CSCanada
Studies in Sociology of Science
Vol. 4, No. 1, 2013, pp. 25-29
DOI:10.3968/j.sss.1923018420130401.2909

ISSN 1923-0176 [Print]
ISSN 1923-0184 [Online]
www.cscanada.net
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Comprehensive Evaluation of Social Benefits of Mineral Resources Development in Ordos Basin

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Supported by The ministry of land and resources project, Social Benefits Comprehensive Evaluation of Mineral Resources Development in Ordos Basin. Bill of project is 1212011088003-01.

Received 1 December 2012; accepted 14 January 2013

Abstract
This paper ranges and analyzes social benefits of the 12 mining cities' mineral resources development in Ordos Basin by using a comprehensive evaluation method of social benefit. It involves the development of coal, oil and natural gas. On this basis, the paper points out a bit of problems and provides corresponding suggestions.

Key words: Social benefit; Mineral resources; Development; Ordos Basin

LIU Huifang, YU Jicong, LEI Lei, LIU Guizhen, YE Changxie (2013). Comprehensive Evaluation of Social Benefits of Mineral Resources Development in Ordos Basin. *Studies in Sociology of Science, 4*(1), 25-29. Available from http://www.cscanada.net/index.php/sss/article/view/j.sss.1923018420130401.2909 DOI: http://dx.doi.org/10.3968/j.sss.1923018420130401.2909

INTRODUCTION
Ordos Basin is the second largest sedimentary basin in China with an area of 370 thousand square kilometers, including the east of Gansu, most of Ningxia, northern parts of Shanxi and some areas in Inner Mongolia and Shaanxi. The basin has rich coal, oil and natural gas resources. Mineral resources exploitation has various influences on social and economic development in the area. Evaluating social benefits of mineral resources development scientifically and objectively will contribute to better understanding status and problems of mineral resources development, in order to provide decision principle for the local comprehensive, coordinated and sustainable development.

1. A COMPREHENSIVE EVALUATION METHOD OF SOCIAL BENEFITS OF MINERAL RESOURCES DEVELOPMENT
The social benefits of mineral resources development in the paper refers to overall impacts that mineral resources development has on integrated social interest and all-round development of the whole society. It is a generalized concept which includes the contribution of mining to the interests of local and overall country and the influence on many aspects of society, economy and ecological environment. Assessment is a comprehensive evaluation through establishing an index system objectively and reasonably.

1.1 Construction of Index System
The social benefits of mineral resources development includes the impacts on the national mineral resources security, local social economy, local people's livelihood, the ecological environment and local social harmony.

The paper establishes the social benefits comprehensive evaluation index system of mineral resources development, as illustrated in Table 1.

Table 1
The Index System of Social Benefit Comprehensive Evaluation of Mineral Resources Development in Ordos Basin

Target	First-class targets	Second-class targets	Third-class targets
Z The comprehensive evaluation of social benefits of mineral resources development	A_1 The influence on national security degree	B_1 The important degree of resources safety	C_1Proportion of resources recoverable reserves in national resources recoverable reserves C_2 Proportion of the minerals output in the annual production of minerals
	A_2 The influence on the local social economic	B_2 The contribution on economic growth	C_3 The local GDP growth rate C_4 Urbanization rate
		B_3 The contribution on revenue	C_5 The contribution on central fiscal revenue C_6 The contribution on local fiscal revenue
		B_4 The influence on industrial structure	C_7 Proportion of the second industry in GDP
	A_3 The influence on local people's livelihood	B_5 The influence on education	C_8 Compulsory education popularization rate of residents C_9 Proportion of the local education investment in revenue
		B_6 The influence on employment	C_{10} Proportion of mining working population in the total population C_{11} The growth rate of disposable income of urban residents
		B_7 The influence on the distribution of income	C_{12} The growth rate of net income of farmers C_{13} Engel coefficient
		B_8 The influence on social security	C_{14} Medical insurance coverage rates C_{15} Endowment insurance coverage rates C_{16} Minimum subsistence guarantee coverage rate of city dwellers
	A_4 The influence on local ecological environment	B_9 The influence on ecological environment	C_{17} Green coverage rate C_{18} Three wastes emissions
	A_5 The influence on local social harmony	B_{10} The influence on national unity and social stability	C_{19} The influence on national unity and social stability

1.2 The Determination of Index Weight

This paper applies analysis hierarchy process (AHP) to determining the weight of every index in the comprehensive evaluation, as shown in Table 2.

Table 2
The Evaluation Index Weight of Social Benefits of Mineral Resource Development and Utilization

Index Strata	Weight of Index Strata	The Ultimate Weight of Index Strata
C_1	a_1	0.121
C_2	a_2	0.183
C_3	a_3	0.112
C_4	a_4	0.037
C_5	a_5	0.036
C_6	a_6	0.053
C_7	a_7	0.061
C_8	a_8	0.009
C_9	a_9	0.032
C_{10}	a_{10}	0.064
C_{11}	a_{11}	0.039
C_{12}	a_{12}	0.029
C_{13}	a_{13}	0.013
C_{14}	a_{14}	0.019
C_{15}	a_{15}	0.015
C_{16}	a_{16}	0.012
C_{17}	a_{17}	0.053
C_{18}	a_{18}	0.061
C_{19}	a_{19}	0.051

1.3 The Comprehensive Evaluation

Direct comparison and calculation can not be made because indicator categories, properties and units in index system are different. Even there are apparent differences between orders of magnitude. So it is needed to standardize the data which are still recorded as Ci before evaluation.

The simplified formula of comprehensive evaluation of social benefits of mineral resources development:

$$Z = \sum a_i C_i^1 \qquad i = 1, 2, 3\ldots, 19$$

2. SOCIAL BENEFITS COMPREHENSIVE EVALUATION OF DEVELOPING MINERAL RESOURCES IN ORDOS BASIN

Development of mineral resources in Ordos Basin is concentrated in some mining cities. The paper evaluates and ranks the social benefits of 12 prefecture-level mining cities with coal, oil and natural gas development, using the data published by the National Bureau of Statistics and the Ministry of Land and Resources in 2010 or 2009.

The evaluation process is as follows: first, standardize the raw data of 19 indicators for each city, then multiply the index weight by the cities' 19 index scores of X_i (i = 1, 2, ... , 19), finally, sum up each index score to get composite scores of social benefits of mineral resources development and rank scores from high to low.

The 12 prefecture-level mining cities are: Yulin, Yan'an, Weinan and Tongchuan in Shaanxi province;

Erdos and Wuhai in Inner Mongolia; Pingliang and Qingyang in Gansu province; Shizuishan, Yinchuan and Wuzhong in Ningxia province; Lvliang in Shanxi province.

2.1 Cities with Coal Mining

Among 12 mining cities, there are 11 cities for coal development. The cities' social benefits evaluation results are shown in Table 3.

Table 3
Cities' Social Benefit Scores and Ranking of Coal Development in Ordos Basin

Rank	City	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
1	Ordos	2.021	2.635	0.276	2.590	1.696	2.518	3.599	0.090	0.176	0.090
2	Wuhai	0.036	0.165	0.120	3.478	0.947	2.380	4.197	0.090	0.272	0.358
3	Tongchuan	0.012	0.128	0.179	1.776	1.235	1.935	3.782	0.090	0.554	2.048
4	Yinchuan	0.012	0.073	0.025	3.145	1.768	2.412	3.032	0.090	0.675	1.920
5	Yulin	0.738	1.446	0.229	1.554	1.210	1.998	4.185	0.090	1.450	0.070
6	Shizuishan	0.002	0.110	0.110	2.183	1.253	2.671	4.026	0.090	0.893	0.003
7	Yan'an	0.048	0.110	0.036	0.770	1.004	0.864	4.319	0.090	0.925	0.173
8	Qingyang	0.024	0.348	0.276	1.110	1.134	1.728	3.666	0.090	1.936	0.025
9	Lvliang	0.496	0.567	0.185	1.369	0.302	1.007	3.971	0.090	0.528	0.096
10	Pingliang	0.008	0.092	0.108	1.221	1.393	1.945	2.861	0.090	0.531	0.064
11	Weinan	0.061	0.055	0.022	1.332	0.522	1.081	3.001	0.090	0.586	0.045
Rank	**City**	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	**Benefit Score**
1	Ordos	0.593	0.354	0.049	0.253	0.134	0.016	1.908	-1.288	0.510	18.217
2	Wuhai	0.468	0.360	0.039	1.723	0.422	0.056	0.848	-0.307	0.510	16.162
3	Tongchuan	0.616	0.600	0.037	0.401	0.269	0.162	1.961	-1.518	0.510	14.776
4	Yinchuan	0.335	0.415	0.040	0.485	0.387	0.034	2.279	-3.044	0.510	14.591
5	Yulin	0.714	0.693	0.047	0.287	0.353	0.043	1.325	-2.774	0.510	14.168
6	Shizuishan	0.374	0.406	0.039	0.441	0.201	0.095	1.855	-1.357	0.510	13.905
7	Yanan	0.683	0.624	0.039	0.188	0.098	0.043	1.855	-0.638	1.020	12.606
8	Qingyang	0.312	0.505	0.035	0.082	0.026	0.028	0.848	-0.075	0.510	12.249
9	Lvliang	0.417	0.392	0.034	0.257	0.077	0.034	1.855	-2.295	0.510	10.233
10	Pingliang	0.398	0.450	0.033	0.184	0.042	0.030	1.166	-0.893	0.510	9.891
11	Weinan	0.647	0.638	0.040	0.213	0.075	0.062	1.908	-3.279	0.510	7.608

Ordos, Yulin, Lvliang have rich reserve and a higher yield of coal resource with a higher share of the country and a great contribution to the security of China's mineral resources; Ordos' most index scores are high, so the comprehensive evaluation is in the first place. Yulin's most index scores are relatively good, but its composite score ranks at an intermediate level due to the impact of excessive waste discharge. Although quantity and production proportion of coal resource are little and contribution to the security of the national mineral resources is not very prominent, Wuhai and Tongchuan's indicator scores closely associated with the local social, economic and livelihood are high, and thus they have high composite scores.

2.2 Cities with Oil Development

There are 4 cities for oil mining. Social benefits evaluation results of the cities are shown in Table 4.

Table 4
Cities' social benefit scores and ranking of oil development in Ordos Basin.

Rank	City	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
1	Yanan	0.448	1.464	0.104	0.770	1.004	0.864	4.319	0.090	0.925	0.173
2	Yulin	0.194	0.732	0.026	1.554	1.210	1.998	4.185	0.090	1.450	0.070
3	Qingyang	0.073	0.366	0.065	1.110	1.134	1.728	3.666	0.090	1.936	0.025
4	Wuzhong	0.012	0.256	0.078	1.332	0.900	1.447	3.264	0.090	0.480	0.0004
Rank	**City**	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	**Benefit Score**
1	Yanan	0.683	0.624	0.039	0.188	0.098	0.043	1.855	-0.638	1.020	14.071
2	Yulin	0.714	0.693	0.047	0.287	0.353	0.043	1.325	-2.774	0.510	12.706
3	Qingyang	0.312	0.505	0.035	0.082	0.026	0.028	0.848	-0.075	0.510	12.462
4	Wuzhong	0.394	0.220	0.038	0.200	0.072	0.031	1.696	-3.768	0.510	7.253

Yanan and Yulin have obvious advantages in oil resource reserve and production, which play important roles in the protection of national oil security. With the development of oil resource, Yulin City promotes the local economy development rapidly, but also it causes environmental pollution serious and reduces its social benefits comprehensive evaluation score. Yanan City develops not oil industry but tourism industry, and pays great attention to ecological environmental protection and social security stability. Thus more than Yulin in the total score, Yanan City ranks the first.

2.3 Cities with Gas Development

Ordos and Yulin are main cities with gas development. Social benefits evaluation results are shown in Table 5.

Table 5
Cities' Social Benefit Scores And Ranking Of Gas Development In Ordos Basin

Rank	City	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
1	Ordos	4.029	3.825	0.010	2.590	1.696	2.518	3.599	0.090	0.176	0.090
2	Yulin	5.421	2.086	0.008	1.554	1.210	1.998	4.185	0.090	1.450	0.070
Rank	**City**	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	**Benefit Score**
1	Ordos	0.593	0.354	0.049	0.253	0.134	0.016	2.196	-1.288	0.510	21.149
2	Yulin	0.714	0.693	0.047	0.287	0.353	0.043	1.525	-2.774	0.510	19.269

Yulin's gas reserve accounts for 44.8% of the national gas reserve as well as the city is the most important natural gas distribution area in China. Ordos gas reserve accounts for 33.3%. Though the latter resource condition is slightly weaker than Yulin's, the role of the development and utilization of Ordos' resources for local social and economic development is relatively obviously, and Ordos ranked higher composite score than Yulin city because of its relatively low emissions of industrial pollution.

2.4 Rank According to Social Benefits of Single Mineral Development

According to the comprehensive score of the main minerals in each city and the single mineral scores, the total ranking has been taken as shown in Table 7.

Table 7
The Ranking of the Social Benefit Comprehensive Score According to Each City's Single Mineral

Total Rank	The Same Mineral Rank	Mineral	City	Comprehensive Score
1	1	Gas	Ordos	21.149
2	2	Gas	Yulin	19.269
3	1	Coal	Ordos	18.217
4	2	Coal	Wuhai	16.162
5	3	Coal	Tongchuan	14.776
6	4	Coal	Yinchuan	14.591
7	5	Coal	Yulin	14.168
8	1	Oil	Yanan	14.071
9	6	Coal	Shizuishan	13.905
10	2	Oil	Yulin	12.706
11	7	Coal	Qingyang	12.606
12	3	Oil	Qingyang	12.462
13	8	Coal	Yanan	12.249
14	9	Coal	Pingliang	10.233
15	10	Coal	Lvliang	9.891
16	11	Coal	Weinan	7.608
17	4	Oil	Wuzhong	7.253

Ordos gas development with highest score ranks first, followed by Yulin gas, Ordos, and Wuhai coal. Obviously, natural gas and coal resources in Ordos City, natural gas in Yulin and coal resource in Wuhai play important roles in improving city's social benefits.

2.5 Total Sorts of Social Benefits After Comprehensive Consideration of Major Minerals

The calculation results are shown in Table 8.

Table 8
The Ranking of the Social Benefit Comprehensive Score of Each City According to

Rank	City	Comprehensive Score
1	Ordos	26.081
2	Yulin	22.635
3	Wuhai	16.162
4	Tongchuan	14.776
5	Yinchuan	14.591
6	Yanan	14.265
7	Shizuishan	13.905
8	Qingyang	13.109
9	Pingliang	10.233
10	Lvliang	9.891
11	Weinan	7.608
12	Wuzhong	7.253

After compositing the major minerals, Ordos, Yulin, Wuhai are in the top three cities ranked by comprehensive scores. Yanan is in center position and Lvliang, Weinan and Wuzhong are the lowest three.

Ordos, Yulin's major minerals have great resource advantages. Their coal and natural gas resources have high contribution to the security of China's mineral resources. At the same time, the cities' indicator scores are relatively high, which are closely related to the local socio-economy and the people's livelihood, including urbanization, local fiscal revenue growth, the industrial structure, employment, income promotion, and social security, and thus have higher social benefits. Wuhai's resource condition does not stand out, but it scores higher on the socio-economy and the people's livelihood indicators. Therefore,Wuhai offers relatively higher social benefits.

Yanan has good economic, social, environmental indicators. With its obvious petroleum resource advantage, Yanan becomes the city with the highest score of oil city; and its coal resource does not have the superiority, so the comprehensive score in the coal cities ranks low. Although the overall score of Yan'an is in the middle after compositing the two kinds of main mineral resources, but its resources exploitation, especially the exploitation and utilization of oil resources plays an important role in protecting China's oil security, promoting Yan'an's economic development, increasing employment and improving the social security and people's life.

Lv Liang, Weinan, Wu Zhong get the lowest comprehensive scores. Among them, Lvliang, and Weinan score lowest in coal cities, Wu Zhong scores lowest in oil cities. The main minerals of the three cities get weaker conditions, and the level of economic development, urbanization rate, income and social security level are low, environmental pollution from mining industry are more serious than other cities.

3. SOME PROBLEMS AND COUNTERMEASURES

3.1 The Problems

Through synthetically analysis and compare of social benefit comprehensive scores of mineral resources development of 12 prefecture-level city in Ordos Basin and the data of every index, it is not difficult to find problems:

i. The cities that social benefits comprehensive evaluation scores of mineral resources development is higher firstly perform that resources are abundant, the output value is higher and it makes a significant contribution to the national resources security, such as Ordos and Yulin. The economic structure of 12 cities whose social and economic development seriously depends on mineral resources development is single.

ii. Mineral resources development plays a vital role in economic growth of 12 cities. However, the improving functions on education, employment, social security are quite different between these cities. It may be related to work objectives, ideas and methods of local government. For instance, inputs of basic education are relatively small in Ordos; however, although resources are relatively less and the score is low in Wuhai and Tongchuan, resource development brings really interests of economic society and the people's livelihood to local population. So they are in the top.

iii. With the development of mineral resources, the ecological environment problems of the cities are all prominent. But there are big differences between 12 cities. For example, the environmental management in Yanan is better. To some degree, it benefits from the development of red tourism. The score of ecological environment in Yulin is relatively low. The environment problems are more serious in Lvliang, Weinan and Wuzhong. It may be tightly tied to the local concept and understanding.

iv. Mineral resources development results in unbalance among different cities and the growing gap between rich and poor and living environment in different groups of the cities.

3.2 Policy Suggestions

i. Ordos Basin is an important energy base in China, resource industry will still be the main industry of the area for a long time in the future, and the development of local mineral resources should formulate feasible development plan, moderate development and certain reserve to ensure the safety of national mineral resource strategy.

ii.Government should attach great importance to ecological and environmental problems brought by development of mineral resources. On one hand, change the development concept, on the other hand, improve the technical and management level, develop circular economy, and strengthen the governance and protection of ecological environment.

iii. Local governments should appropriate tilt the benefits of mineral resource development to education, health care and social security, through implementing free compulsory education, medical treatment and social security in some degree so that the mineral development will better result for the people's benefit and promote the social welfare level.

iv. Local governments should pay attention to regional development imbalances and the widening gap between rich and poor to increase social harmony. The governments should suit the measures to local conditions, adjust the local economic structure and seek new economic growth point with the development of mineral resources, to make the abundance or poor mineral area cities and counties obtain the economic rapid growth.

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