Risk perceptions and mining-induced displacement and resettlement:

a case study from Anhui Province, China

Abstract: Based on data obtained from a survey conducted in the Liang Huai coal mining area in Anhui Province, the author determines the factors that influence affected persons' (APs') willingness to move in relation to four types of risk perception using the multifactor logistic regression method. The results show that the age of householders, the cultivated land area, the proportion of agricultural income, and the scale of the social network have a significant negative correlation with the willingness to move. Education level, household size, the main types of family employment, the proportion of nonagricultural income, the relocation infrastructure, the mode of relocation, and satisfaction with the compensation policy have a significant positive correlation with the willingness to move as a result of mining-induced displacement and resettlement (MIDR). With regard to perceived risk, first, the willingness to move under the institutional risk perception category is strongly affected by the evaluation of government behavior. Second, under the economic risk perception category, the willingness to move is significantly affected by the main type of family employment, the geographical orientation of the resettlement area, and the area of family-owned cultivated land. Third, under the social and cultural risk perception categories, the willingness to move is significantly influenced by the social network scale and expectations of resettlement effects, respectively. These findings remind us that local governments should formulate reasonable income distribution regulations and balance the interests of all stakeholders considering the resource endowment and the level of economic development.

Keywords: Risk perception; coal mining; China; resettlement (MIDR); project-affected persons

1 Introduction

Physical displacement, relocation, and resettlement are widely acknowledged as posing enormous risks to project-affected peoples (*Owen and Kemp, 2015*). Many development projects, such as hydropower dams or mines, cause the resettlement of a large number of people. As *Cernea* (*2018*) demonstrated, when project proponents do not address displacement risks, there is a tendency for affected people to become worse off. Over the past few decades,

many scholars and project-affected people have emphasized the need to focus on the effects of development-induced displacement and resettlement (DIDR) (*Gans, 1968; Colson, 1971; Cernea and McDowell, 2000*). Mining projects can bring great benefits to society; however, they also bring ecological and environmental issues, resulting in the destruction of the environment on which livelihoods depend (*KN Funoh, 2014*). In particular, the development of coal resources (including open-pit- and well-mining) has seriously damaged land resources (*Bian and Zhai, 1996*). Cernea's Impoverishment Risks and Reconstruction model is a theoretical model for involuntary resettlement that highlights the intrinsic risks that cause impoverishment through forced displacement. These risks include the following: landlessness, joblessness, homelessness, marginalization, food insecurity, increased morbidity and mortality, the loss of access to common property, social disintegration, the loss of access to community services, and the violation of human rights (Cernea, 1997). Meanwhile, the generalized nature of current global policy norms for DIDR limits the extent to which the particularities of mining-induced displacement and resettlement (MIDR) can be constructively addressed (*Cernea, 2018*).

Numerous studies have demonstrated that involuntary resettlement can be overwhelmingly detrimental to host communities (*Bennett and McDowell, 2012; Terminski and Bogumil, 2013; Farrell et al. 2012*). *Cernea* (*1997*) notes that being forcibly ousted from one's land and residence carries with it a risk of poverty greater than that experienced before displacement.

Angulo (2007) argues that risk perception has a notable effect on behavior such that households' risk perception will affect their willingness to move. Many scholars have discussed the relationship between displacement-related risk and the damage caused to the interests of APs (*Guoqing Shi, 2005; De Wet, 2009; McDonald-Wilmsen and Webber, 2010; C Graif, 2016*). Numerous studies have focused on the macro level, while deep, quantitative research at the micro level (nations or governments) is lacking. Therefore, from the micro perspective (the perspective of APs), this paper selects the Huainan and Huaibei areas in China to study household relocation intention under different levels of risk perception.

In China, 95% of coal is produced from underground mines compared to 31% in the United States and 22% in Australia (*Bian et al., 2010, p.217*). The development of mineral

resources in China by underground mining has caused an obvious negative impact through land subsidence (*Bian et al., 2010*). The number of displaced farmers is estimated to exceed 2.3 million. This figure is far greater than the number of people displaced due to the Three Gorges Dam (*Vander Klippe, 2015; Xinhua, 2015*). In China, only a few scholars have studied MIDR, mainly focusing on resettling patterns, compensation standards, and compensation measures (*Jiang, 2016*). However, some scholars believe that the majority of migrants could adapt to new living places and could live a better life (*X.F. Maoa et al., 2012*). *Yaozu Xue and Lei Huang (2018)* note that human, natural, and financial assets are positively affecting the livelihoods of ecological migrants in coal mined-out areas.

In this article, the authors analyze the main factors affecting peoples' willingness to move. The authors construct a theoretical model of the relationship between risk perception and relocation willingness considering whether the move is voluntary or involuntary. The authors chose the Liang Huai mining area as a case area for empirical analysis with the aim of providing a reference for how to meet APs' relocation needs. This article is divided into four sections. The following (second) section provides a brief overview of the case area and analyzes the data selection, research framework, and research hypothesis. The third section analyzes the research results, including a statistical description of the sample households and the model fit tests. Finally, the fourth section concludes the paper with a discussion of the research.

In this paper, the authors reach the following conclusions. i) APs' willingness to move is influenced by many factors; nonetheless, these factors have varying influences on APs' willingness to move under different dimensions of risk perception. ii) The factors that influence willingness to move are related to four types of risk perception in MIDR. Under the institutional risk perception category, APs' willingness to move is significantly influenced by the geographic location of the resettlement area and the evaluation of government behavior. Under the economic risk perception category, APs' willingness to move is significantly affected by the main households' types of family employment and family-owned land quantity. Under the social and cultural risk perception categories, APs' willingness to move is significantly influenced by social network scale and the expectation of resettlement effects, respectively. At the end of the article, several ways to achieve a harmonious relocation and

APs' sustainable development are also discussed: i) companies must take the initiative to assume the social responsibilities and risks of mining; ii) local governments should balance the interests of all stakeholders by establishing a reasonable income distribution system; and iii) scholars must conduct systematic studies to describe and explain people's risk perception, willingness to move, and attitudes.

2 Methodology and data sources

2.1 Research theory

Risk perception is a psychological concept that refers to individuals' perception and the recognition of various types of risk. Risk perception is influenced by individuals' subjective experiences, intuitive judgments, and cognition (*Englander et al., 1986; L Sjoberg, 2000*). *Yang (2004*) identifies four forms of risk—institutional risk, technical risk, ecological risk, and life risk—that comprise the modern risk landscape. In addition, the perception and experience of individual risk are simultaneously influenced by psychological factors and probability estimates. Scholars understand risk perception differently according to whether the individual's perspective or that of the group is considered. *Sjoberg* (*2000*) believes that risk perception is an individual's subjective perception and understanding of various external risk factors, perceived by relying on personal intuition. By using a questionnaire, *Fishhoff* and Weingart (*1995*) reveal the quantifiable and measurable nature of risk perception. Meanwhile, social scientists have criticized the techno-scientific concepts[1] of risk. They believe that such risk measurements do not include critical social-cultural factors, such as the important impact of differences among groups and individuals and of different types of "social reality" on certainty (*Renn et al., 2011; Zinn, 2009*). These authors highlight how, for instance, psychological perspectives consider individual perception of harm and its likelihood, and sociological perspectives consider the social constructions of risk (*Jaafari, 2001; Tulloch and Lupton, 2003*). In addition to considering the assessment of risk itself, perceived risk is shaped by subjective dimensions such as involuntariness and dread, and risk is inequitably distributed (*Kemp et al., 2016; Zou and Zhong, 2013*).

[1] Techno-scientific concepts: techno-scientific approaches to risk are derived from the fields of engineering, statistics, actuarialism, epidemiology, and economics and are expressed through the mathematical functions of probability and harm, where harm is associated with human health, the environment, and physical assets (*Lupton,2013*).

Risk is an effective mediator between relocation and the resettlement behavior associated with mining (*Nick Pidgen, 1998; Owen and Kemp, 2013*). Scholars (*Joyce and Thomson, 2000; EY, 2015; Kunz et al., 2013*) have linked social risk to a broad set of mining impacts with the potential to generate social harm through aspects such as changes in land use, in-migration, displacement and resettlement, dependency, and livelihood impacts. The risk perception of MIDR is based on subjective evaluation, experience, and judgment. As the perceived risk of MIDR varies, so does the decision to relocate (*Botin and Anderson, 2009; He, 2013*). According to the classification of risk perception types by predecessors (*Asa Boholm, 1998; Bastide et al., 1989*), this paper classifies the risks people can perceive in MIDR into four categories: economic risk perception, social risk perception, institutional risk perception, and cultural risk perception (*Hang-Min Cho, 2011; DY Kim and J Jung, 2017*). Risk perception regarding a move has, in turn, been associated with the willingness to carry out individual actions to mitigate the effects of this phenomenon on displaced persons.

In the process of studying MIDR willingness, APs' willingness to move has been found to be influenced by multiple factors[2] including psychological, spiritual, and external influences. To analyze the impact of perceived risk on the willingness to move, the authors assume that the main factors affecting willingness to move are those related to the household, resettlement area, social relationships, and institutional policy (see Figure 1). Among them, **household factors** include the age of the householder, the education level of the householder, the number of family members participating in insurance, the main types of employment in the family, the proportion of nonagricultural income, annual net income per household, and annual household expenditures. **Resettlement area** factors are related to the distance from the town to the resettlement area and the infrastructure status of the resettlement area. **Social factors** include aspects related to the scale of the social network, gift giving[3], and neighborhood relationships. **Institutional policy factors** include the evaluation of enterprises and government behavior and the expectations of resettlement.

[2] Factors such as the location of the family, age structure of the population, education levels, political outlooks, and income levels and structure (*Tang, 2010*).

[3] "Gift giving" is common in China, especially at weddings and funerals. It can be regarded as another symbol illustrating whether the relationship between the host and the guest is close (*Liu, 2008*).

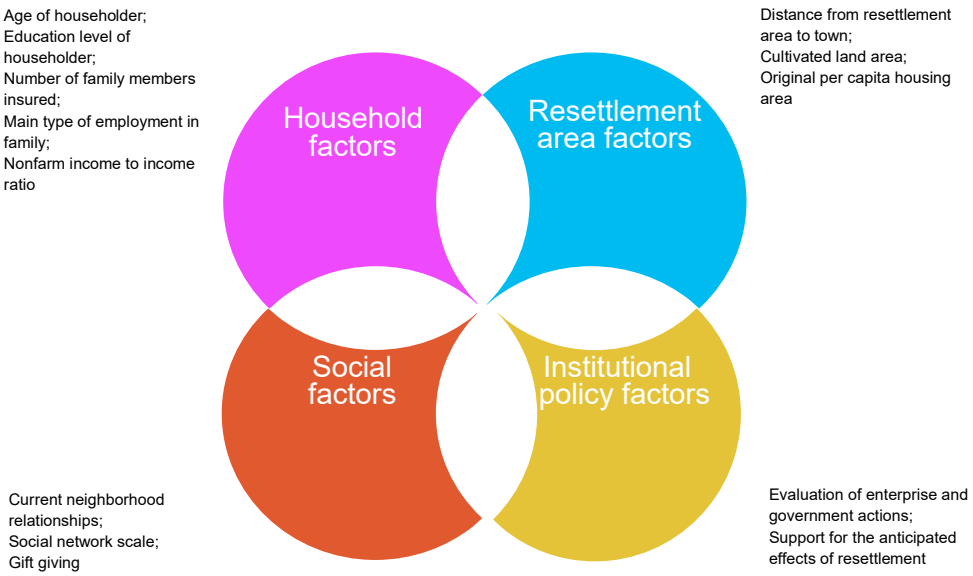

Figure 1 Main factors affecting willingness to move

2.2 Methodology and hypotheses

Through focus groups and in-depth interviews, the authors conduct a qualitative exploration of the perceived risk of MIDR among APs. Based on data collected through field research and the theory of perceived risk, the authors use statistical techniques such as logistic analysis to divide perceived risk into four types: economic, social, cultural, and institutional. In this paper, perceived risk is an intermediary variable that is introduced into a model of the factors that influence resettlement willingness. Then, the authors use risk perception (prc) indicators as the explanatory variables and measure the risk perception of APs as strong (prc = 1) or weak (prc = 0). Finally, the factors that affect the willingness to move (household characteristics, economic factors, social relationship factors, and policy system factors) are taken as the corresponding influencing factors.

The first hypothesis of this paper is proposed as follows:

Hypothesis 1: The risk perception of APs is influenced by many factors such as household characteristics, economic factors, social relationship factors, and policy system factors. The higher the education level of the householder and the household's agricultural income, the higher the perceived risk will be. At the same time, perceived risk is inversely proportional to social interpersonal relationships and a reasonable and perfect policy system. That is, the better the interpersonal relationships are after relocation, the higher the

satisfaction with the policy will be. Additionally, the lower the perceived risk, the higher the resettlement willingness will be. Therefore, hypothesis 2 is proposed:

Hypothesis 2: The stronger the degree of risk perception is, the weaker the willingness to resettle will be. The perception that the advantages outweigh the disadvantages has a positive correlation with the willingness to move, while the perception that the harm is greater than the benefits has a negative correlation with the willingness to move. Therefore, the factors influencing the willingness to move are affected by different risk perception models, and different factors are affected by different modes (i.e., modes of economic risk perception, social risk perception, cultural risk perception, and institutional risk perception).

2.3 Study areas

The authors choose the Liang Huai coal mining area (Huainan and Huaibei)[4] as the case study area (Figure 2). The reasons for choosing this area are as follows. i) The Liang Huai area is the largest coal-producing area in eastern China (*Fan and Luo, 2018*). The relocation of APs in these two places is proceeding to varying degrees, affecting those with voluntary and involuntary willingness to move. In addition, the municipal government adopts different means of resettlement according to the actual situation and wishes of the APs. These different means of resettlement fully consider the willingness of APs. ii) The authors must account for the actual conditions of the investigation such as whether there is a cooperative unit in the case area.

[4] Huainan City is located in the middle reaches of the Huai River, north of Anhui Province, with a total area of 5571 km^2. Huaibei City, located in the northern part of Anhui Province, is located in the hinterland of eastern China, with a total area of 2725 km^2.

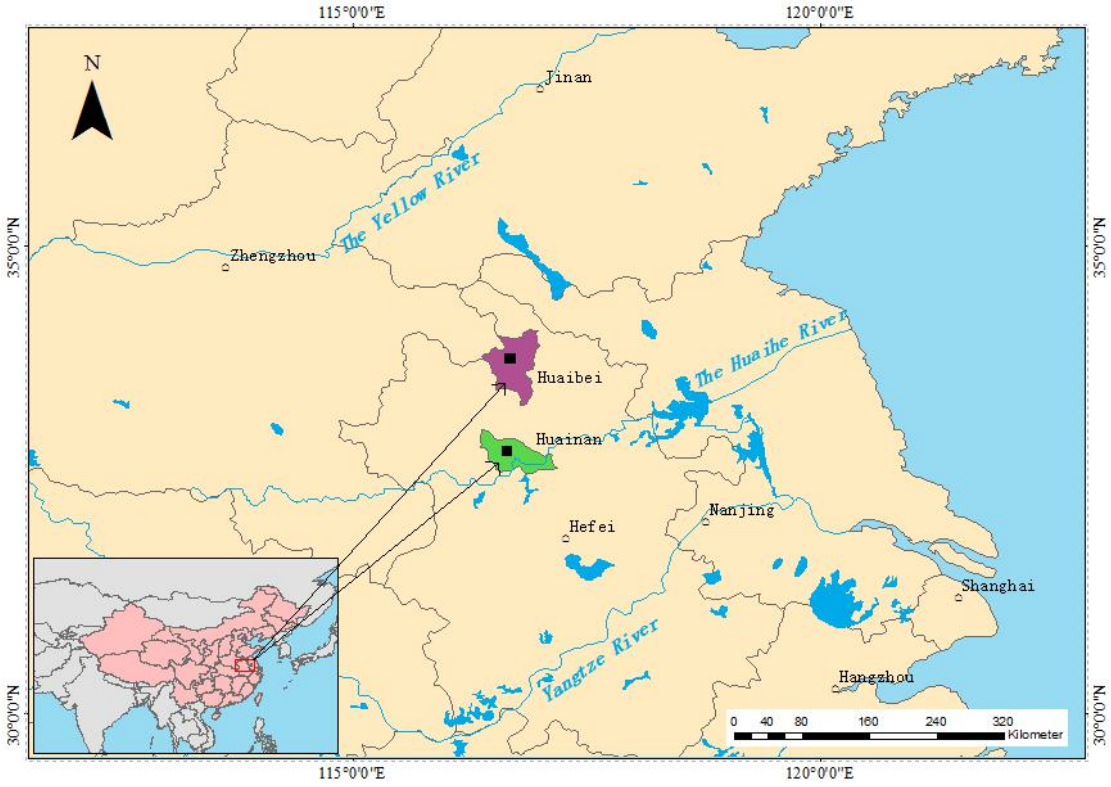

Figure 2 Location and geographic scope of the Liang Huai coal mining area

2.4 Data sources

The data were collected first-hand from a survey and analyzed using descriptive statistics and logistic regression models. Relocation in the Liang Huai mining area affects a large number and range of people. The research group organized a questionnaire survey in Huaibei and Huainan in November 2017 and March 2018. The determination of sample villages (communities) and households was based on the actual situation of existing MIDR (*Jing, 2009*). First, the authors used the quota sampling method to sample 402 and 604 quota samples in Huainan and Huaibei, respectively. Second, the authors used the stratified random sampling[5] method to select 3 villages in Huainan and 4 villages in Huaibei, with each village representing 144 samples.

The survey included 2,853 persons from 1,006 households, 12 groups, and 7 villages. The respondents from Huainan City included the following: Township A: 248 households (754 persons), 3 groups, and 2 villages; Township B: 144 households (443 persons), 2 groups, and 1 village. The respondents from Huaibei City included the following: Township C: 248

[5] Stratified random sampling refers to the method of dividing the subjects into several groups and then randomly sampling each group. In practice, according to the family conditions of households, the proportion of 20% has the best reliability, 60% has an average reliability, and 20% has the worst reliability (according to the statistics of the family income of the village).

households (764 persons), 3 groups, and 2 villages; Township D: 144 households (439 persons), 2 groups, and 1 village; and Township E: 144 households (453 persons), 2 groups, and 1 village. The method of investigation was face-to-face interviews. For APs who were not at home because they had gone elsewhere to work, the research group obtained data with the help of the village group cadres. The research group sent out a total of 1,006 questionnaires, and 948 copies were returned. After questionnaires with missing or contradictory information were eliminated, 897 valid questionnaires remained, accounting for 89.2% of the total number of questionnaires. This number far exceeds the minimum requirement for the model. The distribution of the survey sample is shown in Table 1.

Table 1 The distribution of survey sample

Towns involved in the investigation		**Number of investigations involved (Persons)**	**Proportion of towns in total population (%)**	**Land area involved in the investigation (Mu)**	**Proportion of towns in total land area (%)**
Huainan	**Township A**	754	24.79	229.8252	30.36
	Township B	443	17.85	79.461	14.58
Huaibei	**Township C**	764	29.1	510.4638	57.42
	Township D	439	17.29	355.344	67.3
	Township E	453	10.97	44.4545	13.27

Data source: Calculated by the statistical yearbook “Mining Area of Huainan City and Huaibei City”

2.5 Model construction

The risk perception dimensions are divided into 4 types: Model 1 is economic risk perception, model 2 is social risk perception, model 3 is cultural risk perception, and model 4 is institutional risk perception. By comparing the perceived risk factors with the perception of risk by among households, the authors divide all respondent households into voluntary and involuntary. That is, in the questionnaire, the respondents who choose “yes” are relocating voluntarily, and those who choose “no” are moving involuntarily. Based on the logistic model, the willingness to move is taken as the dependent variable, and the factors that affect the willingness to move are taken as independent variables. Analyzing the relationship between the dependent variable and independent variables reveals the influencing factors and their contribution to the willingness to move. In the model, the Hosmer-Lemeshow test is used to test the goodness of fit of the model (*Sun et al., 2011*).

The function of willingness to relocate is as follows:

Willingness to move

$$(W) = \mathrm{F}\left(\begin{matrix} SELF \text{ the characteristics of the resettlement EXT the resource} \\ \text{endowment factor of resettlement households} \end{matrix}\right) + \mu$$

The logistics model is established as follows:

$$\ln\left[\frac{\text{prob}(y = 1 \mid X_1 \cdots, X_k)}{1 - prob\ (y = 1 \mid X_1 \cdots, X_k)}\right] = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k + \mu$$

where $X_i(i = 1, \cdots, k)$ is the model's independent variable, $\beta_i(i = 0, \cdots, k)$ is the parameter to be estimated, and μ is a random perturbation term.

Based on the logistic model described above, the authors explore the factors influencing the willingness to move from the perspective of perceived risk according to the analysis of risk perception theory. Table 2 contains the definition, assignment explanation, and expected impact direction of each independent variable.

Table 2 Index design and description

Indicator category	**Variable definition**	**Description of assigned values**	**Expected direction of action**
Characteristics of affected households (H)	Age of householder (age) (H_1)	= Actual age	negative
	Education level of householder (H_2)	Illiterate = 1, primary school = 2, middle school = 3, high school = 4, college above = 5	positive
	Number of family members insured (H_3)	= actual number	positive
	Main type of employment in family (H_4)	Farming = 1, part-time = 2, nonagricultural = 3	positive
	Nonfarm income to income ratio (%) (H_5)	Less than 20 = 1, 20–40 = 2, 50 = 3, 60–80 = 4, above 80 = 5	positive
Location characteristics of the household area (L)	Distance from resettlement area to town (m) (L_1)	Less than 3,000 = 1, 3000-5000 = 2, 5000-10000 = 3, over 10,000 = 4	negative
	Cultivated land area (L_2)	Less than 1 mu = 1, 1-3 mu = 2, 3 mu above = 3	positive
	Original per capita housing area (m^2) (L_3)	Less than 15 = 1, 15-30 = 2, 30-50 = 3, 50-80 = 4, above 80 = 5	negative
Characteristics of social networks (S)	Current neighborhood relationships (S_1)	Bad = 1, moderate = 2, good = 3	positive
	Social network scale (S_2)	Small = 1, medium = 2, large = 3	negative
	Gift giving (S_3)	Small = 1, medium = 2, large = 3	undetermined
Characteristics of institutional policy evaluation (I)	Evaluation of enterprise and government actions (I_1)	Strong government: harms the interests of APs =1, basically meets the interests of APs = 2, fully considers the interests of APs and achieves a balanced distribution of interests = 3	positive
	Support for the anticipated effects of resettlement (I_2)	The government is unsupportive = 1, the status quo = 2, the government will provide short-term support = 3	positive

3 Results

3.1 Descriptive analysis of the sample of affected households

Among the 897 households that completed valid questionnaires, 331 were willing to move, accounting for 36.9% of the sample, and 566 were reluctant to move, accounting for 63.1% of the sample. The reason why 229 households (in 331 households) were willing to move is that the original contracted land was less fertile, and the production on the land had sharply declined. With the development of mining activities, APs had to compromise. Another 83 households were willing to move because of the poor living environment. The remaining 19 households were willing to move because they were satisfied with the relocation subsidy provided by the government.

The reasons why the APs were reluctant to move were diverse. In the sample, 197 households were unwilling to move because they were concerned about improper resettlement policy. They thought that the compensation measures were unreasonable and that they would be at risk of losing their land. Another 193 households were reluctant to move because they thought that their income would decrease after relocation. A total of 68 households were reluctant to move because they feared that their social network would dissolve and that they would not get along with their neighbors after relocation. Another 61 households were reluctant to move because of cultural value conflicts after relocation. The remaining 47 households were reluctant to move for other reasons.

1) Structural difference in affected households' income and expenditures

The problems related to farmers' income and expenditures are the focus of China's "three rural issues" (referring to agriculture, the countryside, and farmers) and play a fundamental role in MIDR (*Ding et al., 2017*). In general, if APs' incomes are greater than their expenditures, their willingness to move is relatively high. Therefore, the income and expenditures of affected families are considered in the scope of this study. As observed in the sample survey (Table 3), the annual per capita net income of 31.85% of the affected households was RMB 10,000 to RMB 20,000 (accounting for the largest proportion in the sample), that of 22.38% of the households was less than RMB 10,000, and that of 27.89% of

the households was more than RMB 30,000. With regard to the different types of risk perception, under the perception of economic risk category, the proportion of households with an annual household income exceeding RMB 30,000 per capita was 13.5%. The proportion of households with a per capita income above RMB 30,000 was the lowest under the social risk and institutional risk perception categories. In terms of income sources, migrant work and farming were the main sources of income for households, accounting for 27.30% and 45.40%, respectively. There was little difference between risk sources and major expenditures among the different categories of risk perception.

Table 3 Structural difference in households' income and expenditure (%)

Indicator category	Subcategory	Economic risk perception (ERP)	Social risk perception (SRP)	Institutional risk perception (IRP)	Cultural risk perception (CRP)	Total
Annual per capita net income of the family	**< 10,000 yuan**	9.8	7.1	4.18	1.3	22.38
	10,000 yuan~20,000 yuan	19.78	3.54	4.33	2.2	31.85
	20,000 yuan~30,000 yuan	11.8	2.78	2.5	2.8	19.88
	>30,000 yuan	13.5	4.1	3.1	7.19	27.89
Source of income	**Wage income**	4.8	12.5	5.4	4.6	27.30
	Agricultural income	33.8	6.72	3.13	1.75	45.40
	Business income	7.7	2.1	2.5	1.8	14.10
	Property income	8.44	2.9	1.73	0.13	13.20
Major expenditures	**Living expenses**	22.5	3.1	3.4	0.9	29.90
	Entertainment education	5.4	3.9	7.7	8.3	25.30
	Traffic	1.5	3.5	2.76	3.9	11.66
	Social	2.3	6.39	1.34	2.21	12.24
	Medical	13.2	4.8	1.57	1.33	20.90

2) Differences in social network relations

People's lives depend on the social networks they construct over the years (*F Piselli, 2007*), and resettlement severs these ties. In the survey sample, the larger the network scale was, the greater the APs perception of social risk. As observed in Table 4, 31.8% of large-scale social network relationships were sensitive to social risk. In addition, risk perception is affected by current neighborhood relationships, gift giving, and other factors. If the current neighborhood is intimate, APs have a strong perception of social risks. For example, 22.35% of APs (neighborhood intimacy) perceived that social risk was the greatest risk, followed by cultural risk. Gift giving represents whether interpersonal relationships are

bad or good. The greater the amount of money given, the stronger the perception of social risk is. However, at the same time, gift giving is an economic expenditure; thus, the perception of economic risk will also increase with the increase in the amount given (i.e., APs whose gift giving is more than RMB6000 were more sensitive to economic risk).

Table 4 Differences in social networks of households (%)

Indicator category	Subcategory	ERP	SRP	IRP	CRP	Total
Social network scale	**Small**	4.62	11.42	3.13	4.27	18.82
	Medium	5.65	25.8	4.28	5.16	35.24
	Large	6.78	31.8	5.17	8.97	45.94
Gift giving	**0-3,000**	3.57	11.33	2.12	3.34	20.36
	3,000-6,000	5.16	23.62	3.25	4.15	36.18
	More than 6,000	6.32	28.38	3.78	4.98	43.46
Current neighborhood relationship	**Bad**	2.14	13.52	2.08	4.73	22.47
	Moderate	2.93	21.93	3.11	5.97	33.94
	Good	3.17	22.35	5.33	12.74	43.59

3) Affected households' evaluation of policy

In the process of MIDR, the policies and behaviors of local governments play a vital guiding role and influence the willingness to move (*Abuya, 2013*). Table 5 shows that in the process of MIDR, 36.04% of households thought that the government fully considers the interests of APs and realizes social harmony, and 25.76% of households thought that strong government impairs the interests of APs. In evaluating the behavior of coal mine enterprises, 45.18% of the households thought that these enterprises shared their interests and provided employment opportunities, while 54.82% of the households thought that these enterprises were "full profit grabbers". Although people living near mines may be more vulnerable to social and environmental impacts, they may not be willing to move away if such a move would reduce their chances of benefiting from the project (*Bainton and Mcintryre, 2013*). The evaluation of resettlement policy varies by risk perception type. APs have a relatively low evaluation of corporate and government behaviors when they perceive institutional risk. APs who perceive economic risk have relatively high expectations for relocation followed by social risk perception.

Table 5 Households' cognition and evaluation of policy (%)

Indicator category	Subcategory	ERP	SRP	IRP	CRP	Total

Evaluation of government behavior	**Strong government: harms the interests of APs**	8.3	5.4	11.1	0.96	25.76
	Basically meets the interests of APs	7.7	14.5	14.8	1.2	38.2
	Fully considers the interests of APs	7.9	11.6	15.6	0.94	36.04
Evaluation of coal mine enterprise behavior	**Provides employment opportunities**	20.81	11.02	10.29	3.06	45.18
	Acts as a "full profit grabber"	22.47	18.2	11.66	2.49	54.82
Interest demands of affected households	**Satisfies interest demands**	14.3	14.8	15.5	6.08	50.68
	Damages interests	15.4	15.2	13.3	5.42	49.32

4) Households' willingness to move

Overall (see Figure 3), in the Liang Huai mining area, the willingness to move was relatively low; only 36.95% of households chose "yes". Under the economic risk perception category, 31.6% of households chose "no", with the lowest willingness to move. There may be two reasons for this finding. (i) The households wanted to maximize their benefits in the game with the government and coal enterprises; however, determining the equilibrium point of the three parties' interests is complicated (*Fu et al., 2014*). (ii) The source of household income is fundamental. If households perceive that their income after relocation will be unreasonable, their willingness to move away will be low (*L.E. Swanson Jr et al., 1979*).

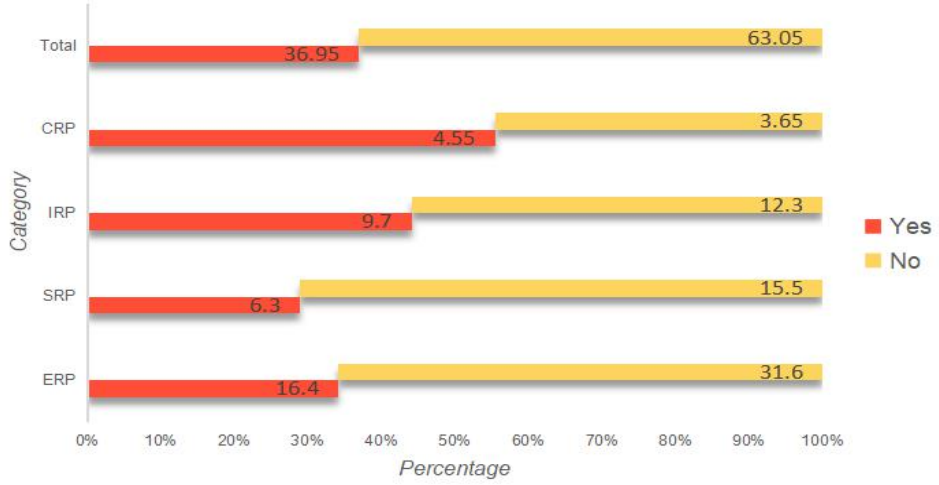

Figure 3 Willingness of affected households to move (%)

3.2 Goodness-of-fit test

The results of checking the model (shown in Table 6) indicate that the maximum likelihood square values for cultural risk perception, institutional risk perception, social risk perception, and economic risk perception are 14.871, 25.214, 15.245, and 15.015, respectively, all of which are low, indicating that the significance level of the model is high. The square

values of the Cox-Snell R are 0.472, 0.615, 0.592, and 0.572, respectively, which are all greater than 0.300. The Nagelkerke R square values are 0.734, 0.753, 0.722, and 0.731, respectively, which are all greater than 0.500, indicating that the goodness of fit of the model is high. The regression results are basically consistent with the statistical descriptions.

Table 6 Logistic regression results of APs' willingness to move

		ERP			SRP			IRP			CRP		
		B	S.E.	Exp (B)	B	S.E.	Exp (B)	B	S.E.	Exp (B)	B	S.E.	Exp (B)
H	H_1	-0.009	0.015	1.242	-0.017*	0.009	1.348	-0.018	0.024	1.185	-0.019*	0.019	1.224
	H_2	0.098*	0.102	1.328	0.086*	0.123	1.446	0.111	0.134	1.182	0.101	1.196	1.317
	H_3	0.319*	0.177	1.184	0.394*	0.188	1.184	0.341*	0.196	0.122	0.441*	0.194	1.161
	H_4	0.314**	0.015	1.456	0.303*	0.019	1.358	0.316	0.022	1.228	0324*	0.02	1.177
	H_5	0.253*	0.352	1.042	0.227*	0.307	1.177	0.214	0.341	1.154	0.223*	0.318	1.083
L	L_1	-0.146**	0.008	1.324	-0.131**	0.011	1.228	-0.165*	0.014	1.236	-0.171	0.008	1.244
	L_2	0.372*	0.032	1.271	0.309	0.027	1.324	0.273	0.028	1.233	0.352	0.024	1.329
	L_3	-0.135*	0.233	0.308	-0.134*	0.229	0.267	-0.114*	0.22	0.341	-0.117*	0.228	0.313
S	S_1	0.467*	0.944	1.243	0.485	1.009	1.267	0.477	0.962	1.344	0.452	0.978	1.282
	S_2	-0.554	0.186	0.854	-0.548*	0.187	0.789	-0.609	0.176	0.832	-0.637	0.188	0.819
	S_3	1.102	0.008	0.265	1.071*	0.011	0.252	1.135	0.014	0.281	1.014*	0.012	0.263
I	I_1	0.372**	0.072	1.681	0.314**	0.064	1.734	0.336***	0.067	1.824	0.342**	0.069	1.743
	I_2	0.463*	0.164	0.445	0.465*	0.176	0.45	0.552	0.169	0.492	0.526*	0.171	0.424
Maximum likelihood square values		15.845			27.255			16.294			16.018		
Square value of Cox & Snell R		0.472			0.615			0.592			0.572		
Square value of Nagelkerke R		0.734			0.753			0.722			0.731		
Sample size		2,114			1,044			941			938		

Note: *, * *, and * * * represent P<0.1, P<0.05, and P<0.01, respectively; B is the regression coefficient, S.E. is the standard error of the regression coefficient, and Exp (B) is the incidence ratio.

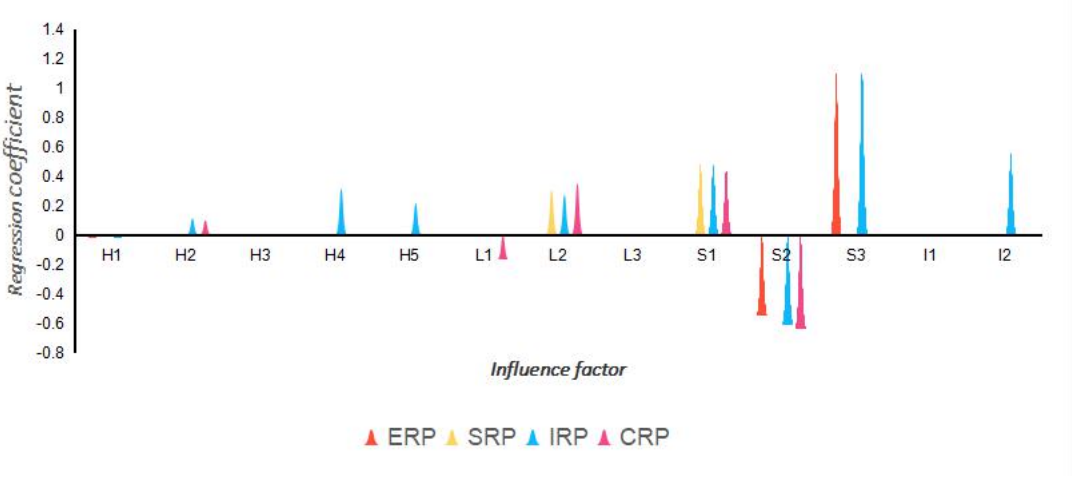

Figure 4 The direction of influencing factors for the four dimensions of risk perception

4 Conclusion and discussion

4.1 Discussion

This study analyzed the risk perception of a group of APs with regard to the reality of relocation and their willingness to move. The purpose was, on the one hand, to test the scales created and, on the other hand, to analyze as a whole the most significant predictors found in the previous literature. The authors discuss the above analysis (from Table 6 and Figure 4) below.

The following findings concern the characteristics of the affected households. (i) The age of the householders passed a significance test in the four risk perception categories and had a significant negative correlation with the willingness to move. This finding shows that the older the householder is, the lower the willingness is to move. On the one hand, older APs are less able to go out and work and can engage only in agricultural production activities at home (*HongqinChang, 2011*). On the other hand, the older APs are, the less likely they are to accept new things; that is, they are less adaptable to their new living environment after relocating (*Shen and Sun, 2014*). (ii) Under the social risk perception category, there is a significant positive correlation between education level and the willingness to move. It is generally believed that education represents the accumulation of individual human capital, and an increase in years of education can raise individuals' cognitive level and working ability (*Luo and Tao, 2015*). (iii) The number of family insurance participants passed the significance test in all four models and showed a significant positive correlation with the willingness to move.

This finding shows that the more family members who are insured, the fewer burdens they have. As opposed to the social security function of land, APs are more likely to consider their land as an asset; that is, they are more willing to move (*Pan and Huang, 2014*). (iv) Under the categories of economic risk perception, social risk perception, and institutional risk perception, there is a significant positive correlation between households' main employment type and their willingness to move. There is no such relationship under the cultural risk perception category. In addition, land is no longer the main source of income for the households; thus, the desire to move is relatively high.

The following findings concern the economic characteristics of the affected households. The nonagricultural income ratio has a significant positive correlation with the willingness to move under the economic risk perception, social risk perception, and institutional risk perception categories. However, it has no influence on the willingness to move under the cultural risk perception category. This variable is similar to the influence mechanism of the household's main employment type in relation to the willingness to move. Generally, the proportion of nonagricultural income in household income is higher, and APs are no longer bound by their original land. Therefore, APs prefer to relocate to build land capital and provide capital for their cities.

The findings regarding the location characteristics of the resettlement area are as follows: (i) Under the economic risk perception, social risk perception, and institutional risk perception categories, the distance between the resettlement area and the town has a significant negative influence on the willingness to move. This shows that the closer an area is to the town, the better the location conditions. The greater the radiation effect of urban development is, the higher the housing value of the resettlement area. Therefore, APs are more willing to move (*Dan and Yin, 2017*). (ii) The amount of cultivated land owned by a household has a significant positive influence on the willingness to move under the economic risk perception category. In economically developed areas, because land demand is strong and housing prices are high, people with more arable land will receive more property subsidies when they are displaced (*Yu et al., 2016*). (iii) The per capita housing area passed the significance test in the four risk perception categories and had a significant negative correlation with the willingness to move. It is generally believed that the greater the per capita housing area in rural areas is,

the higher the satisfaction with the existing housing level.

The findings regarding social networks are as follows. (i) The scale of social networks has a significant negative impact on the social risk perception of APs. This conclusion is consistent with the statistical results of the questionnaire, which show that the larger the network scale is, the greater the perceived social risk. This finding shows that people invest more in their hometown and have more emotional and relationship resources. The social relations of APs in their original places of residence are destroyed when they leave. In a short period of time, when APs are unable to establish social relations similar to those before their relocation, they worry about life after relocation and are reluctant to move (*Geng and Xu, 2008*). (ii) The current neighborhood and dependent elements have a significant impact on the willingness to move under the social risk perception category. Displacement can be regarded as "an unselected and harmful destruction" of "baseline life tactics and social organization in given situations" (*Lubkemann, 2008*). Interpersonal relationships after relocation, especially heterogeneous interpersonal interactions (i.e., interactions with local residents), influence relocation willingness (*Feng, 2008*).

The findings regarding institutional policy evaluation characteristics are as follows. (i) The evaluation of enterprise and government behavior passed the significance test in the four models and had a significant positive correlation with the willingness to move. This finding shows that if APs have a positive view of business and government actions, they support coal mining and are willing to move. If not, they oppose coal mining. As observed, the cognitive bias of APs towards government behavior is influenced by occasional incidents of violent demolition, conflict, and strong government. This phenomenon has created psychological barriers to moving and thus negatively affects the progress of relocation (*Fu et al., 2014*). (ii) There is a significant positive correlation between the expectation of resettlement effects and the willingness to move in the four models.

With regard to the differences in risk perception types, the findings were as follows. (i) APs' willingness to move under the institutional risk perception category is significantly influenced by the geographic location of the resettlement area and the evaluation of government behavior because if the resettlement area is closer to the town, the value of the housing will be higher, and the evaluation of the local government will also be higher.

Therefore, compared with other risk perception categories, these two factors have a significant impact on the willingness to move in this risk perception category. (ii) APs' willingness to move under the economic risk perception category is significantly affected by the main households' types of family employment and family-owned land quantity because, as rational economic actors, if most family members run a business in the town, the idle land and houses can be converted into capital by means of expropriation and resettlement. (iii) APs' willingness to move under the social and cultural risk perception categories is significantly influenced by social network scale and the expectation of resettlement effects, respectively. On the one hand, because of the breakdown of the original social network, APs will be worried about life after their relocation; thus, they will be unwilling to move. On the other hand, the idea of "hating to leave a place where one has lived long" is popular in China. Land is a social resource for the survival and development of APs, and the strong support it offers leads APs to have a strong dependence on their native land.

In summary, APs' willingness to move is influenced by many factors such as household factors, economic factors, resettlement location factors, social relationship factors, and institutional policy factors. These factors have varying influences on APs' willingness to move under different dimensions of risk perception. Therefore, hypotheses 1 and 2 are verified.

4.2 Conclusion

This article discusses the factors that influence willingness to move in relation to four types of risk perception in MIDR. It finds that the willingness to move is positively affected by the factors of the householders' education level, the main type of employment in the family, the cultivated land area, and support for the anticipated effects of resettlement. Additionally, willingness to move is negatively affected by the factors of distance from the resettlement area to a town and social network scale. There are several ways to achieve the harmonious relocation and sustainable development of APs. First, companies must be prepared to think more expansively about risk and responsibility (*Kemp et al., 2016*). Second, local governments should create reasonable income distribution regulations and balance the interests of all stakeholders on the basis of a comprehensive consideration of the resource endowment (*Adisa Azapagic, 2004*). Lastly, scholars must conduct systematic studies to

describe and explain people's risk perception, willingness to move, and other attitudes. The current research aims to contribute to these goals.

References

Abuya, W.O., 2013. What is in a Coconut? An Ethnoecological Analysis of Mining, Social Displacement, Vulnerability, and Development in Rural Kenya. Afr. Stud. Q. 14(1-2):1-21.

Adisa Azapagic. 2004. Developing a framework for sustainable development indicators for the mining and minerals industry. Journal of Cleaner Production. 12(06):639-662.

Asa Boholm . 1998. Comparative studies of risk perception: a review of twenty years of research.. Journal of Risk Research. 1 (2):135-163 .

Bainton, A.N, Macintyre, M., 2013. "My land,my work": business development and large-scale mining in Papua NewGuinea, engaging with capitalism: cases from Oceana. Res. Econ. Anthropol. 33, 139e165.

Bastide, S., Moatti, J-P., Pages, J-P., and Fagnani, F. (1989). Risk perception and the social acceptability of technologies: the French case, Risk Analysis 9, 215-23.

Bennett. O, McDowell, C., 2012. Displaced: the human cost of development and resettlement. Palgrave Macmillan, Gordonsville, VA, USA.

Bian, Z., et al., 2010. Environmental issues from coal mining and their solutions. Min.Sci. Technol. (China) 20 (2), 215–223. Chinese.

Bian Zhengfu. Zhai Guangzhong. 1996. Theory and practice of land reclamation planning in mining area. Beijing. China Coal Industry Publishing House. Chinese.

Botin, J. Anderson, M. 2009. Managing projects feasibility and construction. In: Botin,J. (Ed), Sustainable Management of Mining Operations, Society for Mining, Metallurgy, and Exploration, Inc. (SME), Littleton, USA, pp, 207-260.

C Graif . 2016. (Un)natural disaster: vulnerability, long-distance displacement, and the extended geography of neighborhood distress and attainment after Katrina. Population & Environment. 37 (3): 288-318.

Cernea M. 1997. The risks and reconstruction model for resettling displaced populations. World Dev. 25:1569-1587.

Cernea M. 2003. For a new economics of resettlement: a sociological critique of the compensation principle. Int Soc Sci J. 55:37–45.

Cernea M. 2018. Challenging the prevailing paradigm of displacement and resettlement.

Colson E. 1971. The social consequences of resettlement: the impact of the Kariba resettlement upon the Gwembe Tonga. Manchester: Manchester University Press for the Institute for African Studies.

Dan Jun, Yin Jie. 2017. Migration distance of floating population and regional differences of its influence on urbanization. Acta Scientiarum Naturalium Universitatis Pekinensis. 2017,(53)03,487-496

De Wet, C. 2009. Does development displace ethics? the challenge of forced resettlement. In: Oliver-Smith, A. (Ed.), development and dispossession: the crisis of forced displacement and resettlement. School for Advanced Research Press, Santa Fe, NM, pp. 77-96.

Ding Shijun, Yang Jin. Chen Yuping. 2017. An analysis on changes in income for rural households affected by land acquisition based on income mobility: evidence from Xiangyang and Kunming cities. China Rural Survey. (01),29-40+141, Chinese.

DY Kim , J Jung . 2017. Cultural attributes and risk perception: the moderating role of different types of research and development. Journal of Risk Research. (2): 1-16.

Englander, T., Farago, K., and Slovic, P. A. (1986) Comparative analysis of risk perception in Hungary and the

United states, Social Behaviour 1, 55–66.

F Piselli, 2007. Communities, places, and social networks. American Behavioral Scientist. https://doi.org/10.1177/0002764206298312.

Fan Hesheng, Luo Linfeng. 2018. On reemployment path of land-lost farmers in coal mining subsidence area ----a case study of the areas of Huainan and Huaibei in Anhui province. Journal of Beihua University (Social Sciences), (04), 64-68, Chinese.

Farrell, A,L. Hamann, R. Mackres, E. 2012. A clash of cultures (and lawyers): Anglo Platinum and mine-affected communities in Limpopo Province, South Africa. Resources. Policy 37 (2): 194-204.

Feng Xiaotian. 2008. Resettlement forms, interpersonal communication and migrants adaptation: a comparative study on the 343 rural migrant households from the three gorges that resettled in the provinces of Jiangsu and Zhejiang. Society. (02): 152-161+223. Chinese.

Fishhoff, S.B., Weingart, L.R. Determinants of Risky Decision-Making Behavior: A Test of the Mediating Role of Risk Perceptions and propensity[J]. Academy of management journal, 1995,38(6): 1573-1592.

Fu Shuke. Yang Shuwang. Tang Pengcheng Zang. Mengying. Zheng Kun, 2014. Research on the Compatibility between the Mining Development in Fragile Ecological Area and Ecological Environmental System----In the Perspective of Game among Mining Companies, Community Residents. Natural Resource Economics of China, (27) 04,64-67. Chinese.

Gans HJ. 1968. People and plans: essays on urban problems and solutions. New York (NY): Basic Books.

Geng Guangrong, Xu Yangang. 2008. On Sichuan Reservoir Migrators' Psychological Characteristics and Social Harmonization at Re-settlement. Journal of Sichuan Normal University (Social Sciences Edition), (05): 39-43. Chinese.

Guoqing Shi. 2005. Involuntary resettlement: conflict and harmony. Jiangsu Social Sciences. (05): 22-25. Chinese.

Hang-Min Cho. 2011.Introduction of Digital Media and Consequent New Risk Types - Focus on the Analysis of User Risk Perception and Risk Features of Smart Phones as Convergence Media. Journal of the Korea Contents Association. 11 (8): N/A.

HongqinChang, 2011. Labor Migration and Time Use Patterns of the Left-behind Children and Elderly in Rural China. World Development. 39 (12): 2199-2210.

Jaafari, 2001; Management of risks, uncertainties and opportunities on projects: time for a fundamental shift. Int.J.Proj. Manag. 19,89-101.

Jiang Zhan. 2016. Problems and countermeasures of village relocation in coal mining subsidence area. Mine Surveying, (03): 77-79+108.Chinese.

Jing Enying. 2009. How to design the procedures of the questionnaires. Journal of Hubei University for Nationalities(Philosophy and Social Sciences. (06).99-10. Chinese.

Joyce, S.A, Thomson, I.2000. Earning a social licence to operate:social acceptability and resource development in Latin America. Can. Min. Metall.Bull.93(1037).

Kemp D, Worden S, Owen JR. 2016. Differentiated social risk: Rebound dynamics and sustainability performance in mining. Resources Policy. (50): 19-26.

KN Funoh. 2014. The impacts of artisanal gold mining on local livelihoods and the environment in the forested areas of Cameroon. Cifor Working Paper. 3 (1) :798-801

Kunz, N.C, Moran,C.J, Kastelle, T. 2013; Implementing an integrated approach to water management by matching problem complexity with management responses: a case study of a mine site water committee. Journal of Cleaner Production 52,362-373.

L.E. Swanson Jr, A.E. Luloff, R.H. Warland. 1979. Factors influencing willingness to move: an examination of non metropolitan residents. Rural Sociology 44(4): 719-735.

Liu Jing. 2008. Status quo and problems of resettlement in resource based cities during subsidence period. Inner Mongolia Coal Economy, (04): 51-54. Chinese.

L Sjöberg. 2000. The Methodology of Risk Perception Research. Quality & Quantity. 34 (4): 407-418

Lubkemann, S., 2008. Involuntary immobility: on a theoretical invisibility in forced migration studies. J. Refugee Stud. 21 (4), 454-475.

Luo Mingzhong. Tao Zhi. 2015.An empirical analysis of the influence of rural labor force transfer and employability on their employment quality. Rural Economy. 2015,08,114-119. Chinese.

Lupton, D. 2013. Theorizing Risk, Risk, 2nd ed. Routledge, Milton Park, UK. Luhmann, N., 1995. Lenoir, T., Gumbrecht, H.U. (Eds.), Social Systems. Bednarz, J., D. Baecker, D. (Trans.). Stanford University Press, Stanford, USA.

Mc Donald-Wilmsen, B., Webber, M., 2010. Dams and displacement: raising the standards and broadening the research agenda. Water Altern. 3 (2), 142-161.

Nick Pidgen. 1998. Risk assessment, risk values and the social scienceprogramme: why we do need risk perception research. Relia-bility Engineering and System Safety. 59 (1) .

Owen JR, Kemp D. 2013. Social licence and mining: A critical perspective. Resources Policy 38, 29-35.

Owen JR, Kemp D. 2015. Mining-induced displacement and resettlement: a critical appraisal. Journal of Cleaner Production. 87 (1): 478-488.

Pan Funa. Huang Jianyuan 2014. Study on the Social Security Program for Expropriated Peasant:Take Hydropower Project Resettlement as the Example. Northwest Population Journal. (35)03,84-89. Chinese.

Renn, O., Ortleb, J., Benighaus, L., Benighaus, C., 2011. Risks. In: Pechan, P., et al. (Eds.), Safe or Not Safe: Deciding What Risks to Accept in Our Environment and Food. Springer ScienceþBusiness Media, New York, USA.

Shen Maoying. Sun Mingjian. 2014. A study on social adaptation and policy adjustment of rural elderly population -- Based on the 2010 population census data of Sichuan. Studies on Party and Government. (05): 97-101. Chinese.

Sjoberg L, 2000. Factors in risk perception. Risk Analysis. 20 (1): 1-12

Sun Tianye. Ma Caixue. Guo Jiewei. 2011. Analysis of Involuntary Resettlement and Migration Based on Logit Model. China Population,Resources and Environment. (01): 0110-05. Chinese.

Tang Yongzhi. 2010. Analysis of the attitudes to resettlement of farmers to be relocated in Danjiangkou reservpir area. China Population,Resources and Environment. (05):57-63. Chinese.

Terminski, Bogumil. 2013; Development-induced Displacement and Resettlement: Theoretical Frameworks and Current Challenges. http://hdl.handle.net/10535/8833

Tulloch, J.C., Lupton, D., 2003. Defining Risk. Risk and Everyday Life (16-41). SAGE Publications Ltd., London, UK. http://dx.doi.org/10.4135/9781446216392.n2/

Vander Klippe, N., 2015. When a floating village falls to earth. The Global and Mail. Available at: https://www.theglobeandmail.com/news/world/when-a-floating-village-falls-to-earth/article25876178/

X.F.Maoa, X.Y. Weib, J.X. Xiab. 2012. Evaluation of ecological migrants' adaptation to their new living area in Three-River Headwater wetlands, China. Procedia Environmental Sciences. (13): 1346-1353.

Xinhua, 2015. Land subsidence caused by coal mining in Shanxi | thousand floating village will be relocated. goodchinabrand.com. Available at: http://www.%20goodchinabrand.com/20343700070en.html

Yang Dongxue. 2004. Globalization, risk society and compound governance. Marxism & Reality. (04): 61-77.

Yaozu Xue. Lei Huang. 2018. Factors influencing the livelihoods of ecological migrants in coal mined-out areas in China. Environment, Development and Sustainability:11-15.

Yu Wei. Liu Bencheng. Song Jinping. 2016. A study on farmers' willingness to quit rural residential lands and its

influencing factors. Geographical Research. (35)03,551-560. Chinese.

Zinn, J.O, 2009. The sociology of risk and uncertainty: A response to Judith Green's'Is it time for the sociology of health to abandon "risk"? Health Risk Soc. 11 (6), 509-526.

Zou Xiuqing, Zhong Xiaoyong. 2013. Psychological factors affecting land-lost peasants' land expropriation conflict. Resources Science. (12). 2418-2425. Chinese.