahuang region has become an emergent task related to the development of northeast China.

Shuangyashan city locates in Beidahuang region, which has also abundant coal resources. Shuangyashan Coal Company is in this city, which is a stated-owned coal unit and has ten coalmines. Thus, this paper took Shuangyashan coal mining area as research objectives.

Shuangyashan City is in the agricultural area

of Three-river Plain, Heilongjiang Province, Northeast of China, where is one important part of the famous Beidahuang. Shuangyashan City is a resource type city as national major coalmine cities, has more than 60 years of developing history, producing more than ten million tons of coal each year. However, with the development of coal production, as a statistic in seven mines area, there has formed 2917.49hm<sup>2</sup> of subsided lands, where appear large range of accumulated water with barren phenomena, so that the ecologic environment has been damaged dramatically, and the quality of farmland falls down rapidly with decrease quantity, and making the basic agricultural production conditions to be destroyed that endangers the position of national major comprehensive developing area of agricultural industry. As the subsided lands of mine area is located at farm or country mostly, the local residents have appealed to the higher authorities for help or the higher court for settling the problem for times. For an example, the subsided area at Shuangfeng Village, Taibao Town in Jixian mine area has gotten up to 33.3hm<sup>2</sup>, which accounts for 12.6% of all the cultivated land of this village that the villagers have come to the Mines Affairs Bureau times and screamed for resolution.

Accordingly, subsidence due to coal mining has influenced local people's production, living and social security and stability. The compensation for the subsided land was increased year-by-year, and was up to 10.14 million RMB in 1999, so that the Shuangyashan Coal Company can not afford the compensation and has no enough money to do land reclamation, which has a strong impact on production activity and development of the mines area. Therefore, the reclamation work of subsided lands due to coal mining in Shuangyashan has become a quite

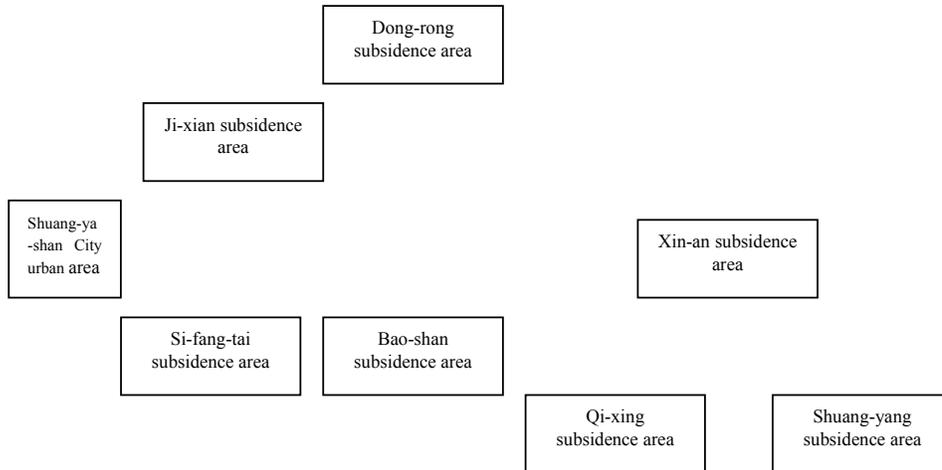
emergent task that related to the mines area development, local agricultural production, the protection and development of cultivated area, and ecological environment protection of special lands area of the famous Beidahuang.

## **2 Damage characteristics of subsided land in Shuangya shan coal mining areas**

The subsided lands in Shuangyashan city were distributed in ten state-owned coal mines of Shuangyashan Coal Company. As the three mines such as Lingdong, Lingxi, Dongbaowei are located at mountain areas, which do not damaged land seriously. Thus the focus of this study is for the seven coal mines exception of Lingdong, Lingxi, and Dongbaowei coal mines.

There are 2917.49hm<sup>2</sup> of subsided lands that mainly belong to national lands of agricultural cultivation system and collective lands of villages, which relate to seven areas including Qixing, Jixian, Shuangyang, Xin-an, dongrong, sifangtai, Baoshan. The diagrammatic sketch shows as figure 1. The conditions of subsidence areas are listed in table 1.

The subsided lands of these areas take very low reclaimed ratio that only 133hm<sup>2</sup> being 0.12% of all the subsided lands have been reclaimed by the end of 1999 while most of them have not been utilized. However, the utilization of subsided lands can be considered to be adjusted measures to local condition flexibly as being conducted by the adjacent lands in better state. The subsided lands take entire sections collectively, majority of which are cultivated lands, easy to be reclaimed in large scale. Besides, the subsidence areas have ascendant location in microscopic view, convenient traffic, developed hydrographic net, with stable state of subsidence basically, easy to be reclaimed for utilizing.



**Fig.1 Subsidence areas distribution of Shuangyashan coalmines area**

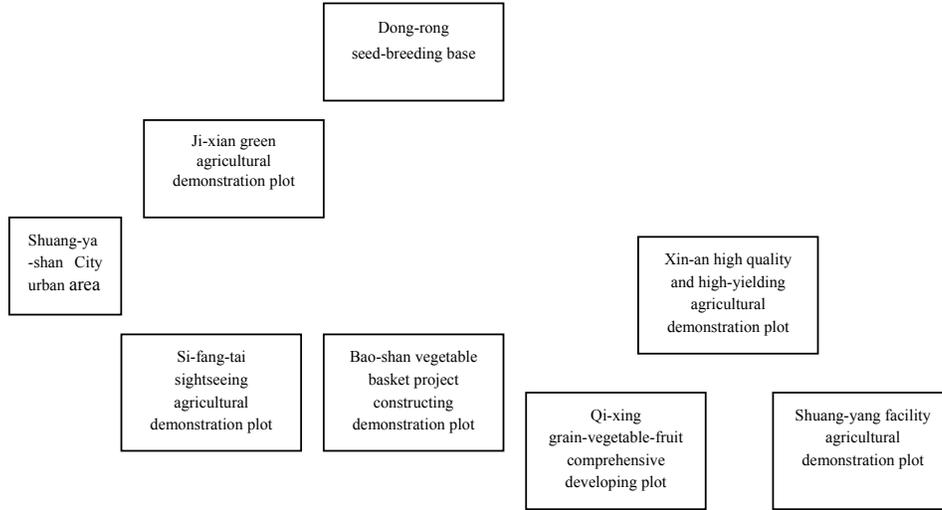
**Table 1 Damage characteristics of subsided areas**

Subsidence site	Area statistic	Total subsidence area	Perennial accumulated water area	Seasonal accumulated water area	Roads and channels area	Else occupied area	Sloping fields area	Reclaimed fishponds area
(Total area of items)	Area(hm <sup>2</sup> )	2917.49	264.26	327.90	38.69	20.48	2240.37	25.79
	%	100	9.06	11.24	1.33	0.70	76.79	0.88
Qixing	Area(hm <sup>2</sup> )	387.93	17.03		4.77	4.22	361.91	
	%	100	4.39		1.23	1.09	93.29	
Jixian	Area(hm <sup>2</sup> )	731.62	105.81	41.00	10.22	5.57	569.02	
	%	100	14.46	5.60	1.40	0.76	77.78	
Shuangyang	Area(hm <sup>2</sup> )	509.92	30.68	49.15	4.77		425.32	
	%	100	6.02	9.64	0.93		83.41	
Xin-an	Area(hm <sup>2</sup> )	696.13	85.43	185.44	7.89		405.07	12.30
	%	100	12.27	26.64	1.13		58.19	1.77
Dongrong	Area(hm <sup>2</sup> )	221.22	23.64	20.11	6.92	2.16	168.39	
	%	100	10.69	9.09	3.13	0.97	76.12	
Sifangtai	Area(hm <sup>2</sup> )	177.99	0.48	30.85	2.07		144.59	
	%	100	0.27	17.33	1.16		81.24	
Baoshan	Area(hm <sup>2</sup> )	192.68	1.18	1.35	2.05	8.53	166.08	13.49
	%	100	0.61	0.70	1.07	4.43	86.19	7.00

### **3 Subsided land reclamation planning**

Based of investigation and surveying in the seven coal mines in Shuangyashan coal company,

the land use plan for reclaimed land can be designed as figure 2 and table 2. Each coal mine has its own typical post-mining land use.



**Fig.2 Planning and layout of the subsidence areas of Shuangyashan coalmines area**

**Table 2 Reclaiming planning to the subsidence areas of Shuangyashan coalmines area**

Planning plot	Area statistic	Total reclaimed area	Crop farmland	green stuff base area	Rice field area	Fish pond area	Fruit ranch area	Wood-land area	Roads and channels area	Park area	Live-stock breeding area	Else area
(Total area)	Area(hm <sup>2</sup> )	2917.49	890.67	161.01	1395.28	198.64	135.35	10.85	48.52	7.12	13.81	56.24
	%	100	30.53	5.52	47.82	6.81	4.64	0.37	1.66	0.24	0.47	1.93
Qixing	Area(hm <sup>2</sup> )	387.93	273.67	27.23		15.64	59.18		5.09	7.12		
	%	100	70.55	7.02		4.03	15.25		1.31	1.84		
Jixian	Area(hm <sup>2</sup> )	731.62	355.95	27.06	277.37	50.38			8.77		12.09	
	%	100	48.65	3.70	37.91	6.89			1.20		1.65	
Shuang-yang	Area(hm <sup>2</sup> )	509.92		13.62	399.39	14.10	72.80		7.59		1.72	0.70
	%	100		2.67	78.32	2.77	14.28		1.49		0.34	0.14
Xin-an	Area(hm <sup>2</sup> )	696.13	162.04		437.25	79.44			16.20			1.20
	%	100	23.28		62.81	11.41			2.33			0.17
Dongrong	Area(hm <sup>2</sup> )	221.22	19.18		142.58				5.13			54.33
	%	100	8.67		64.45				2.32			24.56
Sifangtai	Area(hm <sup>2</sup> )	177.99		29.96	138.70	3.64	3.37		2.32			
	%	100		16.83	77.93	2.05	1.89		1.30			
Baoshan	Area(hm <sup>2</sup> )	192.68	79.83	63.13		35.44		10.85	3.43			
	%	100	41.43	32.77		18.40		5.63	1.78			

(1) Qixing coal mine: Grain-vegetable-fruit Comprehensive Developing Site

The subsided land was 387.93hm<sup>2</sup>, the reclamation plan was:

Crop farmland lands: located at west to residential area, occupying 273.66hm<sup>2</sup> with

mainly planting crops such as wheat, corn, potato, soybean etc.

Vegetable Basket Project base: to convenience the life of the people in mines area with abundant vegetable basket, 23 fishponds will be constructed at the northwest corner to the

edge of residential area with occupying 15.6hm<sup>2</sup>, while vegetable growing base be arranged at west to the edge of residential area with occupying 27.23hm<sup>2</sup>.

Orchards: located at west to the residential plot of mines area, occupying 59.18hm<sup>2</sup> with mainly growing Chinese pear-leaved crab-apple.

Park: to beautify environment and enrich after-hours cultural life of the people in mines area, a park will be constructed at the north edge of residential plot of mines area with occupying 7.13hm<sup>2</sup>.

(2) Jixian coal mine: Green Agricultural Demonstration Site

The planning area occupies 731.62hm<sup>2</sup>. This item takes green agriculture as guideline, with constructing green rice base, green livestock breeding plot, vegetable greenhouse and green marine lives breeding base to form agriculture-herd-fish integration with an ecologic pattern combining planting to breeding. The specific scheme is as follows.

The 277.37hm<sup>2</sup> of subsidence area at west to the coalmine will be constructed to be green rice base.

In the 454.25hm<sup>2</sup> of subsidence area east to the coalmine, combining growing, breeding to planting will be carried out. At west of Shuangfeng Village there will build 12.09hm<sup>2</sup> of green livestock breeding farm. At near west to Jixian coalmine, making use of the location dominance close with residential plot, 27.06hm<sup>2</sup> of vegetable greenhouse will be build up to develop highly active green stuff base, at west to which there are site in deep accumulated water that can layout comprehensively 50.38hm<sup>2</sup> of green aquiculture base. The else 355.95hm<sup>2</sup> subsided lands will be reclaimed as cultivation for growing green crops.

(3) Shuangyang coal mine: Facility Agricultural Demonstration Site

In the 466.67hm<sup>2</sup> of item area, adopting advanced facility agricultural technology; three bases will be set up, which are vegetable basket

project base, modern agricultural production base and fruit base of water-saving culture. The specific situations are as follows.

The vegetable basket project base is located at the subsidence area near mines along the bilateral sides of railway, taking area 31.11hm<sup>2</sup>. There-into that, at near residential plot of mines, 13.67hm<sup>2</sup> vegetable greenhouse with advanced facilities will be set up, meanwhile, mating terminal vegetable market that not only make use of the subsidence lands effectively, but also convenience life of the masses. The area has convenient traffic, with large acreage of accumulated water that is propitious to complement three-space breeding including 14.1hm<sup>2</sup> of aquiculture area, 0.93hm<sup>2</sup> of cattle farm, 0.79hm<sup>2</sup> of duck farm.

The modern agricultural production base takes 399.39hm<sup>2</sup>, where has fertile soils, flat topographical feature that are propitious to proceed large scale mechanical operation, will grow high quality of potato, wheat, corn and soybean.

The fruit base of water-saving culture in 72.8hm<sup>2</sup> is located at the south of development area where is hilly ground, mainly growing apple and Chinese pear-leaved crab-apple.

(4) Xin-an coal mine: High Quality and High-yielding Agricultural Demonstration Site

There are 696.13hm<sup>2</sup> of subsidence area in Xin-an Coal Mine, which are mostly specific black lands of State Friendship Farm with flat topographical feature, fertile soils and well-known agricultural production conditions. So the area will be reclaimed to high quality and high-yielding agricultural demonstration plot, which will make the black lands developed by solders of production constructing corps before dozens years to reappear past brilliance. The main items are 437.25hm<sup>2</sup> of rice field, 162.04hm<sup>2</sup> of arid lands and 79.44hm<sup>2</sup> of fishponds. The plane geographical distribution is as follows.

The 437.25hm<sup>2</sup> of lands east to Yi-Rao

highway, as there are a lot of seasonal accumulated water plots due to subsidence, with a few irrigation and drainage channels, will be reclaimed as high quality and high-yielding rice fields.

At the west to Yi-Rao highway along bilateral sides of railway, there are large quantities of perennial accumulated water plots that can be developed as high-yielding intensive breeding fishponds, 79.44hm<sup>2</sup> totals. The else subsided lands except fishponds, by utilizing the soils gotten from digging fishponds to fill part of subsided lands, as high-yielding arid lands through leveling, will grow grain crops such as corn, wheat etc. and fodder grass. 162.04hm<sup>2</sup> totals.

(5) Dongrong coal mine: Seed-breeding Base

In 221.22hm<sup>2</sup> of subsidence area, a water-storage reservoir, rice fields and arid lands are planed to be built with specific as follows.

At southwest to the air shaft of Dongrong 2<sup>nd</sup> Mine, a plain water-storage reservoir will be built up in 51.32hm<sup>2</sup>.

Rice seed-breeding base: the subsided lands take subsidence depth between 0.5m and 2.6m, flat topographical feature, high groundwater table, dense artificial discharge ditches, being suitable to be reclaimed as paddy fields for rice seed-breeding.

Wheat seed-breeding base: as there are protective coal wedge under roads, the lands between highway and railway don't fall in subsidence that take higher topographical feature than bilateral sides of roads, which will be reclaimed as arid lands for wheat seed-breeding.

(6) Sifangtai coal mine: Sightseeing Agricultural Demonstration Site

There are suitable natural conditions in this area where is close to urban area with ascendant geographical position, so that there are great significance to establish a sightseeing agricultural demonstration plot at the site. Here will plan vegetable growing base, orchards and

fishponds to get an optimizational assemblage for agriculture, fruit planting, fishing etc. that there are not only variety of produces but also multi-variant income. At the same time of increasing agricultural outputs, there provides situation for residents lying fallow and sightseeing to promote the development of tourist trade of Shuangyashan City. The specific planning is as follows.

At north to the 1<sup>st</sup> Team of the state farm and close to the urban area of Sifangtai, the subsided lands will be reclaimed as vegetable growing base in 29.96hm<sup>2</sup>.

The subsided lands inside the urban area of Sifangtai, will be utilized to build fishponds with fruit-planting base in 7.01hm<sup>2</sup> of area.

The two pieces of subsided lands at near bilateral sides of the reservoir of the 4<sup>th</sup> Team, as the water resource is abundant that the irrigation condition is better, are suitable to be reclaimed as rice growing base, taking 138.70hm<sup>2</sup> totals.

(7) Baoshan coal mine: Vegetable Basket Project Constructing Demonstration Site.

Total area of the planning plot is 192.68hm<sup>2</sup>. As being located near the urban area of Baoshan and Baoshan Mine where there are many residents, the subsidence area can be mainly reclaimed to abundance the vegetable baskets of the residents. Two vegetable growing bases will be set up along the bilateral sides of Baoshan urban area on east and west respectively, occupying 63.13hm<sup>2</sup>. The original fishing ground near the west vegetable growing base will be expanded to construct aquiculture base with 33.58hm<sup>2</sup>. The subsided lands inside the residents' plot of Baoshan urban area have potential probability as construction use for urban area enlarging, under present conditions, with the northern gangue pile being reclaimed partly as woodlands in 10.85hm<sup>2</sup> previously, will be filled by use of gangues to reclaim as arid lands such as growing wheat, corn etc. the part on the east side of Baoshan urban area except vegetable growing base, will also be reclaimed

as arid lands. The total area of arid lands will get 79.83hm<sup>2</sup>.

#### **4 General investment estimation and benefit analysis**

##### ***4.1 General investment estimation***

According as Chinese relevant reference standard, the total investment of the reclaiming projects for the 7 coal mines in Shuangyashan coal company is calculated to be RMB 177.055 millions Yuan, which the investment of the seven item areas are respectively 21.805 millions Yuan to Qixing, 45.608 millions Yuan to Jixian, 18.825 millions Yuan to Shuangyang, 47.865 millions Yuan to Xin-an, 14.139 millions Yuan to Dongrong, 11.846 millions Yuan to Sifangtai, 16.966 millions Yuan to Baoshan.

To assure the reclamation plan being carried out, three ways to get fund such as National Fund for Land Development and Rehabilitation, mating fund from Province and City finance, and other funds from local or privacy companies and persons. Recently, China government sets up a National Fund for Land Development and Rehabilitation, which is about 3 billions RMB per year.

##### ***4.2 Benefit analysis***

###### ***4.2.1 Social benefit***

Land reclamation of mines area has very high social benefit, which mainly represent as follow four aspects.

(1) Through land reclamation of mines area, cultivated lands will increase 792.37hm<sup>2</sup> by 53.05%, which is a good way to complement farm lands occupied by non-agricultural construction, to carry out the new Land Administration Law, and to play assuring role in implementing the dynamical balance of the general quantity of farm lands of Shuangyashan City.

(2) The reclaiming work with diverse farming will attract the laid-off staffs of mines area and part of surplus rural workers, which will supply extensive employment chance for

discharging mines' difficulties and transforming labor power that will alleviate employing pressure effectively and play an apparent affection to social stability and solidification.

(3) The development and utilization of the subsidized lands will enhance the aftereffect of agricultural production of Shuangyashan City, which will assure the sustainable development of agricultural production and accelerate the all-round development in agriculture, forestry, livestock breeding, fishing and side-line, and increase incomes of urban and rural residents, contributing to the Reconstructing Shuangyashan Project.

###### ***4.2.2 Economical benefit***

Based on the distribution and scale of reclaiming items, according to the products price from market survey, considering the present national and local policies, the sales profit is encountered out to be from RMB 8.92 millions Yuan in the first year of reclamation getting to RMB 42.05 millions Yuan in the eighth year after taking out tax and non-business expenditure. The internal rate of return will get to 26.63%; meanwhile the capital pay-off time is 5.54 years.

###### ***4.2.3 Ecologic benefit***

By carrying out ecological agricultural reclamation in the items area and rational distributing, traditional agriculture will be developed and transform to integration of agriculture, forestry, livestock breeding, fishing and side-line, which will mend the restructuring of agricultural industries to enhance and maintain good cycle among agricultural ecological systems, behaving obvious ecological benefit.

In the course of coal production, there are serious pollutions of Industrial Three Wastes, so to reform for utilizing the subsidence area will not only increase the cultivated lands area but also clean the pollution source. At mean time, as tree planting and gross growing, the green cover area will increase, which decorates the environment, reduces noise, breaks wind with

fixing sand, decreases water-soil running-off and improves ecological environment, providing wonderful space for people's production and life in maximum limit.

#### 4.2.4 Comprehensive benefit

From hereinbefore, it shows that the lands reclamation of the subsidence area has obvious economical, social and ecological benefits, which will realize high unification on resource developing and environmental protecting. The implement of reclamation will alleviate employment pressure, maintain social stability and solidarity, improve environmental quality, applying wonderful life situation for residents and enhancing the life quality, behaving well investment efficiency.

### 5 Conclusions

Shuangyashan city, locating in Beidahaung of the northeast of China, has a large amount of subsided land, which mainly scatted in seven coal mines. The damaged characteristics of these subsided lands were analyzed. Based on local requirements, a general reclamation plan was

made for the seven coalmines. Each coal mine has its own typical post-mining land use, which makes the effectiveness of reclamation could be best. Reclamation is a powerful work for restoring the damaged land to fertile cultivated land, which will keep its position of national important commodity grains base and taking the reclaimed area to be important agricultural demonstration plot.

The reclamation of subsidence areas in Shuangyashan City will create tremendous social benefits, economical benefits and environmental benefits.

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