frontiers | Frontiers in Environmental Science

ORIGINAL RESEARCH
published: 10 May 2022
doi: 10.3389/fenvs.2022.838146

# Research of Mining Area Ecological Compensation From the Perspective of Knowledge Innovation

*Qinfeng Xing*, He Gang and Wanyan Yao*

*State Key Laboratory of Mining Response and Disaster Prevention and Control in Deep Coal Mines, Anhui University of Science and Technology, Huainan, China*

Ecological compensation has been the favorite subject of ecological depletion caused in mining areas with the aim of sustainable development. So, an analytical model is presented to assess the knowledge innovation of ecological compensation. Later, the methods of factor analysis, resistance diagnosis, and multiple regressions are integrated to evaluate its satisfaction in the Huainan mining area. The study found that (1) the influence of factors related to work mechanism is identical, while the influence of factors related to strategic planning and action skills is heterogenous; and (2) in terms of the relative importance of the three dimensions of work mechanism (0.479), strategic planning (0.467), and action skills (0.351), their influence decreases in order. The results can provide reference materials for the effective governance of ecological compensation and its scientific management of ecological safety in the mining area. So, the findings can help for better improvement of ecological compensation, and then the following strategies are proposed to improve its knowledge innovation: First, the harmonious development of individual behavior and overall interests needs to be realized; Second, the coordinated development of top-level design and adherence to faith needs to be optimized; Third, the interactive development guided by competence and mass entrepreneurship and innovation needs to be achieved.

**Keywords: ecological compensation, knowledge innovation, empirical analysis, mining area, Huainan (China)**

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***Edited by:***
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****Correspondence:***
*Qinfeng Xing*
*xqinfeng@163.com*

***Specialty section:***
*This article was submitted to Science and Environmental Communication, a section of the journal Frontiers in Environmental Science*

***Received:*** *17 December 2021*
***Accepted:*** *05 April 2022*
***Published:*** *10 May 2022*

***Citation:***
*Xing Q, Gang H and Yao W (2022) Research of Mining Area Ecological Compensation From the Perspective of Knowledge Innovation. Front. Environ. Sci. 10:838146. doi: 10.3389/fenvs.2022.838146*

## 1 INTRODUCTION

Ecological compensation is derived from ecosystem services of "human benefit" (Westman, 1977; Costanza, 1997). It is the internalization of external costs to control ecological damage, and it is the fulfillment of repair and restoration responsibility based on ecological environment damage (Zhuang, 1995). Furthermore, ecological compensation is used to avoid the "negative externalities" of ecological compensation (Li, 2021). Then, the "uncertainty" of ecological destruction can be avoided by means of the identification of the compensation object, the construction of a performance evaluation mechanism, the coordination between responsibility and right, etc. (Xiao and Pan, 2016; Yan and Liu, 2018; Zhu, 2018; Deng, 2019; Liu, 2019). Later, the overall social interest coordination and individual behavior adjustment are realized through cross-regional coordination, diversified participation, social financing, and other mechanisms (Muadian et al., 2010; Zhang et al., 2018; Jiang and You, 2019; Xie, 2021).

As for the research methods of ecological compensation knowledge innovation, the logical correlation between ecological compensation and knowledge innovation–related factors is mainly explored. Specific

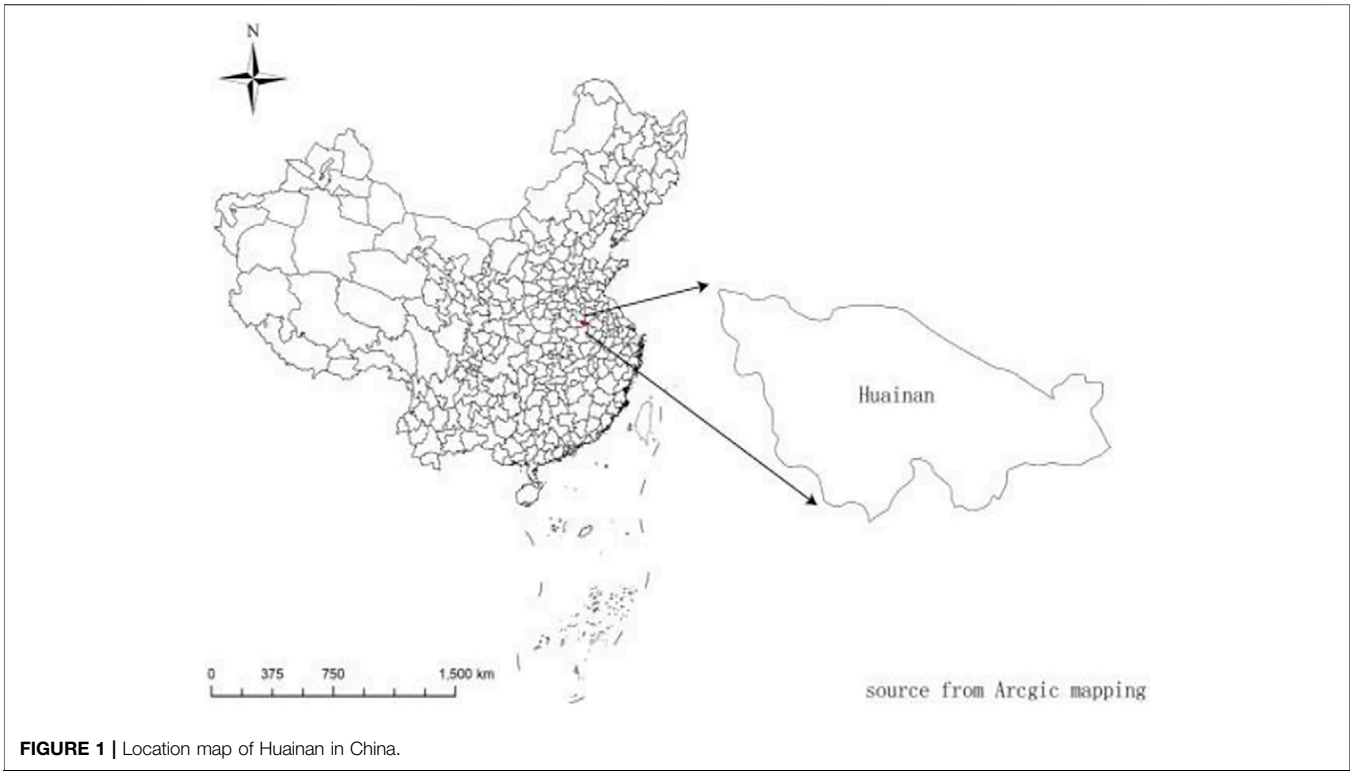


**FIGURE 1 |** Location map of Huainan in China.

research methods are applied as follows: DICEF concept model, principal–agent model, Lotka–Volterra model, systematic coupling model, multiparametric method, inter-organizational functional stream model, case study method, interviewing method, and function model (Han et al., 2016; Stubrin, 2017; Rodrigues and Leitao, 2018; Kapsalis et al., 2019; Kyriakopoulos et al., 2019; Liu et al., 2020; Yu et al., 2020; Che et al., 2021). Through sorting out these research methods, qualitative research methods supplemented by quantitative research methods are mainly used in the fields.

Considering the purpose of our research, the quantitative research method supplemented by the qualitative analysis of the indicator system is applied as follows: factor analysis, resistance diagnosis, and multiple regressions. They are integrated to evaluate the satisfaction of ecological compensation knowledge production in the Huainan mining area to improve the deterministic intervention and then, the satisfaction of ecological compensation from the perspective of knowledge innovation can be improved.

# 2 MATERIALS AND METHODS

## 2.1 Study Area

Huainan is located in the middle reaches of the Huaihe River in China (**Figure 1**) On 30 November 2020, Huainan city had a total population of 3,905 thousand and a total regional GDP of 133.72 billion yuan. Furthermore, Huainan successfully declared the national key mining subsidence area comprehensive control pilot city with a total investment amount of 4.028 billion yuan, including 38.5 million yuan of innovation special fund.

Huainan is a larger city in Anhui Province and an important part of the Huaihe River ecological economic belt. At present, as a mineral resource–based city, it has formed an industrial system with coal as its pillar. The Huainan mining area is about 180 km long from east to west and 15–25 km wide from north to south, covering an area of about 3,200 $km^2$, roughly equivalent to the area in Huainan. The "resource dividend" is shared as a special functional type for a quite long period of time. However, since the 1990s, a series of problems have been encountered in the Huainan mining area such as economic recession, ecological environmental damage, and recession. Therefore, as an important strategy for ecological protection, ecological compensation in the Huainan mining area has already threatened the sustainable development in the Huaihe River ecological economic belt.

## 2.2 Analysis Methods

Knowledge innovation is to some extent inspired by Schumpeter's interpretation of innovation theory in Economic Development Theory (Schumpeter, 1990). "Knowledge innovation" which is the creation, exchange, and application of new ideas was first proposed from the perspective of knowledge production in 1993 (Rogers, 1993) so as to realize the "new combination" of cognitive conditions and elements or knowledge innovation. Some scholars believe that knowledge innovation refers to the deepening understanding of objective things and the realization of scientific discoveries and technological inventions in new fields, new perspectives, and new viewpoints through deep knowledge accumulation (Deng and Qian, 2009; Tang et al., 2018; Su andLi, 2021). Scholars also

believe that knowledge innovation is a kind of ability to apply knowledge elements and obtain value realization of explicit or tacit knowledge elements in the process of economic production and social reproduction (Zhou and Li, 2012; Zou and Wang, 2016; Li, 2017). Therefore, knowledge innovation is to realize knowledge production through "knowledge aggregation, knowledge inheritance, knowledge creation, knowledge application, and knowledge dissemination." In addition, knowledge innovation can realize the fundamental improvement of innovation ability and productivity (Wang et al., 2013; Wang and Liu, 2017).

Next, the production factors of knowledge innovation space and their logical correlation are constructed, and the changing rules of ecological compensation knowledge innovation in the Huainan mining area are analyzed.

### 2.2.1 Dependent Variable: Satisfaction of Ecological Compensation Knowledge Innovation

The satisfaction of ecological compensation knowledge innovation in mining areas is not only beneficial in exploring the operation mechanism of the current ecological compensation in the mining area but also in realizing the comprehensive innovation of ecological compensation knowledge production. Following this, the fundamental improvement of ecological compensation productivity can be improved in resource-based cities.

Therefore, "the satisfaction of ecological compensation knowledge innovation" is operated as the first-level indicator "are you satisfied with the current ecological compensation knowledge innovation", which includes two observation indicators, "knowledge production satisfaction" and "value realization satisfaction." Then, two specific questions "are you satisfied with the production of ecological compensation knowledge?" and "are you satisfied with the value realization of ecological compensation?" are formed, and then, 1–9 points are assigned to them by the Likert scale.

### 2.2.2 Independent Variable (A): "Strategic Planning"

This study converts "strategic planning" into two secondary indicators, "the satisfaction of top-level design knowledge innovation" and "the satisfaction of belief adherence to knowledge innovation."

The satisfaction of top-level design knowledge innovation is knowledge production satisfaction and value realization satisfaction in the process of top-level design. It mainly involves the construction of sustainable development of ecological compensation knowledge innovation, such as "strengthening the construction of ecological civilization," "exploring the ecological priority to quality development in a new way," and "intensifying the protection of ecological system," etc. They both promote action direction of ecological compensation satisfaction. It is known that "in the process of China's rapid economic growth to high-quality development stage", socio-economic development and ecological compensation often are in a relationship of departure. If the ecological compensation knowledge innovation of top-level design ignores the satisfaction of the public, it will definitely be separated from the natural appeal and original intention. Only by taking into account public opinion, adhering to the "harmonious coexistence between man and nature," and highlighting the "pollution prevention and control", its scientific treatment can be realized to obtain the value of "scientific discovery and technological invention."

The satisfaction of belief adherence to knowledge innovation is its comprehensive satisfaction of knowledge production and value realization based on the "real ecological compensation resources." Belief adherence means that "*a priori* thought (either as a consequence or as a ground) must be given to its dutiable use." It may not be proved by experience or it is difficult to find enough factual basis and value reason to support the "truth" and "goodness" of ecological compensation. However, ecological compensation is "a major political issue and a major social issue." Therefore, the knowledge innovation of "true" and "goodness" must be adhered. In addition, belief adherence is the third cognitive processing. When the first two methods cannot effectively solve the problem of ecological compensation knowledge innovation, then belief adherence may become the key to judgment in the process of improving the satisfaction of ecological compensation.

Therefore, two observation indicators are further manipulated into "do you think the current top-level design of ecological compensation knowledge innovation is reasonable?" and "do you think the current belief adherence of ecological compensation knowledge innovation is effective?" And then, 1–9 points are assigned by the Likert scale.

Based on the abovementioned analysis, the first relational hypothesis is formed as follows:

Hypothesis H1: "The overall satisfaction of ecological compensation knowledge innovation" is defined as $Y_0$, and "the satisfaction of strategic planning knowledge innovation" is defined as $X_1$, which contains two influencing factors: "the satisfaction of top-level design knowledge innovation" ($X_{11}$) and "the satisfaction of belief adherence knowledge innovation" ($X_{12}$). It is assumed that $X_1$ has a positive correlation with $Y_0$ through two observation indicators ($X_{11}$ , $X_{12}$).

### 2.2.3 Independent Variable (B): "Working Mechanism"

In this study, the "working mechanism" is operated into three secondary indicators: "the satisfaction of compensation object, standard, and capital"; "the satisfaction of behavior subject knowledge innovation"; and "the satisfaction of platform knowledge innovation".

As for the satisfaction of the compensation object, standard, and capital, its knowledge production and value realization are important based on the following considerations. On the one hand, the current compensation fund mainly depends on the national finance: if the compensation objects and compensation standards cannot be scientifically selected, it may be difficult for the limited compensation fund to truly accomplish the purpose of ecological compensation. On the other hand, if the operation standard of the limited compensation fund is not clear, it is hard to imagine how such a limited compensation fund can avoid the problem of "negative externalities" of ecological compensation.

After all, the central financial support and guarantee are relatively limited compared with the intention of ecological compensation, so it is necessary to optimize the financing methods, especially to integrate social financing into the financing system.

As for the satisfaction of behavior subject knowledge innovation, its knowledge production and value realization are important based on the following considerations: First, behavior subjects are the important subjects of ecological compensation, which requires them to fulfill the power and responsibility of ecological compensation in the multicollaborative knowledge innovation system. Without their knowledge innovation, it will be difficult to promote the governance effect of ecological compensation. Second, behavior subjects here not only involve the relevant decision-makers, managers, and administrative personnel at the governmental and non-governmental levels but also involve the target groups of ecological compensation. They are all the core behavior subjects of co-governance. In addition, behavior subject knowledge innovation not only needs the embedding of science and technology but also needs to undergo the test of practice. This is because when the limited and time-limited financial compensation is exhausted, the compensation benefits can be shared with the people.

As for the satisfaction of platform knowledge innovation, its knowledge creation and knowledge transfer are the important media of ecological compensation. Through this platform, the scientific spirit and technology related to ecological compensation can be organically combined with governance organizations. Therefore, the satisfaction for platform knowledge innovation can let us know its problems, and then the integration function of the relevant platform can be optimized. In this way, the new ideas, new techniques, and new values can be "circled" and highlighted, and then the available space can be expanded.

Therefore, three observation indicators are further manipulated into "do you think the knowledge innovation of compensation object, standard, and capital is accurate?", "do you think whether the current knowledge innovation of ecological compensation among behavior subjects is scientific or not?", and "are you satisfied to the current knowledge innovation of ecological compensation among related platforms". And then, 1–9 points are assigned by the Likert scale.

Based on the abovementioned analysis, the second hypothesis is formed.

Hypothesis H2: "the knowledge innovation satisfaction of the working mechanism" is defined as $X_2$, which contains "the satisfaction of compensation object, standard, and capital" ($X_{21}$), "the satisfaction of behavior subject knowledge innovation" ($X_{22}$), and "the satisfaction of platform knowledge innovation" ($X_{23}$). It is assumed that $X_2$ has a positive correlation with $Y_0$ through three observation indicators ($X_{21}$, $X_{22}$, and $X_{23}$).

### 2.2.4 Independent Variable (C): "Action Skill"

This study converts "action skills" into two secondary indicators: "the satisfaction of the competency of ecological compensation knowledge innovation" and "the satisfaction of ecological compensation knowledge innovation led by mass entrepreneurship".

As for the satisfaction of the competency of ecological compensation knowledge innovation, it is a comprehensive satisfaction of success ability in the process of ecological compensation creation, exchange, and application among new ideas. Scholars generally agree with the definition proposed by Lyle Spencer and Sig Spencer in 1994 (Li, 2020). Here, competency refers to the underlying characteristics of an individual that can distinguish the high achiever from the average performer in a job, organization, or culture. Measurable and exploitable knowledge production is associated with success, where the knowledge production of competency emphasizes the shaping and evaluation of three-dimensional competency. What is the three-dimensional competency? It is based on the nature of the likelihood as follows: First, through competency shaping and evaluation, the knowledge innovation ability of the target group can be improved, as well as the inter-group compatibility and the individual competency. Second, through competency shaping and evaluation, the production relationship based on the division of labor and cooperation in the industry circle can be more matched. This competency is a modern operation mode with the value of upstream and downstream production chains. Third, competency shaping and evaluation make the living community more green, ecological, and intelligent. Such a living community has more self-adaptability within the group and a strong adaptability between groups.

As for the satisfaction of ecological compensation knowledge innovation led by mass entrepreneurship, it refers to making knowledge production and value realization of ecological compensation more planned and more predictable to the people through mass entrepreneurship. Therefore, on the one hand, through scientific division of labor and desirable evaluation of ecological compensation, the effective components of ecological compensation led can be accurately identified by mass entrepreneurship from the perspective of knowledge innovation, and then its optimization and development can be realized by "scientific and technological innovation." On the other hand, action skills focus on transforming the guidance of the mass entrepreneurship and innovation of a target group into a skill. In this way, the knowledge innovation of ecological compensation has more certainty of instrumental rationality and artistry of humanistic construction, and it is conducive to the effective use of national finance and the reasonable increase of citizen welfare. If ecological compensation knowledge innovation can be creatively transformed and innovatively developed in the leading process of mass entrepreneurship, then the strategic requirements of "fighting the attack war of pollution prevention and control" will be definitely achieved by limited compensation funds.

Therefore, two observation indicators are further operated into "are you satisfied with the current competence of ecological compensation knowledge innovation/" and "are you satisfied with the ecological compensation knowledge innovation led by mass entrepreneurship?" And then, 1–9 points are assigned by the Likert scale.

Based on the abovementioned analysis, the third hypothesis is formed.

**TABLE 1 |** Parameter definition and operation assignment.

| Parameter name | Variable definition | Variable description | Variable assignment |
|---|---|---|---|
| Sex | Constant | Gender involves two parameters: male and female | "Male" = "1"<br>"Female" = "0" |
| Age | Constant | Age involves the following four parameters<br>"0–18 years old"<br>"19–35 years old"<br>"36–60 years old"<br>"61 years old and above" | "0–18 years old" = "1"<br>"Other years old" = "0"<br>. |
| Education level | Constant | Education level involves three observation parameters<br>"Primary school and below"<br>"Middle school"<br>"High school"<br>"University and above" | "Primary school and below " = "1"<br>"Other education levels" = "0" |
| Satisfaction of ecological compensation knowledge innovation in the mining area | Y0 | Y0 is measured by the independent variable X | —— |
| Satisfaction of strategic planning | X1 | X1 involves two observation indicators and is measured with the Likert scale as follows<br>Satisfaction of top-level design knowledge innovation (X11)<br>Satisfaction of belief adherence to knowledge innovation (X12) | "Very dissatisfied" = "1"<br>"Dissatisfied" = "3"<br>"General" = "5"<br>"Satisfied" = "7"<br>"Very satisfied" = "9" |
| Satisfaction of working mechanism | X2 | X2 involves three observation indicators and is measured with the Likert scale as follows<br>Satisfaction of compensation object, standard, and capital (X21)<br>Satisfaction of behavior subject knowledge innovation (X22)<br>Satisfaction of platform knowledge innovation (X23) | "Very dissatisfied" = "1"<br>"Dissatisfied" = "3"<br>"General" = "5"<br>"Satisfied" = "7"<br>"Very satisfied" = "9" |
| Satisfaction of action skill | X3 | X3 involves two observation indicators and is measured with the Likert scale as follows<br>Satisfaction of the competency of ecological compensation knowledge innovation (X31)<br>Satisfaction of ecological compensation knowledge innovation led by mass entrepreneurship (X32) | "Very dissatisfied" = "1"<br>"Dissatisfied" = "3"<br>"General" = "5"<br>"Satisfied" = "7"<br>"Very satisfied" = "9" |

Hypothesis H3: Action skill knowledge innovation satisfaction is defined as $X_3$, which contains two influencing factors, namely, "the satisfaction of the competency of ecological compensation knowledge innovation" ($X_{31}$) and "the satisfaction of ecological compensation knowledge innovation led by mass entrepreneurship" ($X_{32}$). It is assumed that $X_3$ has a positive correlation with $Y_0$ through two observation indicators ($X_{31}$ and $X_{32}$).

### 2.2.5 Control Variables

To clarify the degree of independence of the influence of independent variables on dependent variables, gender, age, and education level are selected as control variables. Where gender is set as a dichotomous dummy variable: the male is 1, female is 0. Age was the ordinal variable (1 for those 18 and younger, 2 for those 19 to 35, 3 for those 36 to 60, and 4 for those 60 and older). When the regression model is included, age is converted into dummy variables, 1 is used as the reference frame for age 18 and below, and 0/1 is used as dummy variables for other age groups. Education level is also transformed into dummy variables when it is included in the regression model. Primary school and below is the reference frame, and middle school, high school, university, and above are set as 0/1 coded dummy variables.

### 2.2.6 Research Hypothesis

It is assumed that the independent variable shows a positive correlation with the dependent variable through observation indicators. Specifically, three relationship assumptions H1, H2, and H3 are formed based on three potential variables $X_1$, $X_2$, and $X_3$. Then, constants, dependent variables, independent variables, and their observation indicators are described in **Table 1**.

## 2.3 Data Collection

The data used in this study come from field surveys conducted in four coal mining areas of Huainan from August to December 2019. Considering the area, economic situation, and population distribution of the coal mine area in the study area, and the difficulty of the survey, the ordinary residents, miners (local absenteeism and non-local absenteeism), and some managers of mining enterprises in Panji District are selected as the investigation objects.

Based on the principle of stratified sampling and simple random sampling, Pan town, Qi town, Pingwei town, and Reed town first are selected as a sample unit, four–six samples are selected in each sample of town and four–eight production peer supports (brigade) are chosen in each sample of the village. And then, 10 to 20 families are chosen by one-on-one questionnaire interviews in each sample of peer support. Second, 240 miners (90 local absentees and 150 non-local absentees) are selected from Panyi Mine, Paner Mine, and Pansidong Mine. Finally, 40 relevant management personnel are selected in the four districts of the Huainan Mining Group. A total of 1,026 questionnaires are sent out and collected in this time. After

**TABLE 2 |** Factor analysis of indicators.

| $X_1$ | | | $X_2$ | | | $X_3$ | | |
|---|---|---|---|---|---|---|---|---|
| **a = 1.789 , b = 25.268%** | | | **a = 1.162 , b = 28.763%** | | | **a = 1.107 , b = 18.558%** | | |
| **Factor** | **Load capacity** | **Common degree** | **Factor** | **Load capacity** | **Common degree** | **Factor** | **Load capacity** | **Common degree** |
| $X_{11}$ | 0.649 | 0.623 | X21 | 0.856 | 0.654 | X31 | 0.712 | 0.711 |
| $X_{12}$ | 0.854 | 0.665 | X22 | 0.686 | 0.643 | X32 | 0.884 | 0.737 |
| | —— | | X23 | 0.798 | 0.723 | | —— | |
| | | | | *c* = 72.589% | | | | |

*Note: A is the eigenvalue of the factor, B is the contribution rate of the factor, and C is the cumulative contribution rate of the factor.*

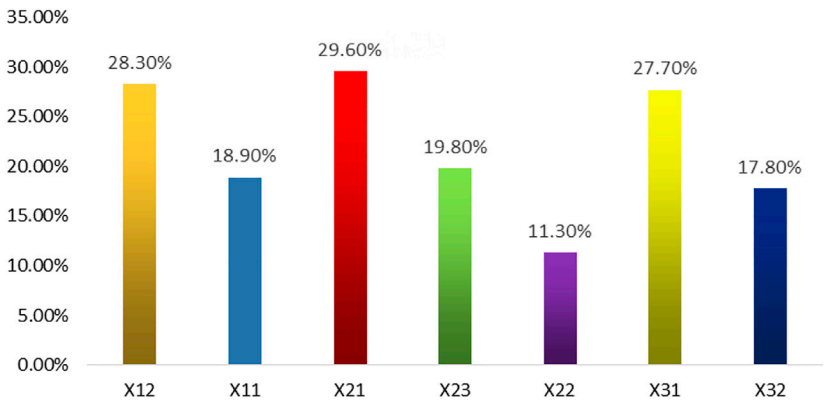


**FIGURE 2 |** Main resistance factors and resistance values.

validity test and elimination of invalid samples, a total of 1,023 samples are used for the analysis with an effective rate of 99.9%.

# 3 MODEL ANALYSIS

## 3.1 Factor Analysis

Factor analysis is introduced to estimate the contribution of observation indicators. Characteristic value, contribution rate, and the cumulative contribution rate of factors are analyzed, as well as the load amount and common degree of observation indicators. The analysis results are shown in **Table 2**.

In **Table 2**, when the eigenvalue is greater than 1, the cumulative contribution rate reaches 72.589%, which is representative to some extent. Furthermore, the minimum and maximum loads of the seven early warning indicators are 0.649 and 0.884, respectively, and the common degree is not less than 0.6. The fitting degree is good, and the correlation is significant. Otherwise, the contribution of $X_{21}$, $X_{12,}$ and $X_{32}$ has an obvious influence on their respective dimensions. In addition, through factor analysis, the factor loads and specific contributions of the seven observation indicators are effectively identified.

## 3.2 Resistance Diagnosis

Later, the verification of the relationship hypothesis is also inseparable from the accurate identification of the resistance pattern of observed indicators. Therefore, the following resistance diagnosis model is introduced. The results are obtained by **Eqs 1–4** (shown in **Figure 2**).

$$F_j = W_r \cdot W_j. \tag{1}$$

$$I_{ij} = 1 - Z_{ij}. \tag{2}$$

$$\mathrm{Y}_{ij} = \left( F_j \cdot I_{ij} \Big/ \sum_{j=1}^{n} F_j \cdot I_{ij} \right) \cdot 100\%. \tag{3}$$

$$Y_r = \sum Y_{ij}. \tag{4}$$

Here, $F_j$ is the contribution degree, $I_{ij}$ is the deviation degree, $Z_{ij}$ is the standardized value of the observation indicator, $W_j$ is the weight of a single observation indicator, $W_r$ is the weight of dimension to which the observation indicator belongs, $Y_{ij}$ and $Y_r$ are the resistance values of a single observation indicator and the observation indicators of each criterion layer, respectively.

In **Figure 2**, the resistance of observation indicators such as $X_{21}$, $X_{12,}$ and $X_{31}$ has a significant influence on the resistance of the criterion layer. Furthermore, through resistance diagnosis, the primary and secondary relationships of seven resistance indicators and the strength of resistance values are presented.

## 3.3 Multiple Regression

The satisfaction of ecological compensation knowledge innovation is a continuous numerical variable, and the

**TABLE 3 |** Factor multiple regression analysis.

| Variable name | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| $X_1$ | | 0.467****** | 0.348****** | 0.463****** |
| $X_2$ | | | 0.479****** | 0.358****** |
| $X_3$ | | | | 0.351****** |
| Gender ( Female = 0 ) | 0.275****** | 0.278****** | 0.289****** | 0.271****** |
| Age | | | | |
| Age 18 and below (Reference ) | | | | |
| From 19 to 35 years old | 0.328****** | 0.247****** | 0.335****** | 0.248****** |
| From 36 to 60 years old | 0.247****** | 0.259 | 0.271****** | 0.264****** |
| More than 60 years old | 0.273 | 0.279 | 0.349 | 0.214 |
| Education level | | | | |
| Primary school and below (Reference ) | | | | |
| Junior high school | −0.203 | 0.208 | 0.319 | 0.324 |
| Senior high school | 0.232 | 0.328****** | 0.264****** | 0.264 |
| University and above | 0.341****** | 0.278****** | 0.310****** | 0.317****** |
| *F*-value | 5.128****** | 7.147****** | 6.524****** | 6.314****** |
| Adjust $R^2$ | 0.028 | 0.048 | 0.042 | 0.057 |
| Sample size | 1,023 | 1,023 | 1,023 | 1,023 |

*Note: ******p ≤ 0.1, **p ≤ 0.05, and ***p ≤ 0.01.*

independent variables are multiple variables. So, the multiple linear regression statistical method is adopted. Based on the control variables, three variables of $X_1$, $X_2$ and $X_3$ are gradually incorporated into the model, and four nested models are constructed to test the influencing factors of satisfaction and their relationship hypothesis in **Table 3**.

In Model 1, gender, age (19–35 years old; 36–60 years old), and education level (college or above) pass the significance test. Furthermore, there is a positive correlation between males and $Y_0$, which is 0.275 times the reference frame. Age (19–35 years old; 36–60 years old) is positively correlated with $Y_0$, which is 0.328 and 0.247 times the reference frame. The education level of college or above is positively correlated with $Y_0$, which is 0.341 times the reference frame.

Based on Model 1, variable $X_1$ is included in Model 2. $X_1$ passed the significance test, and the relation hypothesis H1 passed the verification. When $X_1$ is increased by one level, $Y_0$ is increased 0.467 times. In terms of control variables, gender, age (19–35 years old), and education (high school, college, and above) pass the significance test.

Based on Model 2, the variable $X_2$ is included in Model 3. $X_2$ passes the significance test, and the relation hypothesis H2 passes the verification. When $X_2$ is increased by one unit, $Y_0$ is increased by 0.479 times. Furthermore, compared with Model 2, the influence of variable $X_1$ is reduced. In addition, among the control variables, gender, age (19–35 years old, 36–60 years old), and education level (high school, college, and above) pass the significance test.

Based on Model 3, variable $X_3$ is included in Model 4. $X_3$ passes the significance test, and the relationship hypothesis H3 passes the verification. If $X_3$ increases by one unit, $Y_0$ increases by 0.351 times. Furthermore, compared with Model 3, the influence of variable $X_2$ is increased. The effect of variable $X_1$ is less than that of Model 2 but greater than that of Model 3. In addition, among the control variables, gender, age (19–35 years old, 36–60 years old), and education level (college or above) pass the significance test.

# 4 RESULTS

In this study, an empirical model is conducted on the satisfaction of strategic planning, working mechanism, and acting skills from the perspective of ecological compensation knowledge innovation. It is found that the basic situation of the survey object is consistent with the actual situation in the Huainan mining area, which can reflect its expectation and dilemma of improving ecological compensation knowledge innovation. Among them, the respondents show a strong interest in the related variables and observation indicators, which reflects that the public hope to help sustainable development by improving ecological compensation knowledge innovation. Furthermore, some objective problems are also exposed during the investigation, which requires us to further find out the causes, clarify the intervention target and direction, and optimize the observation indicators and their potential variables. And then, the intervention effect of ecological compensation knowledge innovation can be improved.

## 4.1 Strategic Planning Knowledge Innovation

In the process of factor analysis, the latent variable "strategic planning knowledge innovation" involves two observation indicators, namely, "top-level design knowledge innovation" and "belief adherence knowledge innovation." It is found that the characteristic value of potential variables is greater than 1, and the contribution ranks second, which is identical with the result of factor analysis. Furthermore, the correlation between the two observation indicators and potential variables is strong (greater than 0.6), and the factor load of "belief adherence knowledge innovation" is in the dominant position. In the process of resistance diagnosis, the resistance value of "belief adherence knowledge innovation" is larger. Therefore, belief adherence is related to the success or failure of ecological compensation knowledge innovation. Furthermore, only by establishing the

correct ecological compensation, strategic planning knowledge innovation can be more easily recognized by the public and then obtain the power source of knowledge innovation. In addition, the top design cannot be ignored. If belief adherence is the content of "promoting goodness", then the top-level design is the content of "seeking truth." Without it, it is difficult for ecological compensation knowledge innovation to achieve governance expectations. In the process of multiple regression analysis, the independent variable "strategic planning knowledge innovation" passes the model test. When the independent variable is introduced, the effect of the control variable is significant. Therefore, if the effectiveness of strategic planning interventions has to be improved, the attitudes of knowledge innovation participants need to be focused and their interests, knowledge, and capabilities need to be intervened effectively.

## 4.2 Work Mechanism Knowledge Innovation

In the process of factor analysis, the latent variable is "the satisfaction of compensation object, standard, and capital," "the satisfaction of behavior subject knowledge innovation," and "the satisfaction of platform knowledge innovation." It is found that the characteristic value of potential variables is greater than 1, and the co-contribution ranks first, which is identical with the results of regression analysis. Furthermore, the correlation between the three observation indicators and potential variables is strong, and the factor load of "the satisfaction of platform knowledge innovation" is in a dominant position. In the process of resistance diagnosis, the resistance value of "the satisfaction of compensation object, standard, and capital" is large. According to the research results of factor loading and resistance diagnosis, there is heterogeneity in the specific order among the three observation indicators, which requires accurate intervention. Furthermore, according to the analysis results of the two factors, although the satisfaction of platform knowledge innovation has changed, it is still in a dominant position. Therefore, how to build a knowledge innovation platform for everyone to participate in is crucial. In addition, the influence of compensation objects, standards, and funds should not be ignored. Only when the core behavioral object is operable, ecological compensation knowledge innovation can achieve more reliable results. In the process of multiple regression analysis, the independent variable "work mechanism knowledge innovation" passes the model test. When the independent variable is introduced, not only the independent variable "strategic planning knowledge innovation" passes the model test, but the control variable also plays a significant role. Therefore, if the intervention effect of the working mechanism has to be improved, the following two aspects should be focused: on the one hand, the synergistic effect of strategic planning and working mechanism should be focused, that is, the thing whether the strategic planning is scientific and reasonable has a direct impact on the working mechanism; and on the other hand, the status of knowledge innovation participants and effective intervention need to be paid more attention. After all, the main force of working mechanism knowledge innovation depends on the strength and realization force, which are the main force of knowledge innovation.

## 4.3 Action Skill Knowledge Innovation

In the process of factor analysis, the latent variable "action skill knowledge innovation" involves two observation indicators, namely, "the satisfaction of the competency of ecological compensation knowledge innovation" and "the satisfaction of ecological compensation knowledge innovation led by mass entrepreneurship." It is found that the characteristic value of the potential variable is greater than 1 and the co-donation ranks third. Furthermore, the two observation indicators have a strong correlation with potential variables, and the factor load of "the satisfaction of ecological compensation knowledge innovation led by mass entrepreneurship" is in a dominant position, which is consistent with the result ordering of resistance diagnosis. Therefore, the guidance of "mass entrepreneurship" has a significant impact on ecological compensation knowledge innovation. Therefore, it is necessary to help participants improve the ability of mass entrepreneurship so as to realize the knowledge innovation of ecological compensation. In the process of multiple regression analysis, the independent variable "action skill knowledge innovation" passes the model test. Furthermore, when the independent variable is introduced, the independent indicators "strategic planning knowledge innovation" and "working mechanism knowledge innovation" pass the model test, and the control variables also pass the significance test. Therefore, if the intervention effect of action skills has to be improved, the following two viewpoints should be considered: on the one hand, strategic planning, working mechanism, and action skills are a trinity, so their linkage effect of should be strengthened to realize holistic governance; on the other hand, the soft power of participants in knowledge innovation needs to be enhanced. Only the participants have the corresponding innovation consciousness, knowledge, and ability, and they will be competent for knowledge innovation.

## 4.4 Ecological Compensation Knowledge Innovation

In the study, the satisfaction of ecological compensation knowledge innovation includes three potential variables as follows: "the satisfaction of strategic planning knowledge innovation," "the satisfaction of working mechanism knowledge innovation," and "the satisfaction of action skill knowledge innovation." According to factor analysis and multiple regression analysis, working mechanism knowledge innovation has the contribution with the rate of 28.763%, and its contribution to the dependent variable is 0.479; Strategic planning knowledge innovation has the contribution with the rate of 25.268%, and its contribution to the dependent variable is 0.467; action skill knowledge innovation has the contribution with the rate of 18.558%, and its contribution to the dependent variable is 0.351. Therefore, it can be found that the relative importance of the three potential variables is consistent, namely, the influence of working mechanism knowledge innovation, strategic planning knowledge innovation, and action skill knowledge innovation decreases in order. In order to improve the satisfaction of ecological compensation knowledge innovation, three potential variables should be dealt with by

the given different concerns, and the concept of holistic governance to three potential variables is also indispensable. And then, the governance effect of ecological compensation can be improved.

# 5 DISCUSSION

Based on the abovementioned analysis, the following knowledge innovation should be focused on effectively improving the satisfaction of ecological compensation in the Huainan mining area, and then experiences could be provided for other resource-based cities to realize the transformation of the ecological compensation level of efficient governance.

## 5.1 Harmonious Development

As far as the working mechanism is concerned, the harmonious development of individual behavior regulation and overall interest coordination needs to be realized. Working mechanism knowledge innovation should have serious consistent orientation. As a new recognition, harmonious development attaches importance to the certainty of complexity and dynamic knowledge innovation. Furthermore, harmonious development requires that behavior subjects have the ability and skills to deal with the working mechanism and its related factors scientifically. If it cannot come from the target group and then goes to the target group, then it cannot realize the value realization of ecological compensation legitimacy. In addition, harmonious development also requires the scientific discovery and technological invention of the working mechanism and its related factors to be subjected to the interrogation of universal reflection. If the universal reflection is lost, the knowledge innovation based on it will be lost.

## 5.2 Coordinated Development

In terms of strategic planning, the coordinated development of top-level design and belief adherence needs to be optimized. Coordinated development requires us to explore the basis for strategic planning and highlight value demands in the process of top-level design and belief adherence. In other words, the coordinated development of the two factors should be unified in the "purposeful" knowledge innovation, and the "uncertain" action of ecological destruction should be avoided. Therefore, the coordinated development of top-level design and belief adherence should be strengthened along with its direction guidance. Furthermore, coordinated development may be beneficial to performance projects of officials and profit capture of powerful groups but may not be conducive to the avoidance of "uncertainty" of ecological damage and maybe further away from the goal of avoiding "negative externalities' of ecological compensation. The reason why there is such a judgment is that coordinated development is the proper reference for strategic planning. In addition, coordinated development reflects the spirit of "seeking truth from facts." If the actual situation of individual behavior regulation and overall interest coordination cannot be targeted and the real situation of knowledge innovation between the two is not understood, then it will be difficult for us to consolidate the red line of ecological compensation and stick to the bottom line. In other words, without coordinated development, it is difficult for strategic planning to reflect the original intention of top-level design, and it is difficult to agree with belief adherence.

## 5.3 Interactive Development

In terms of action skills, interactive development led by competence and "mass entrepreneurship" needs to be achieved. Interactive development is not easy to be achieved because it is difficult to achieve development expectations due to the existence of contradictory relations between the two. Furthermore, whether they can realize the interactive development depends on whether they can realize the identification and interaction at the level of their relationship. Therefore, behavior subjects who have the same or similar values should be identified, and the linkage between them should be strengthened. In this way, the action skills of the target group can realize the "new combination" of cognitive elements and conditions, and then the knowledge innovation with specific demands can be formed. In addition, in the process of interactive development, identity, virtue, regulation, and mission should be taken as relational parameters to highlight the advantages of behavior subjects, behavior objects, and the environment. And then, the knowledge innovation of action skills can be strengthened. In other words, the effective integration of the advantages of scientific discovery and technological invention should be strengthened to provide a strong material guarantee and intellectual support for interactive development.

# 6 SUMMARY AND CONCLUSION

The satisfaction of ecological compensation knowledge innovation in the Huainan mining area has certain reference significance for the mineral resource–based cities to avoid the externality of ecological compensation and realize the efficient management of ecological protection. Furthermore, in terms of the coverage of the local mining areas, the status of ecological damage, and the impact on the Huaihe River Ecological Economic Zone, it is also of significant practical significance to improve the satisfaction of ecological compensation knowledge innovation in the mining areas. Therefore, the focus points and potential space need to be consolidated as follows:

## 6.1 Strengthening a New Pattern of "Good Governance"

A new pattern of "good governance" needs to be built with the ecological compensation knowledge innovation in the mining area. The framework of ecological compensation knowledge elements with universal guiding significance needs to be obtained to identify the influencing factors of working mechanism, strategic planning, and action skills and their logical correlation. Only then, ecological compensated knowledge production can consolidate the value foundation and obtain intellectual support, a new pattern of "good

governance" can be obtained, and the satisfaction of ecological compensation can be improved.

### 6.2 Constructing a Governance Pattern of "Co-construction, Co-Governance, and Sharing"

A solid foundation needs to be laid for "co-construction, co-governance, and sharing" of the ecological compensation knowledge innovation in the mining area. Ecological compensation knowledge innovation should undergo the practice test of "co-construction, co-governance, and sharing." And then, the physical and spiritual core of ecological compensation knowledge innovation can be consolidated to reconcile the interest demands of individuals and groups, and the orderly development of "upper" and "lower", and the synergy between internal development potential and external development advantages.

### 6.3 Optimizing the Knowledge Innovation that "Benefits Mankind"

A complete modern mining area ecological compensation needs to be established to optimize the knowledge innovation that "benefits mankind". Ecological compensation knowledge innovation can perfect the modern environmental governance system with the help of modern information technology and its terminal technology. Furthermore, the knowledge element, ability element, and value element of ecological compensation knowledge innovation need to be expanded to optimize the relevant measurement model and analyze the logical correlation among their impact factors. Then, the advantage of ecological compensation knowledge innovation can be fully focused and the governance system of "human benefit" can be fully realized.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## AUTHOR CONTRIBUTIONS

QX: conceptualization, literature search, literature analysis, and writing—review. HG and WY: conceptualization and writing—review and editing. All authors agreed with the content and all gave explicit consent to submit the manuscript.

## FUNDING

This work was supported by the following programs: Anhui Provincial Philosophy and Social Science funding project: research on the index system of Rural revitalization of Revolutionary Fellow villagers in Dabie Mountains (No. AHSKQ2021D19).

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