

# Spatial transferring of ecosystem services and property rights allocation of ecological compensation

Wujun WEN<sup>1,2</sup>, Geng XU (✉)<sup>1</sup>, Xingjie WANG<sup>3,4</sup>

<sup>1</sup> Research Center for Sustainable Development of Shandong Province, Shandong Normal University, Jinan 250014, China

<sup>2</sup> College of Life Sciences, Shandong Normal University, Jinan 250014, China

<sup>3</sup> Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

<sup>4</sup> Graduate University of Chinese Academy of Sciences, Chinese Academy of Sciences, Beijing 100049, China

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**Abstract** Ecological compensation is an important means to maintain the sustainability and stability of ecosystem services. The property rights analysis of ecosystem services is indispensable when we implement ecological compensation. In this paper, ecosystem services are evaluated via spatial transferring and property rights analysis. Take the Millennium Ecosystem Assessment (MA) as an example, we attempt to classify the spatial structure of 31 categories of ecosystem services into four dimensions, i.e., local, regional, national and global ones, and divide the property rights structure into three types, i.e., private property rights, common property rights and state-owned property rights. Through the case study of forestry, farming industry, drainage area, development of mineral resources, nature reserves, functional areas, agricultural land expropriation, and international cooperation on ecological compensation, the feasible ecological compensation mechanism is illustrated under the spatial structure and property rights structure of the concerned ecosystem services. For private property rights, the ecological compensation mode mainly depends on the market mechanism. If the initial common property rights are “hidden,” the implementation of ecological compensation mainly relies on the quota market transactions and the state investment under the state-owned property rights, and the fairness of property rights is thereby guaranteed through central administration.

**Keywords** ecosystem services, ecological compensation, property rights, transaction costs, spatial transferring

## 1 Introduction

With the accelerating process of globalization and in-depth global cooperation, ecological compensation, an effective environmental and economic instrument to adjust the interest-based relationships between interested parties, has been widely employed around the world including China in response to the serious global environmental challenges.

Improved levels of sustainability could be achieved through the improved compensation in the environmental protection practice (Villarroya and Puig, 2010). The reasons why the relationships between interested parties need to be modified is that in the production, consumption and value realization process of ecosystem services, there is a distortion of interest-based relationships. The straightening out of the interest-based relationships of interested parties should rely on the restoration, maintenance, improvement, utilization and protection of ecosystem services so as to maintain the continuity and stability of ecosystem services. Ecological compensation has been defined as the substitution of ecological functions or qualities that are impaired by social-economic development, in order to improve damaged areas due to adverse impacts on nature or to create new habitat with ecological functions and quality attributes (Cuperus et al., 1999). Rundcrantz and Skärbäck (2003) also stated that the term “ecological compensation” is not used in the same way in all countries. In this paper, ecological compensation will be understood as the set of measures carried out to maintain the sustainable ecosystem services of concerned system and compensate (improve or create) the ecological values and functions that remain definitively damaged or lost. Recently, it has become a common practice to restore the habitats and ecosystems worldwide, such as agricultural production areas on biodiversity and water quality (Herzog

et al., 2005), intensively managed adjacent grassland (Albrecht et al., 2010), and even landscape scenery (Junge et al., 2011).

The property right of ecosystem services is the premise and necessary condition of ecological compensation. Only when the property rights of ecosystem services are defined, can the interested parties of interest-based relationships be clear and the beneficiaries and losers clarified. In this way, it is possible for the beneficiaries to compensate the losers. The property rights analysis of ecosystem services is then indispensable for the implementation of ecological compensation. However, the definition and allocation of property rights of ecosystem services are often hidden from the practice of ecological compensation, even if as the “invisible hands”, they are controlling, influencing and dominating the practice of ecological compensation. The ecological compensation practice has always unconsciously followed the established structure of property rights of ecosystem services, and has given tacit consent to the existence of property rights of ecosystem services. Barzel (1989) stated that all social systems in human societies can be analyzed in the framework of property rights. Therefore, we choose to analyze the ecological compensation in the framework of property rights analysis in this paper. Most ecosystem services are public goods or quasi-public goods, and their property rights can hardly be defined or their definition costs are too high. Thereby, most studies on ecological compensation assume that the property rights of ecosystem services are clear and the ecological compensation practice is trying to avoid defining the property rights of ecosystem services. Likewise, because the property rights of ecosystem services can hardly be defined or the definition costs of them are too high, so it is hard to directly explain the function of the property rights of ecosystem services “behind” the ecological compensation.

In this paper, we intend to interpret the ecological compensation practice from the perspective of property rights of ecosystem services to further clarify the action rules of ecological compensation. The rest of the paper is organized as follows: Sect. 2 is devoted to the spatial transferring and property rights of ecosystem services. Sect. 3 presents the structure of private property rights, common property rights and state-owned property rights. Finally, some conclusions are summarized in Sect. 4.

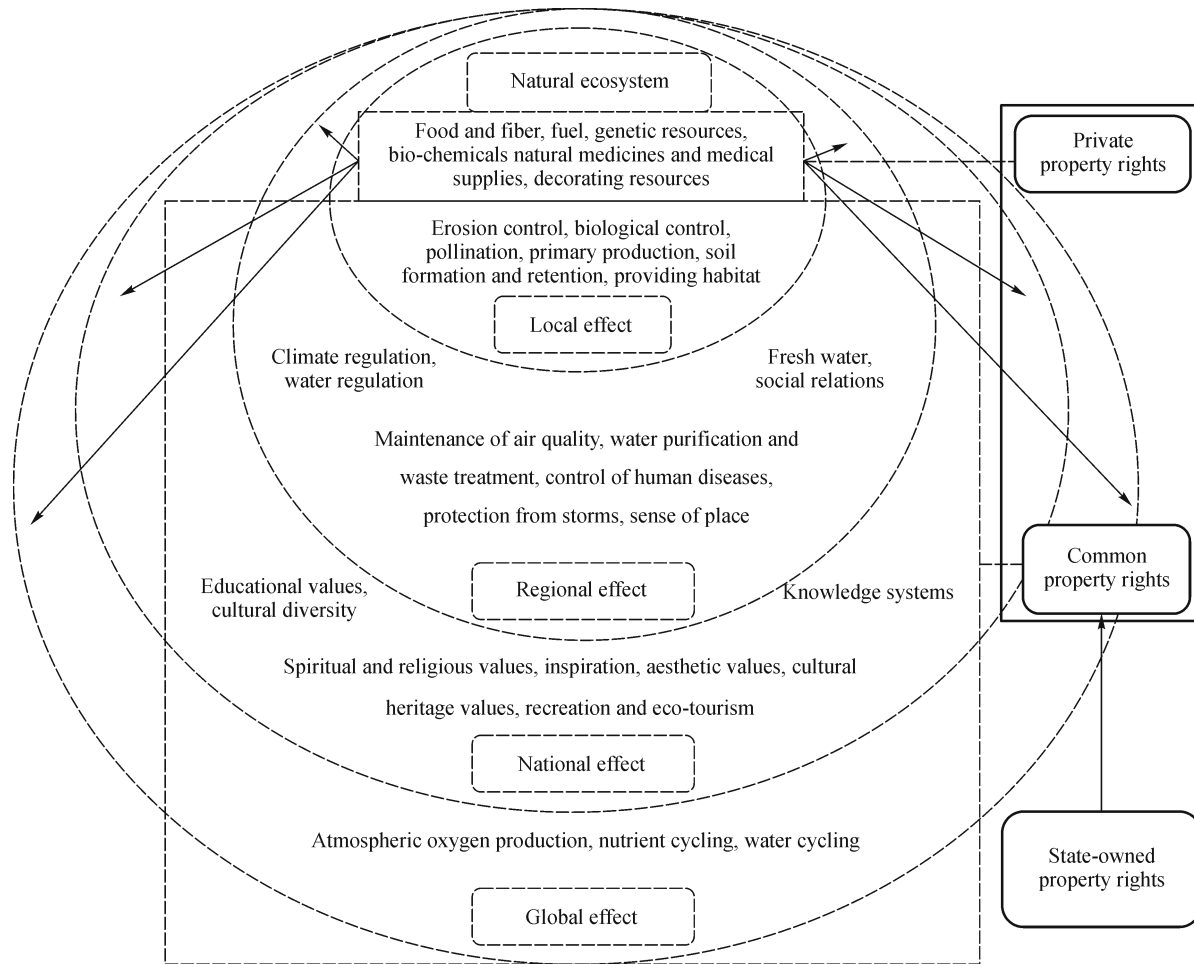
## 2 Spatial transferring and property rights structure of ecosystem services

Costanza et al. (1997), de Groot et al. (2002) and MA (2003) classified the global ecosystem services into 16 categories, 23 categories and 31 categories, respectively, and the corresponding references can be referred to ACCA (2009). In MA (2003), 31 categories of ecosystem services include 4 dimensions, ranging from local, regional,

national to global scales. Among this, local dimension is in the scope of physical distribution of forest ecosystem, and 11 categories of ecosystem services are generally considered to have local effects, including erosion control, biologic control, pollination, primary production, soil formation and retention, providing habitat, food and fiber, fuel, genetic resources, bio-chemicals and natural medicines and medical supplies, and decorating resources, and the latter five categories can be transferred to the other regions, countries or even the whole world through trade and transport. Nine categories of ecosystem services are generally considered to have regional effects, including maintenance of air quality, climate regulation, water regulation, water purification and waste treatment, control of human diseases, protection from storms, fresh water, social relations, and sense of place. Eight categories of ecosystem services are generally considered to have national effects and some have global effects, including cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, cultural heritage values, and recreation and eco-tourism. And three categories of ecosystem services are generally regarded to have global effects, including atmospheric oxygen production, nutrient cycling, and water cycling (Fig. 1).

Property rights are a bundle of rights. Based on the degree of exclusiveness, most researchers divide property rights into three categories, i.e., private property rights, common property rights, and state-owned property rights (Lu and Zhu, 2007). It is generally believed that the suppliers have private property rights toward some ecological products, including food and fiber, fuel, genetic resources, bio-chemicals natural medicines and medical supplies, and decorating resources, and the owners of private property rights have the right to exclude others from the exercise of these rights. In private property rights, the owners of ecological products can internalize the external effects of the producing, restoring, maintaining, improving and protecting of ecological products. Therefore, in private property rights, there are no externality problems. The problems of interest imbalance in the production, consumption and value realization process of ecological products can be solved through fair market transactions.

All members of the four communities, i.e., local, regional, national or global community, have common property rights toward the remaining 26 categories of ecosystem services. Common property rights are completely inseparable among individuals. A person exercising a certain right toward a particular ecosystem service does not exclude the rights of others to exercise the same right toward ecosystem services. Each member of the community has the right to equally share the rights of the community. When a person maximizes his personal benefits, he may invade the benefits of others or may burden the other people at the cost of his maximized



**Fig. 1** Spatial transferring and property rights structure of ecosystem services

benefits. Therefore, under the common property rights, there often exists significant externality.

A country can determine the private property rights or the common property rights of a person toward particular ecosystem services according to acceptable procedures. In accordance with the Coase Theorem II, first, in the real world where the transaction costs are greater than zero, the initial distribution of property rights will not change to the optimal condition through non-cost transactions. Therefore, the definition of initial property rights will have an impact on economic efficiency. Second, the adjustment of rights only occurs when it is in favor of the GDP growth, and the amount of GDP growth must be greater than the transaction costs of rights adjustment. Since the initial arrangement of rights will affect the social welfare, the initial arrangement of rights providing greater social welfare is optimized. The goal of defining property rights is to maximize the net economic value, or is to minimize the social welfare loss. According to this theorem, it can be deduced that: first, when all the tradable rights are going to be defined to one or the other, the government should define the rights to those who can finally maximize the

social welfare or minimize the social welfare loss. Second, once the initial rights are defined, it is still possible to improve social welfare through transaction. However, because the transaction costs are positive, the transaction can only remove some but not all of the social welfare loss related to the initial arrangement of rights. Because rights are exercised through agents chosen by the state and the users of rights do not have sufficient power to the production, consumption and value realization of ecosystem services, they may reduce their supervision and incentives to other members and to the economic performance of the restoration, maintenance, improvement, protection and utilization of ecosystem services, while, for the state, the costs of fully monitoring these agents are extremely high. Moreover, the entities that exercise state power are often pursuing their political interests instead of diverging from the principle of profit maximization, and when choosing agents, there is also an inclination of political interests rather than the tendency of economic considerations. Therefore, under the state-owned property rights, the externality effect is also very high (Lu and Zhu, 2007).

### 3 Ecological compensation mechanism under structure of private property rights, common property rights and state-owned property rights

The main objectives of ecological compensation can be summarized from the following three aspects:

1) Make up for the absent content of the existing system of environmental protection and utilization, and balance the benefits of interested parties;

2) Reduce the transaction costs of environmental protection and utilization, and improve the efficiency of protection and utilization;

3) Provide incentives for the protection and utilization of ecosystem services, and protect the natural ecosystem.

These three objectives can be generalized as securing fairness, enhancing efficiency, and protecting natural objects. To achieve these objectives, ecological compensation should address three key issues: first, defining the interested parties, including the definition of the border between the interested parties and non-interested parties of ecological compensation and the definition of the border between beneficiaries and losers within interested parties; second, calculating the degree of benefit and damage, i.e., determining the amount of compensation; and third, developing compensation mode, i.e., determining a compensation mode that can maintain the balance of the benefits of interested parties, that has low transaction costs, and that can actually protect and make sustainable use of the ecosystem services. These issues constitute a complete ecological compensation mechanism. The following part is focused on the analysis on feasible ecological compensation mechanism under the structure of private property rights, common property rights, and state-owned property rights.

#### 3.1 Ecological compensation mechanism under private property rights

Under the conditions that the suppliers of ecosystem services have private property rights and there are transaction prices and market for ecosystem services, what we should do is to improve and ensure that the market system can run normally and efficiently, to allow free trade, and to guarantee that the suppliers and demanders of ecosystem services are willing to realize the balance of interests under the equilibrium price of supply and demand, whether the market is perfectly competitive or non-perfectly competitive (whatever the monopoly degree is).

If there are no transaction prices and market for ecosystem services, it is necessary to distinguish between stock value and incremental value, natural capital and man-made capital, external value and non-external value, and value ecosystem services so as to determine the

corresponding prices and establish market for ecosystem services (Wang et al., 2010).

#### 3.2 Ecological compensation mechanism under the “hidden” initial common property rights

For most ecosystem service with attributes of public goods or quasi-public goods, their initial common property rights do not necessarily exist, because the property rights can hardly be defined or the costs for the definition are too high. In addition, due to the social and cultural foundations, the basic institutional environment, and other reasons, they are established through long social practice. They are not systematically clarified but are the “hidden” initial common property rights, e.g., the usufruct right of mankind for the non-exclusive use of forest carbon-sink services and the non-exclusive use of ecosystem services of certain types of drainage area. In the following part, by analyzing the evolution of “hidden” initial common property rights of ecosystem services, we can clarify the fundamental reasons and the manifestation mode of externality after the initial property rights are defined.

To facilitate the analysis, we make the following premises:

1) The basic unit of all analysis on rights is “individual”, and the behavior of so-called “organization” can be regarded as an integration of behavior of individuals (Barzel, 1989). All the analysis on ecosystem services and property rights is based on “individual” as the basic unit. If in a specific geographical area there are ( $n$ ) individual entities of property rights, all the individual property rights are set to be equal.

2) The parties that protect, restore, maintain and improve ecosystem services are termed as suppliers of ecosystem services (since the supply of ecosystem services is the result of the combined function of human and natural forces, here we do not take into account the role of natural forces), while the parties that utilize ecosystem services are the demanders of ecosystem services.

3) Within specific time and space, the same ecosystem services are ubiquitous and uniform (if not ubiquitous or not uniform, the area coverage could be narrowed). With respect to unlimited demand of human beings, any ecosystem services within specific time and space are always scarce.

4) Property rights are measurable, and the value of ecosystem services is an objective standard to measure the size of the property rights. The total amount of property rights of ecosystem services is stable within specific time and space.

5) Time: the initial state of property rights is ( $t_0$ ); development and change of property rights is ( $t_1$ ).

6) Spatial scale: a specific geographical area can be the whole world, one country, one region or across regions.

Assuming that within a particular time and space, the total amount and value of initial common property rights of

(No.  $i$ ) category of ecosystem services are  $(M_{0i})$  and  $(X_{0i})$ , respectively. The initial common property rights and its value of (No.  $i$ ) category of ecosystem services of each entity of property rights among the  $(n)$  entities of individual property rights are  $(M_{0i}/n)$  and  $(X_{0i}/n)$ , respectively. To maximize its benefits, the individual entity of property rights ( $A$ ) has used far more than its share of initial common property rights, and has misappropriated the property rights of ( $B$ ), so that the overall quality of ecosystem services has declined. Assuming that after the overall quality of ecosystem services has declined, the total number and value of initial common property rights of (No.  $i$ ) category of ecosystem services are  $(M_{1i})$  and  $(X_{1i})$ , respectively, and  $M_{1i} < M_{0i}$ ,  $X_{1i} < X_{0i}$ .

If their rights are equal, the individual common property rights owned by ( $A$ ) and ( $B$ ) decreases from  $(M_{0i}/n)$  to  $(M_{1i}/n)$ . Then the corresponding value of ecosystem services will decrease from  $(X_{0i}/n)$  to  $(X_{1i}/n)$ , and  $X_{1i} < X_{0i}$ . For individual entity of property rights ( $A$ ), the utilization of ecosystem services enables it to make some profits, and its common property rights to ecosystem services will increase instead of decreasing. Because the total number of property rights of ecosystem services within specific time and space is invariant, the increase in property rights of ( $A$ ) is originated from the result of subtracting  $A$ 's share of the decreased part of total common property rights due to  $A$ 's consumption of ecosystem services when the rights are equal from the misappropriated property rights of ( $B$ ). In other words,  $A$ 's behavior has negative externality on ( $B$ ):  $A$ 's consumption of ecosystem services and his misappropriating  $B$ 's initial property rights enable ( $A$ ) to obtain additional revenue. Because of  $A$ 's excessive consumption on ecosystem services,  $B$ 's initial share of property rights is misappropriated by ( $A$ ), so that ( $B$ ) suffers from additional damage. After this variation,  $A$ 's property rights and its value of ecosystem services are as follows:

$A$ 's property rights can be given as:

$$P_{1Ai} = M_{0i}/n + (R_{1Ai} - U_{1i}/n), \quad (1)$$

and  $A$ 's value of ecosystem services as:

$$X_{2Ai} = X_{0Ai}/n + (X_{2Ai} - X_{1Ai}/n) - S_{1A}, \quad (2)$$

where,  $P_{1Ai}$  is  $A$ 's common property rights after variation. The corresponding value of ecosystem services after variation is  $X_{2Ai}$ .  $M_{0i}/n$  is  $A$ 's initial common property rights before the variation, and the corresponding value of ecosystem services before variation is  $M_{0Ai}/n$ .  $U_{1i}/n$  is  $A$ 's share of the decreased part of total common property rights due to  $A$ 's consumption of ecosystem services when the rights are equal, and the corresponding value of ecosystem services is  $X_{1Ai}/n$ .  $R_{1Ai}$  is the misappropriated initial common property rights of ( $B$ ), and the corresponding value of ecosystem services is  $X_{2Ai}$ .  $(R_{1Ai} - U_{1i}/n)$  is the amount of variation of  $A$ 's common property rights

brought about by  $A$ 's consumption of ecosystem services, and it is referred to as  $X'_{2Ai}$ ;  $S_{1A}$  is the transaction costs of ( $A$ ).

Similarly, after variation,  $B$ 's property rights and his value of ecosystem services are as follows:

$B$ 's property rights can be presented as:

$$P_{1Bi} = M_{0i}/n - (R_{1Bi} + U_{1i}/n), \quad (3)$$

and  $B$ 's value of ecosystem services as:

$$X_{2Bi} = X_{0Bi}/n - (X_{2Bi} + X_{1Bi}/n) + S_{1B}, \quad (4)$$

where,  $P_{1Bi}$  is  $B$ 's common property rights after variation, and the corresponding value of ecosystem services after variation is  $X_{2Bi}$ .  $M_{0i}/n$  is  $B$ 's initial common property rights before variation, and the corresponding value of ecosystem services before variation is  $X_{0Bi}/n$ .  $U_{1i}/n$  is  $B$ 's share of the decreased part of total common property rights due to  $A$ 's consumption of ecosystem services when the rights are equal, and the corresponding value of ecosystem services is  $X_{1Bi}/n$ .  $R_{1Bi}$  is the lost initial common property rights of ( $B$ ), and the corresponding value of ecosystem services is  $X_{2Bi}$ .  $(R_{1Bi} + U_{1i}/n)$  is the amount of variation of  $B$ 's common property rights brought about by  $A$ 's consumption of ecosystem services, and it is referred to as  $X'_{2Bi}$ ;  $S_{1B}$  is the transaction costs of ( $B$ ).

$A$ 's earning value from consuming ecosystem services must be greater than its compensation to ( $B$ ) and transaction costs as well, and then  $A$ 's behavior is of economic rationality. The transaction costs will have an important impact on the definition and protection of property rights. If ( $A$ ) exerts on the ecosystem a certain amount of input, the ecosystem services are thereby restored, maintained, and improved. The analysis process on  $B$ 's earnings is the same as the above can be ignored here ( $A$ 's maintenance and protection of ecosystem services can also be seen as changes in ecosystem services. Without  $A$ 's investment, the ecosystem services will not be maintained). In addition, the above process occurs when there is no cross-region transferring of ecosystem services. With cross-region transferring of ecosystem services in the specific time and space, the total number of property rights of ecosystem services and its corresponding value will change. But the analyzing procedure is the same as the situation when there is no cross-region transferring of ecosystem services.

When the initial common property rights are "hidden" and difficult to define, in order to balance the interests of interested parties, we must use organization to substitute market transaction. Coase Theorem II proposes two ways to adjust the rights, i.e., using organization enterprise or government control to substitute market transaction. It is also pointed out that both of the two adjustment methods need extra costs. At the enterprise level, the transaction costs are for the management fee that is generated when the organization transaction inside enterprises substitutes the

market transaction. At the government level, however, the transaction costs are the administrative management fee that is generated when the government substitutes market transaction with administration order, including the expenses for searching economic information, specifying the regulations and policies, and ensuring the implementation of its decisions. In short, Coase believes that any kind of arrangement of rights needs relevant costs, and the essence of the problem is to choose a less expensive arrangement. In reality, there is no certain way of arrangement that has the least costs in all fields. Thus, based on the principle of lower cost, the market, enterprises, and the government all have their own optimal boundaries upon their function on allocation of resources. From the dynamic point of view, the optimal boundary of the three entities will change with respect to the variation of costs of a certain resource's allocation (Lu and Zhu, 2007). Entities of private property rights are usually corresponding to individual market entities. Based on the fact that property rights are defined to a certain degree, a certain degree of market transactions can balance the interests of interested parties. According  $A$ 's earnings ( $X'_{2Ai} - S_{1A}$ ) and  $B$ 's loss ( $X'_{2Bi} + S_{1B}$ ), through negotiation or market transactions, ( $A$ ) can compensate ( $B$ ).

By studying the small range of common-pool resources (CPR), under the condition that property rights can hardly be defined, and outside the state and the market, Ostrom provided a collective self-organization tool. She stated that, "How a group of interdependent clients can organize themselves and carry out self-governance, so that when all people are faced with the temptation of thumbing a lift, avoiding liability or other opportunistic behavior, they can achieve lasting common benefits." Ostrom also limited her investigated subjects at small-scale common-pool resources, "It is located within a country, and about 50 to 15000 people are influenced by it, and the economic benefits of these people rely heavily on the common-pool resources. .... Since the economic benefits of a majority of individuals involved are from the common-pool resources, and they have a strong desire to solve public problems so as to continuously improve their own productivity. ... The investigated types of common-pool resources are limited to (Ostrom, 1990):

- 1) Renewable rather than non-renewable resources;
- 2) Resources are very scarce rather than abundant;
- 3) Resource users can hurt each other, but it is impossible for the participants to harm other people from the external.

It should be noted that the collective self-organization can achieve the self-governance of small-scale common-pool resources through the development of system, implementation and supervision, and hierarchical sanctions. In the process of using common-pool resources, a member of the collective organization violates the rules and earns benefits, which will inevitably bring about damage to other members of the organization. Those who

violate the rules will be sanctioned hierarchically, so as to maintain the balance of interests among group members. However, the system of collective self-organization is mainly reflected in the system that should be observed by all members and in the hierarchical sanctions, but not in the connotation of compensation. Therefore, collective self-organization cannot be included in the framework of ecological compensation.

### 3.3 Quota market transactions under the state-owned property rights

In accordance with the Coase Theorem II, when the transaction costs are greater than zero, clear definition of property rights will help to reduce people's costs in the trading process and improve its efficiency. In other words, if there are transaction costs, but there are no rules for the definition and protection of property rights, i.e., there is no property rights system, the transaction of property rights and the improvement of economic efficiency will be difficult to be carried out. If the government chooses an optimal arrangement of initial property rights, then the welfare can be improved on the original basis. This kind of improvement may be better than the welfare improvement achieved through transactions under other arrangements of initial property rights. The tradability of rights can improve the initial arrangement of rights so as to improve social welfare. We can deduce that the market is not the only allocation method, and also allocate resources through the clear definition of property rights. If, at the very beginning, the government can accurately allocate the rights among economic entities, then it will better improve social welfare. But there must be a prerequisite—the government has full information. Thus, when the transaction costs are greater than zero, if the government chooses an optimal arrangement of initial property rights, then the welfare can be improved on the original basis. This kind of improvement may be better than the welfare improvement achieved through transactions under other arrangements of initial property rights. The essence is that when the transaction costs are positive, if the government chooses an optimal initial arrangement of property rights, then, the corrective transactions between the economic entities will become unnecessary, and thus the transaction costs of corrective transactions can be saved. The assumption of the theorem is more demanding, i.e., the government should be able to cost-effectively and approximately estimate and compare the warfare results of different definitions of property rights. Meanwhile, the government can fairly and equitably define the rights (Lu and Zhu, 2007). Tradable permits and quota trading system can be seen as typical examples of such scenarios. To safeguard the sustainable use of ecosystem services, the state should identify the capacity of the ecosystem, when setting the quota of individual property rights. Entities of individual property rights can purchase their shares of property rights from the state, but

any entity of individual property rights should not exceed the limits of their rights. When the individuals get their own shares of rights, they can earn profits through market transactions between entities of individual property rights.

Finally, when the initial common property rights are “hidden” and cannot be defined, outside of the quota market transactions under the state-owned property rights, it is often the government who safeguards the fairness of property rights. This leads to two major means. First, because the rights of every entity of property rights are equal, each entity of individual property rights is entitled to have given and non-exclusive usufruct right. If (*A*) misappropriates *B*'s non-exclusive usufruct right, which has declined the quality of ecosystem services, according to the misappropriation of (*A*) to *B*'s rights, the decrease in the quality of ecosystem services, and *A*'s earnings, the state should charge (*A*) a certain amount of expenses of taxation (if on the contrary, take some measures of taxation incentives) to compensate (*B*) and restore the ecosystem services. Second, the government centralizes *A*'s profits and establish fiscal policies or special funds, so as to carry out large-scale investment in ecosystem services.

#### 4 Conclusions

The ecosystem services are evaluated from the aspects of spatial transferring and property rights analysis. Totally 31 categories of ecosystem services are classified into four dimensions, i.e., local, regional, national and global ones, and the property rights structure are divided into three types, i.e., private property rights, common property rights and state-owned property rights. The feasible ecological compensation mechanism is explored under the proposed spatial structure and property rights structure of the ecosystem services mentioned.

Under private property rights, the ecological compensation mainly depends on the market mechanism. Under the condition that the initial common property rights are “hidden”, for small-scale common-pool resources, the lasting common interests of the interested parties mainly relies on the collective self-organization. However, the system of collective self-organization is mainly reflected in the system that should be observed by all members and in the hierarchical sanctions rather than in the connotation of compensation. Therefore, collective self-organization cannot be included in the framework of ecological compensation. For a wide range of ecosystem services with attributes of public goods and quasi-public goods, ecological compensation is mainly implemented through quota market transactions and state investment under the state-owned property rights, and the fairness of property rights is achieved through the central administration.

The spatial transferring and expansion of different ecosystem services are different. The forms of property rights of most ecosystem services with attributes of public

goods or quasi-public goods are mainly common property rights and state-owned property rights. Among them, regarding the forest ecological compensation, since the injured parties are clear, it is mainly used to compensate the ecological benefit of forest, carbon sink, water quality and quantity control, function of digesting pollutants, biodiversity protection, production function and process, landscape entertainment values, and scientific research and educational values. Farmland and grassland integrate important production function and ecological function in one. For ecological compensation of farming industry, the injured parties are clear with the government investing on behalf of the beneficiaries. Since the beneficiaries and injured parties of drainage area ecological compensation are relatively clear, it is feasible to use market transactions in order to balance the interests of interested parties. The beneficiaries of mineral resources development are clear, thus the compensation is mainly reflected in the restoration of eco-environment that is destroyed due to the heavy exploitation, most of which belongs to indirect compensation mode. The injured parties of nature reserves are clear, and generally the government is on behalf of the beneficiaries to compensate the injured parties. The benefited areas and the injured areas of regional ecological compensation are clear, and it is mainly used to compensate the lost development opportunities for the injured area. Ecological compensation of land expropriation does not belong to the usual ecological compensation, but for preventing agricultural land from becoming construction land, and ensuring the sustainable and steady function of ecosystem services of agricultural land, it is necessary for the benefited parties to pay ecological compensation fund for land expropriation (agricultural land). The associated funding will be used to straighten out the land, re-establish ecological environment, and compensate the expropriated land (agricultural land). The international cooperation of ecological compensation involves the definition and allocation of property rights of ecosystem services with global effects, and thus by defining “global property right”, the beneficiary countries can compensate the injured countries as expected.

**Acknowledgements** This study was supported by the Key Project of the National Science and Technology Pillar Program in the “11th Five Year Plan” Period (No. 2006BAC18B04).

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