ATLANTIS PRESS

Advances in Social Science, Education and Humanities Research, volume 357

2nd International Conference on Education, Economics and Social Science (ICEESS 2019)

Willingness to Pay for Environmental Losses: A Contingent Valuation Analysis of Pastoral Area within Coal Mining in Ejin Horo Banner, Ordos

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***Abstract*—In grassland areas subject to pollution caused by coal mining such as the Ejin Horo Banner in Inner Mongolia, a reasonable compensation scenario for local herders should be considered. Willingness to Pay (WTP) was assessed with the use of contingent valuation (CV) methodology to estimate the value for environmental losses. The results indicated that: 1. The local environmental problem included dust, noise, water pollution and mine subsidence. 2. 77.61% of herders were extremely not satisfied with the compensation and 56.52% of herders disagreed mining in grassland. 3. The WTP has been estimated at 556.55 yuan annually per household. The total WTP in the coal mining area of Ejin Horo was estimated to be between 16337786.4 yuan and 48426292.7 yuan.**

Keywords—coal mining; contingent valuation; ecological compensation; grassland pollution

I. INTRODUCTION

Inner Mongolia grassland is one of the four major pastoral areas in China, accounting for 22% of Inner Mongolia Autonomous Region(IMAR). It is not only the base of animal husbandry and an important ecological barrier, but also rich in coal resource (Da and Zheng,2006)[1]. Inner Mongolia has 658 billion tons of proven coal reserves and produces around one fourth of the country's coal. From the 21st century onward, with the economic development and the implementation of the western-like development strategy in China, coal mining in grassland has become a common practice in IMAR. The coal exploration promotes the development of regional economy. However, it also made the environment destroyed, especially made great harm on the grassland and reduced the number of livestock. For those who rely on livestock, reducing numbers results in reduced development opportunities, and may affect social and cultural status (Carson et al.,2001)[2]. In particular, the Mongolians do not feel they have benefited from the mining of their resources(Liu et al.,2014). Overall, coal resource exploitation in grasslands has more negative than positive effects on the well-being of herdsmen(G.S.dai et al.,2014)[3].Herdsmen got very little directly benefits by receiving the compensation and donation from exploration companies(Zhang Q,2016)[4].Therefore, a reasonable compensation scenario for local herders must be considered in mining area.

This article will explore the use of ecological compensation tools, lookforward to solve the contradiction between environmental protection and coal mining development in Inner Mongolia grassland.

II. METHODS

A. Study Area

This survey was carried out in Ejin Horo Banner[1], which lies on a plateau in the southern portion of the Ordos ,ranging from east longitudes of 108° 58′ to 110° 25′ , and north latitudes of 38° 56′ to 39° 49′ . The altitude ranges from 1070 m to 1556 m with an annual average temperature of 6.2C (ranging from -10.78C in January to 36.6C in July), and 230 frost days annually. The banner is named for the Mausoleum of Genghis Khan, whose Mongolian name Ejin Horo translates as “the Lord's Enclosure”(Man et al.,2004)[5].

Ejin Horo contains seven town and 138 villages, with a population of about 20,9400 people. The grassland ecosystem is about 433550 ha located Ejin Horo(EHLSY,2017)[6]. The grassland area provides both local resources(forage for animals; a place to live) and acts as a natural ecological buffer and water conservation. Animal numbers were estimated to 481531 sheep equivalents in 2017.Total fossil fuel reserves beneath the Ejin Horo Banner are estimated to be about 50.5 billion tons, which includes coal and natural gas. Although beginning at the end of 1940s, the coal mining industry did not have too much effect on the local economy for a long period. In the late 1980s, Erdos grasped the opportunities that the national energy strategy transferred from east to West, building a large scale of energy projects with coal as the center(liu et al.,2012)[7]. Ordos became the new “coal capital” of China within a few decades(Zeng et al.,2018)[8] .An increasing number of coal factories are being built in grasslands to generate revenues through large-scale coal exploitation. Coal mining is the main force of the GDP growth in Ejin Horo. In 2018, the per capita GDP amounts to 43000 dollars and reached the level of per capita GDP of a moderately developed country.

Historically, herds in Ejin Horo have been engaged in animal husbandry and are referred to as “the nationality on horseback”. However, coal resource development has polluted

This work is supported by the National Social Science Foundation of China under Grant No. 15XSH010.

[1]In the administrative organization of the Inner Mongolia Autonomous Region, banner, sum, gachaa correspond to county, township and village in the provinces.

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and damaged the local ecological environment. Pasture degradation, soil erosion, and desertification were ongoing problems during the late 20th century in this area(Kasperson et al.,2011)[9]. In addition, Coal exploitation activities are characterized by persistence in time, space scalability, long development cycles, numerous forms of perturbations of environmental systems, a wide range influence and complex mechanisms; the influence of coal exploitation on human well-being is profound and long-lasting [10](Wang et al., 2010).

B. Method: Contingent Valuation

Ecological compensation can be regarded as the price paid for individuals or regions to sacrifice their development opportunities in order to protect ecology and the environment (Liu et al.,2008)[11].Since Davis(1963) put forward the Contingent valuation method(CVM), it has been a popular and flexible non-market valuation method for Ecological compensation. With CVM, a contingent scenario is constructed and then direct money measures for the changes in welfare are elicited.

CV involves the direct elicitation of respondents' willingness to pay (WTP) or willingness to accept (WTA) payment for changes in the quantity or quality of a public good or service. (Fried B M et al.,1995)[12].In economics, willingness to accept (WTA) is the minimum amount of money that a person is willing to accept to abandon a good or to put up with something negative, such as pollution. It is equivalent to the minimum monetary amount required for sale of a good or acquisition of something undesirable to be accepted by an individual. Willingness to pay (WTP) is the maximum amount that people would be willing to pay for the resource or to avoid any damages that might be sustained by the resource. Economists have been using the method for well over three decades in many countries. In China, this method has been widely used in the study of natural and environmental resources' value, ecological value, social value and people's willingness(Li G P,2014)[13].However, there is lack of comprehensive analysis about the CV method on coal mining in grassland.

In pastoral areas of Ejin Horo Banner, we opt to use WTP. Firstly, in the long-term social practice, local herdsmen thought that they could not easily be compensated for the destruction of the ecological environment. Secondly, many herdsmen lack trust in the government. They think that even if there are compensation, it will be withheld or misappropriated by the government. It is impossible to give them the full compensation. What's important is that most of herdsmen think it should be their duty to protect the grassland.

C. Questionnaire Design and Field Study

The types of questionnaires on CVM include Iterative Bidding Game, Open-Ended, Payment Card, and Dichotomous Choice. According to the local current situation of ecological environment and the basic principle of CVM method, we applied the Payment Card (PC) to estimate the WTA of local herdsmen. The questionnaire structure is designed to three parts in this article. The first part of the questionnaire is about the basic family situation of herds (population structure, household situation). The second part is about the understanding of grassland ecological environment and herd's attitude toward the coal mining. The third part is the WTP question, which format asked each household to pay a particular amount of money each year. With the use of PC, respondents are given a range of values to select from (bids). Respondents were given the WTP scenario and asked if they were willing to pay a certain predetermined amount (bid) i.e. a discrete yes/no bid. Respondents who selected payment bids ranging from 1000 yuan, 500yuan and 100yuan from which they had to select a bid that indicates their willingness to pay for annually.

Between July and August 2019, 16 undergraduate students from the School of Ethnology and sociology of Inner Mongolia University conducted one field questionnaires on the coal-mining grassland of Ejin Horo. The survey was deployed to a sample of 400 families selected with the use of randomized cluster sampling. It has investigated three villages, two gacha. A total of 400 households were surveyed by face-to-face. The effective number of questionnaires was 372. The effective rate of the questionnaires was 85.8%.

III. RESULTS

A. Socioeconomic Characteristics of the Respondents

TABLE I. SOCIOECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Item	N
Sex	
Male	**202**
Female	**170**
Nationality	
Han	**104**
Mongolian	**262**
Hui	**4**
Manchu	**2**
Age (yr)	
< 20	
20-29	**31**
30-39	**89**
40-49	**60**
≥50	**172**
Education	
Illiterate	**80**
Elementary	**95**
Senior	**130**
Higher	**41**
Associate degree and above	**26**
Financial characteristics Income (x 10000 RMB)	
<1	**64**
1-2	**43**
2-3	**33**
3-4	**36**
4-5	**43**
5-6	**35**
6-7	**31**
>7	**87**

The basic socioeconomic information of the respondents is shown in Table I. Of the 372 respondents, 202 (54.3%) were male and 170 (45.7 %) female. In terms of nationality structure, there are 104 Hans, 262 Mongolians, 4 Huis and 2 Manchus. The mean age was 47 yr, ranging from 18 to 74 yr, 80 were illiterate with no formal education and 26 respondent had a college education. The average income a family was 51213 RMB per year.

B. The Influence of Coal Mining on Respondents

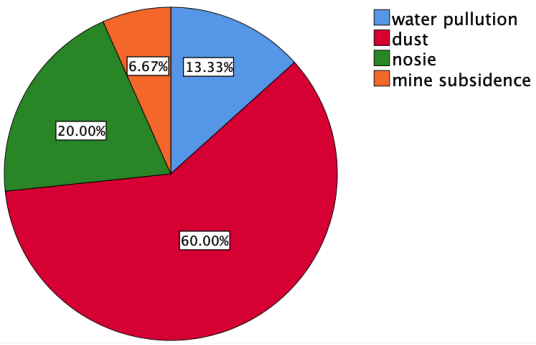

Fig. 1. What was the perception of herdsmen think the main environmental problem caused by coal-mining

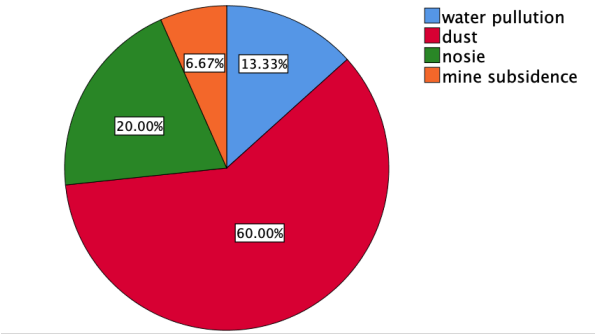

Fig. 2. Did the herdsman satisfy with the compensation they received from the coal mining enterprise

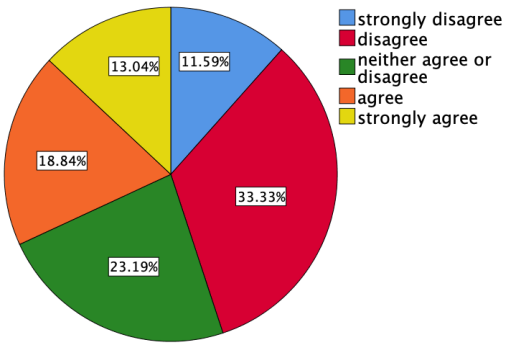

Fig. 3. What was the opinion of herdsmen regarding the coal mining in grasslands

The pollution of coal exploitation on grassland are multifaceted. According to the survey of the opinions of local herdsman, the main environmental problem caused by coal mining included dust(60%),noise(20%),water pollution (13.33%) and mine subsidence (6.67%) . Dust can be caused by coal crushing operations, drilling operations and trucks being driven on unsealed roads, wind blowing over areas disturbed by coal mining. Noise mainly caused by the mine blasting task and the sound around fan outlet. Coal mining activities frequently impinge on water resources. Some discharges are acidic and contain high concentrations of dissolved metals and trace elements. Acid mine drainage may cause serious and highly visible pollution (Clarke L B,1995)[14]. Coal mining also cause the overlying strata to cave in continuously, forming caving zone, producing fissures and subsidence zones on the grassland. The number of collapsed areas will increase due to the degree of development and the intensity of coal resource exploitation (Li et al., 2009)[15].

Coal mining compensation assumed enormous importance for the local herdsman. Based on existing compensation standard, they can get two kinds of compensation by coal mining enterprises, one is for grassland damage (150yuan/per mu), the other is for water resource decrease (100yuan/per mu). However, this standard is limited to herdsmen near coal mines. Moreover, compensation for land use are opaque, weak and poorly regulated. As the result, most herdsmen do not believe that these compensations are reasonable and can make up for the loss of their livelihood. In our survey, 77.61% of herders stated that they were extremely not satisfied with the amount of compensation they received, while 22.39% of herdsmen were of the opinion that they satisfied with the compensation (Fig. 2).

Grassland is the material basis for the development of pastoral areas and is the living protection of herdsmen. Although coal mining in Ejin Horo has been enhanced the governmental revenues, the herdsmen had to bear the risk of pollution. According to the Survey of the opinions of local herds, 56.52% of herdsmen would disagree mining in grassland. Only 24.63 of the surveyed herdsmen approved mining in grassland(Fig. 3).

C. Wtp Analysis

TABLE II. WTP ANALYSIS

Willingness to pay

	Frequency	Percentage
WTP>=Lowestbid(100)	227	61.0
0<WTP<Lowestbid(100)	12	3.2
WTP=0	133	35.8
Total	372	100.0

From table II, out of the 372 successfully completed respondents, 35.8 percent were invalid responses. We note that out of 61.0 percent that reported positive WTP, 3.2 per cent reported WTP values less than the minimum/lowest presented bid. In terms of payment level, the average WTP per household

is 556.55 yuan per year, the result show that mean WTP for the sampled households is estimated to be 556.55 yuan. The reason for willingness to pay are as follows: improving the ecological environment is closely related to personal life; for the good environment of the next generation; it is a response for them to protect the environment. The reasons for the unwillingness to pay are as follows: the destruction of the environment is caused by the coal enterprises and should be borne by the enterprises; the ecological environment belongs to public affairs and should be borne by the government; the respondents had low income, heavy family burden and could not afford to pay.

Based on the principle of random sampling, we can therefore use the result to calculate total willingness to pay for the relevant population in Ejin Horo.

$$N(\overline{wtp} - t\mu\overline{wtp}) \le N\overline{WTP} \le N(\overline{wtp} + t\mu\overline{wtp})$$

In the above formula, $\overline{wtp}$ is the mean WTP for the sampled households. $\overline{WTP}$ is the value for environmental losses in the coal mining area of Ejin Horo. t means probability degree. $\mu\overline{wtp}$ is the standard error of mean. With the 95% confidence interval, $\overline{WTP}$ is estimated to be 556.55 yuan annually with interval estimates of 280.80 yuan and 832.31yuan. We expand the $\overline{WTP}$ estimate for the model without covariates to the population value here. According to there were 58183 households in coal mining area of Ejin Horo in 2017. Multiplying this by the mean WTP and annualizing it yields a total of approximately 32381748.6 yuan with interval estimates of 16337786.4 yuan and 48426292.7 yuan.

IV. Conclusion

The grassland of IMAR is and continues to be an important source of livelihood to the herdsman in terms livestock support, and income generation. However, coal mining in grassland has exerted a negative influence on herds' livelihood. Herds have a right to expect fair compensation within coal mining. How to calculate reasonable compensation value is the key to this problem.

The main objective of this study was to obtain estimates of WTP values for the environmental pollution by coal mining in the pastoral area of Ejin Horo, Ordos. The study shows the main environmental problem within coal exploitation included dust, noise, water pollution and mine subsidence. At least 64.2 percent of respondents had willingness to pay for environmental loss. This WTP has been estimated at 556.55 yuan annually. The estimate of WTP to relevant herds in the coal-mining area of Ejin Horo was 32381748.6 yuan annually. This study demonstrated the applicability of the CV method to the issue of the compensation for herds within coal mining in grassland. Due to financial and other constraints, this study did not cover a wider area. In the forthcoming studies, more households need to be surveyed. The empirical results from this study suggest some important ideas and may act as a good foundation for many more studies on the ecological and environmental compensation within coal exploitation in the pastoral area of IMAR.

Acknowledgment

This work was financial supported by the project: China Northern Minority Areas Social Survey Databases. I would like to thank entire project team for their commitment.

References

[1] Lintai Da,and Yisheng Zheng,“Pastoral area and market: pastoralists economy,”Beijing:Social Sciences Academic Press,2006,pp.438.(In Chinese)

[2] Carson, R.T,Flores,N.F,and Meade, “Contingent valuation: controversies and evidence,” Environmental and Resource Economics, vol.19,2001,pp.173-210.

[3] Daia,G.S. and Ulgiatib,S,“The false promises of coal exploitation: How mining affects herdsmen well-being in the grassland ecosystems of Inner Mongolia,” Energy Policy,vol.4,2014,pp.146-148.

[4] Zhang Q. “The Logic of Interest Distribution and Herdsmen's Profit within Mineral Exploitation: A Case Study of Huogeqi Sum in Inner Mongolia”, Sociology and Anthropology , vol.4(9),2016,pp. 836-843.

[5] John Man, “Genghis Khan: Life, Death and Resurrection”, London: Bantham,2007,pp.286.

[6] Ejin Horo League Statistics Bureau, “Ejin Horo League Statistical Yearbook”,2017, unpublished. (In Chinese)

[7] Liu H, Ye C. and Qi X, “Study on developing coal resource with the social-economic influence in Erdos City,” Cross-Cultural Communication, vol.8(6), 2012,pp.112-117.

[8] Zeng X, Liu Z, He C, Ma Q, and Wu J, “Quantifying surface coal-mining patterns to promote regional sustainability in Ordos,Inner Mongolia,” Sustainability, vol.10(4), 2018, pp.1135-1-17.

[9] Kasperson, Jeanne X, Kasperson, Roger E and Turner II, B. L, “The Ordos Plateau of China. Regions at risk: comparisons of threatened environments”,New York: United Nations University Press,2011,pp27.

[10] Wang Y J, Zhang D C, Lian D J, Li Y F, and Wang, X.F, “Cumulative effects of coal mine development on resources and environment”, Sci. Technol. Rev, vol.28 (10), 2010, pp.61-67.

[11] Liu G H,J Wan, H Y Zhang,and L J Cai, “Eco-compensation policies and mechanisms in China”, Review of European Community & International Environmental Law, vol.17,2008,pp.234-242.

[12] Fried B M , Adams R M , and Bergland B O ,“Changes and Challenges in the Wildlife Profession. Willingness to Pay for a Change in Elk Hunting Quality”, Wildlife Society Bulletin,vol.23(4),1995, pp.680-686.

[13] Li G P, “Research on paid use system and Eco-compensation mechanism of mineral resources”, Beijing: Economic Sciences Press,2014,pp.148.(In Chinese)

[14] Clarke LB.Coal Mining and Water Quality,London:IEA Coal Research,1995,pp.99.

[15] Li Y F, Liu YH, Du Z P, and Chen J, “Effect of coal resources development and compensation for damage to cultivated land in mining areas” ,Min. Sci. Technol. vol.19 (5), 2009,pp.0620-0625.