

## Design of an Ecological Immigrant Compensation Program for China's Nature Reserves

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**Abstract**—Reasonable ecological compensation is about efficiency, equity and sustainable development of nature reserves in China. A large quantity of cases on ecological migrant's compensation in various nature reserves of China was utilized to summarize the main program, contents and methods of ecological compensation of nature reserves in China. Some issues in different compensation stages were discussed to get a more scientific design. The current study may provide new ideas for ecological compensation for the eco-compensation with nature reserves in China.

**Keywords**—Nature reserves; Ecological compensation; Program design

### I. INTRODUCTION

Nature reserves of different types provide a guarantee for ecological and environmental safety[1]. However, ecological immigrant compensation for the construction of nature reserves in China has been crippled by a lack of theoretical and practical guidance and ecological compensation is a troublesome issue at present[2].

Ecological immigrant compensation of the nature reserves has its unique features as compared with other immigration policies[3]: (1) Difficulty in clearly defining the participants receiving compensation; (2) Greatly diverse and unquantifiable loss and hence the compensation for the immigrants; (3) Long cycle of compensation; (4) great impact from local culture, custom and religious belief. Thus to devise an ecological immigrant compensation system reasonably and to ensure the sustainable development of the nature reserves, it is important to learn from the experiences of other compensation and make innovations.

In the absence of an established set of standards and procedures, ecological compensation contains high arbitrariness. Based on a summary of the ecological compensation cases of China's nature reserves, we come up with the differences and similarities as compared with other types of ecological compensation. We tentatively proposed a design of ecological immigrant compensation system of the nature reserves so as to provide inspirations for the ecological compensation practice.

### II. OVERALL DESIGN OF AN ECOLOGICAL IMMIGRANT COMPENSATION SYSTEM OF THE NATURE RESERVES

Nature reserves may differ greatly in the ecosystem, which includes forest, desert and wetland. Given to large disparities in the natural and social environment, there is rarely a unified set of standards and procedures of ecological compensation[4]. Whatever the ecosystem, ecological compensation for the immigrants should consider the following aspects: firstly, contributions made by the immigrants, and secondly, immigrants' loss. Immigrants' relocation is of high ecosystem service value and facilitates the ecosystem restoration. Loss, on the part of the immigrants, mainly refers to the loss of fixed assets, opportunity cost and social capital. However, the actual standards and procedures of compensation depend on the local economic development level combined with considerations of natural and social factors. Several methods are now in use for determining the standards and procedures of compensation, such as willingness investigation, market value investigation and opportunity cost estimation [5-7].

By analyzing the commonality across ecological compensation cases, we proposed a general design of ecological immigrant compensation system, which consists of four stages: the first is the preparation stage, during which large amount of data are collected; the second is the planning stage, during which the participants receiving the compensation and compensation standards and procedures are determined; the third is the implementation stage, during which the compensation is implemented in accordance with the standards; the fourth is the assessment stage, which is intended for assessing the compensation effect, identifying defects and formulating the countermeasures.

### III. RESEARCH CONTENTS AND METHOD FOR EACH STAGE OF ECOLOGICAL COMPENSATION

#### A. The preparation stage

The preparation stage mainly involves the collection of data related to ecological compensation, which is divided

into four types: the first is the basic information of the nature reserves; the second is local social and economic background; the third is the information of the stakeholders, including local residents, immigrants and managerial personnel; the fourth is the relevant rules, policies and regulations concerning ecological compensation. Data of different types can be collected by literature review, field survey and questionnaire survey[8], as illustrated in Table 1.

Data collection should be based on a full awareness of disparities across the ecosystems, which usually displays large variations in provisioning, supporting, regulating and cultural services[9,10]. The ecological services most pertinent to local production and livelihood will be the focus of discussion, and a careful analysis paves the way for ecological compensation accounting[11]. Take three typical ecosystems, grassland, forest land and wetland, as an example. These three ecosystems are associated with different immigrants' loss and contribution[12-19]. For the grassland, the major ecological services are provisioning of pasture plants, mutton and beef[12-13]. Forest land's main ecological services are provisioning of food, fuels, raw materials and forest tourism[14-18]. Wetland's main ecological services are provisioning of fish, wetland plants and wetland tourism[19-25].

TABLE I. TYPES, CONTENTS AND COLLECTION METHOD OF DATA

Type	Content	Collection method
Basic data of the nature reserves	1. Natural resources: ecosystem type, resources type, amount and exploitation status; mineral resources; types, amount, growth status and distribution of wild animals and wild plants	Investigation of historical data,
	2. Geological environment: physical and chemical properties of rocks and soils, soil fertility, land use types and distributions including farmland, pasture, forest land and barren mountains	naturalistic observation
	3. Geographic environment: geographic conditions, location on the administrative region map, terrain & topography, altitudes	Field survey, experimental research
	4. Weather and meteorology: air temperature, precipitation, sunshine hours, frost-free period, wind force, meteorological disasters	Expert consultation, 3S technology
Social, economic and cultural background of the nature reserves	1.Means of production and livelihood for local residents, dependence on natural environment, development prospect, external support	Investigation of historical data, questionnaire survey, expert consultation, field survey
	1. Population size and distribution, education, medical care and sanitation status, economic income and expenditure, land use types, infrastructures, administrative body and management level	
	2. Local history, historical sites, cultural resources, traditional culture, ethnic knowledge	
Information of the stakeholders	3. Land planning, urban planning, environmental protection planning, tourist planning and social development planning that have been approved and are now executed	
Relevant laws and regulations	1. Basic information of the victims, such as the willingness to accept compensation and protection and willingness to relocate	Investigation of historical data, questionnaire survey, expert consultation,
	2.Information of the beneficiaries (eg. government and enterprises), such as fiscal income, industrial structure, economic development level, ability and willingness to pay	
	3.Attitude and other information of the third parties (eg., NGO and research institutes)	
	National and local policies, rules and regulations on ecological compensation	Expert consultation, investigation of historical data, questionnaire survey

Advantages and disadvantages of each data collection method are taken into account and applied with discretion for different situations. Investigation of historical data has low cost, but lacks in timeliness. Naturalistic observation is more objective and intuitive, but labor- and time-consuming. Field survey can acquire the latest and objective data, but is also labor- and time-consuming. Experimental research provides accurate and scientific data, but it may be restrained by lack of equipments and skills. Expert consultation is easy and direct, but contains considerable subjectivity. 3S technology can acquire large-scale data very quickly, but further verification and analysis will be needed on a smaller scale.

### B. The planning stage

The planning stage is the most important of the four stages as the standards and procedures of ecological compensation are determined at this stage through technical means. Immigrants' loss and contribution are the major contents of accounting to determine the compensation standards. The accounting methods and the features of each method are shown in Table 2.

Different accounting methods can be used depending on distinctive local natural and social background. Then by comparing the results of different accounting methods, the most accurate one can be chosen. Besides the compensation standards, the specific procedures and length of compensation are also to be determined along with proposals of safeguard measures on the fiscal, material, policy and legal levels. That is to say, the institutional, policy, legal and fiscal measures[27,28] should be grounded in the comprehensive consideration of local economic development, payment ability, and social culture[29]. Willingness of ethnic minorities to relocate and to be involved in the ecological protection of the nature reserves can be mobilized by resorting to the minority cultural folklore and heritage that encourages ecological protection, sustainable use of natural resources and efforts to increase the income. The benefits are two-fold: firstly, it mobilizes the ethnic minorities' enthusiasm to be involved, and secondly, it helps protects minority culture[30].

TABLE II. METHODS FOR ACCOUNTING OF COMPENSATION STANDARDS AND THE ADVANTAGES OF EACH METHOD

Method	Basis of accounting	Advantages
1.Ecosystem service increment-market value method	Determine the compensation standards based on the market value associated with ecosystem service increment incurred by immigrants' relocation	Objective and accurate, but difficult to acquire the monitoring data
2.Accounting of immigrants' capital loss-market value method	Determine the compensation standards based on the immigrants' physical and social capital loss	Objective and comprehensive, but capital- and labor-consuming
3. Estimating the contribution of immigrants' ecological footprint+estimating the efficiency of ecological footprint	Determine the compensation standards based on the changes of ecological footprint before and after relocation and the accounting of the values associated with it	Scientific and direct, but sometimes difficult to acquire the data
4. Survey on the willingness to pay and the willingness to accept the compensation	Determine the compensation standards based on the willingness of the responsibility subjects to pay and willingness of the immigrants to accept the compensation	Simple and direct, but greatly influenced by subjective factors

## IV. THE IMPLEMENTATION STAGE

The implementation stage is the stage of enforcing the compensation standards through laws, regulations and policies under coordination between different government departments.

Building the information disclosure mechanism and holding public hearings on the compensation standards and procedures are effective measures to win public acceptance and support. Information such as the destinations of the compensation capitals and supplies can be disclosed via this mechanism regularly so as to mobilize the general public to get involved in the construction and perfection of the compensation system.

Moreover, sufficient communication and coordination between the immigrants, managerial personal of the nature reserves, local residents and the general public via unobstructed channels are indispensable for ensuring the

equity and transparency of compensation implementation. That is, ensuring that the compensation capitals and supplies are received by the "right people".

A multi-channel supervisory mechanism is another important aspect of implementation. An auditing mechanism can be built and operated in parallel with inquires and exchange visits among the people receiving the compensation and working staff of the responsible authorities.

A market-based mechanism for ecological compensation will be the new orientation. Compensation funds, subsidies, guarantee payment (refunded after meeting the ecological requirements) and donations can all be the concrete forms of the market-based operation [31]. Any valuable experiences and lessons should be summarized for institutionalization and standardization of ecological compensation, providing reference for ecological compensation in other districts.

## V. THE ASSESSMENT STAGE

The assessment stage, which is the final stage, consists of the following contents: firstly, assessing the compensation effect; secondly, assessing the development of the immigrants after relocation; thirdly, doing cost-benefit analysis of the ecological compensation.

Technologies such as remote sensing, GIS and GPS will provide considerable benefits for assessing the compensation effect. Building ecological monitoring and GIS platform can greatly facilitate the assessment of ecological environment changes, ecosystem structure, ecological functions, ecological sensitivity, resources and environment carrying capacity and ecosystem restoration. This will further promote the implementation assessment of major ecological projects, creation of ecosystem service evaluation system and performance evaluation system, improvement of database and information inquiry system and finally the sharing of information resources.

Suitability of immigrants' production and livelihood after relocation should be also assessed [32-35], by focusing on the following contents: living standards, income level, changes of living environment, building of a new social relation network, reconstruction of traditional customs and cultural transitions. The effects of various support measures (eg., policies, projects, industries, and training) are also assessed to monitor the infrastructure construction of the resettlement area, ensure social harmony and stability and increase immigrants' income.

The cost-benefit analysis of ecological compensation is based on an input-output comparison. The input terms mainly include the capital investment for the early and middle stage of relocation and for subsequent development of the resettlement area. Outputs included into the accounting are changes in ecosystem service values before and after immigration and social benefits of immigration.

## VI. CONCLUSIONS

We analyzed the commonality and individuality of ecological compensation of nature reserves in China as compared with other types of ecological compensation based

on existing achievements. Then general procedures of ecological compensation of nature reserves were proposed. The disparities of ecological compensation of nature reserves mainly consist in the stakeholders, contents and time length of compensation. By reviewing different cases, we put forward the issues deserving attention for each stage of ecological compensation. We hope that our findings from this general analysis will shed new light onto the ecological compensation work in China.

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