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TRANSACTION COST AND PERFORMANCE EVALUATION OF ECOLOGICAL RESTORATION PROJECTS IN CHINA: CASE STUDYOF CHICHENG COUNTY, HEBEI PROVINCE

Since the beginning of the 21th century, China has implemented a large-scale ecological restoration policy. Evaluating the performance of this policy after implementation is an important topic. In this paper, transaction cost analysis is introduced into the performance evaluation of ecological restoration projects. The transaction costs are divided into five parts, including costs related to search, contracting, construction and operating, monitoring the cost of default, and seeking compensation. The model used for calculating transaction costs is provided. The concept and composition index of structure and performance indices are analyzed. The calculation model of the structure and performance indices is developed as the weighted sum of three indicators: endogenous transaction costs as a part of transaction costs, the proportion of farmers' input in production costs, and the proportion of transaction costs in total costs. Chicheng County, Hebei Province, China was studied as an example. The transaction costs of three categories of projects that have been implemented were calculated, including Returning Farmland to Forest, Small Watershed Management, and Grazing Prohibition, and the average performance of the projects and the change of performance during project execution were analyzed. Transaction cost and performance calculation will provide a new perspective for the comparison and performance evaluation of different ecological restoration projects, which is of great significance.

Key words: Chicheng County, ecological restoration project, performance evaluation, transaction cost.

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Стоимость сделки и оценка эффективности проектов экологического восстановления в Китае: на примере округа Чичэн, провинция Хэбэй

С начала 21 века в Китае проводится масштабная политика восстановления окружающей среды. Оценка эффективности этой политики после внедрения является важной темой. В этой статье анализ транзакционных издержек вводится в оценку эффективности проектов по восстановлению окружающей среды. Затраты по сделке разделены на пять частей, включая расходы, связанные с поиском, заключением контрактов, строительством и эксплуатацией, отслеживанием стоимости невыполнения обязательств и получением компенсации. Представлена модель, используемая для расчета трансакционных издержек. Анализируются понятие и состав индекса структуры и показателей эффективности. Модель расчета структуры и показателей эффективности разработана как взвешенная сумма трех показателей: эндогенных трансакционных издержек как части трансакционных издержек, доли затрат фермеров в производственных затратах и доли трансакционных издержек в общих затратах. В качестве примера был изучен уезд Чичэн, провинция Хэбэй, Китай. Были рассчитаны транзакционные издержки по трем категориям реализованных проектов, включая «Возвращение сельскохозяйственных угодий в лес», «Управление малым водоразделом» и «Запрет выпаса скота», а также были проанализированы средние показатели эффективности проектов и изменения показателей в ходе выполнения проекта. Транзакционная стоимость и расчет эффективности откроют новую перспективу для сравнения и оценки эффективности различных проектов по восстановлению окружающей среды, что имеет большое значение.

Ключевые слова: округ Чичэн, проект экологической реставрации, оценка эффективности, транзакционные издержки.

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Қытайдағы экологиялық жағдайын қалпына келтіру жобаларының транзакциялық құны мен өнімділігін бағалау: Хэбэй провинциясы, Чичэн округінің мысалында зерттеу

21 ғасырдың басынан бастап Қытай қоршаған ортаны қалпына келтіру бойынша ауқымды саясат жүргізді. Бұл саясаттарды іске асырғаннан кейін тиімділігін бағалау маңызды тақырып болып табылады. Бұл мақалада транзакциялық шығындарды талдау қоршаған ортаны қалпына келтіру жобаларының тиімділігін бағалауға енгізілген. Мәміле бойынша шығындар бес бөлікке бөлінеді, оның ішінде іздеуге, мердігерлікке, құрылысқа және пайдалануға, орындалмаған шығындарды қадағалауға және өтемақы алуға байланысты шығындар кіреді. Транзакциялық шығындарды есептеу үшін қолданылатын модель ұсынылған. Құрылым индексінің түсінігі мен құрамы және тиімділік көрсеткіштері талданады. Құрылым мен тиімділік көрсеткіштерін есептеу моделі үш көрсеткіштің өлшенген сомасы ретінде әзірленеді: транзакциялық шығындардың бөлігі ретіндегі эндогендік транзакциялық шығындар, өндіріс шығындарындағы фермерлер шығындарының үлесі және жалпы шығындардағы транзакциялық шығындардың үлесі. Мысал ретінде Қытайдың Хэбэй провинциясындағы Чичэн уезі зерттелді. Іске асырылған жобалардың үш санаты бойынша транзакциялық шығындар есептелді, соның ішінде «Ауыл шаруашылығы алқаптарын орманға қайтару», «Шағын су айдындарын басқару» және «Мал жаюға тыйым салу», сондай-ақ жобалардың орташа тиімділік көрсеткіштері мен жыл ішінде көрсеткіштердің өзгеруіне талдау жасалды. Транзакция құны мен тиімділікті есептеу қоршаған ортаны қалпына келтіру бойынша әртүрлі жобалардың тиімділігін салыстыру және бағалау үшін жаңа перспектива ашады, бұл үлкен маңызға ие.

Түйін сөздер: Чичен округі, қоршаған ортаны қалпына келтіру жобасы, өнімділікті бағалау, транзакциялық шығындар.

1. Introduction

Since the beginning of the 21st century, large-scale ecological restoration projects have been carried out in China, including Returning Farmland to Forest and Grazing Prohibition, the Governance North Shelterbelt Construction, Natural Forest Protection, Tianjin Sandstorm Source Control, and Small Watershed Management. The effects and performance evaluation of these ecological management projects is one of the most important problems that many scholars address and analyze (State Environmental Protection Administration 2011; State Forestry Administration 2008; Fan et al., 2011; Wang et al., 2010; Lai et al., 2006; Wang et al., 2013). The evaluation of the performance of ecological restoration projects is a multidisciplinary field and can be performed mainly through the following three methods: evaluation of ecological, economic and social benefits based on the value of ecological services provided by ecosystems (State Environmental Protection Administration 2011; State Forestry Administration 2008; Man and Luo, 2006; Wang et al., 2007; Song et al., 2007). This method is only concerned with the evaluation method of the results of ecological projects while ignoring the methods used by government agencies and farmers participating in ecological restoration projects. Therefore, it does not satisfactorily answer the question of whether compensation to farmers for a project is fair and sustainable nor does it address other major issues. As such, it cannot be included in a government performance evaluation system. The second method is the government performance evaluation system based on public values (Moor 1995; Bao et al., 2012a; O'Flynn 2007; Osborne 2010). Public value management is a new public administrative paradigm that comes after the new public management system. However, a government performance evaluation system based on the public value of a project is still part of the research and practice of the field of management, and direct reference for the research of the performance evaluation of ecological projects is relatively limited (Bao et al., 2012b; Fan et al., 2013a; 2013b). The third method is ecological project performance evaluation based on an analysis of each farmer's behavior and transaction costs (McCann 2013; McCanna et al., 2005; Coggan et al., 2010; Pannell et al., 2013). The results of these studies have calculated the total transaction cost and the proportion of the total cost, but the definition and calculation methods of the transaction costs of different projects varied. Few studies have addressed the direct measurement of performance changes.

Based on the research results of the analysis of the transaction cost of the environment, this paper analyzes the concept of transaction cost and its structure index, determines the transaction cost of an eco-governance

project analysis framework and calculation method, designs a structure index and performance index according to the concept of total cost structure, and evaluates the performance of different ecological restoration projects.Chicheng County in Hebei Province, which is located in an important area of

ecological restoration for the city of Beijing, was selected as a case study. The transaction costs and performance indices of four ecological restoration projects were calculated and the feasibility of the performance evaluation index of different ecological projects were compared and discussed (Table 1).

Table 1. Ecological restoration policy performance index

Structure index	0.0000–0.2000	0.2001–0.4000	0.4000–0.6000	0.6001–0.8000	0.8001–1.0000
Grade	1	2	3	4	5
Meaning	Very poor	Poor	Common	Good	Very good

2. Concept and Calculation Method of Transaction Cost, Structure Index and Performance Index

2.1. Concept and Application of Transaction Cost

Coase explained the reason of the existence of a business using transaction cost in an article titled the "The Nature of the Firm" (Coase, 1937); however, Coase did not reveal what a transaction cost is. In "The Problem of Social Cost" published in 1960, Coase defined the content of transaction cost and believed that the transaction cost is the cost of the contract which is stipulated and implemented, and contains all the costs of the political and economic organizations that are obtained from trade (Coase, 1960). Since then, many articles have been written that give a wide definition of transaction costs (Cheung, 1969; Williamson, 1981; Dahlman, 1979; Barzel, 1985; North, 1990; Allen, 1991). We use the definition that states transaction costs are the resource costs entailed for the definition, establishment, maintenance and transfer of property rights (McCann et al., 2005).

Transaction cost theory has been gradually applied to many aspects of the environment; for example, Soloman (1999) discussed the role of transaction cost in tradable emission permits and the design of an incentive mechanism in environmental protection. Colby (1990) studied the transaction costs of a policy from the transfer of agricultural water resources to other applications, including legal fees, engineering and hydrological research costs, the operating costs of the court, and the cost of operating an institution. McCann and Easter (1997) studied non-point source pollution control projects for the Missouri River, USA, and the transaction cost of four different policy control measures of non-point source pollution. Shen (2004) used the concept of transaction cost to study

the design of a system for water rights trading in China. Ofei-Mensa and Bennett (2013) studied the change of transaction cost of CO_2, providing strong evidence designed to improve policy design and reduce the government budget deficit. Because the implementation process of the environmental policies involves multiple actors, data acquisition is more difficult, so different calculation models have been applied for the specific calculation of the transaction costs of different environmental policies.

2.2. Method Used to Calculate Transaction Cost

Williamson (1985) studied transaction costs extensively, and divided them into pre-, in- and after-process costs. The pre-process costs include search, information, negotiation, and decision costs. In-process costs include cost of compensating unsatisfactory negotiations, construction and operation, and cost paid in order to solve any disputes. After-process costs cover costs such as supervision or breach of contract.

McCann et al. (2005) constructed a wide framework for measuring transaction costs. In this framework, transaction costs are divided into information collection, analysis and research, policy formulation, policy design and implementation, support and management, signing contracts, supervision and execution, prosecution and other specific links. McCann also stressed the importance of completed efficiency by measuring transaction costs during all stages of the policy. The planning of ecological restoration projects and the implementation process of the boundary is relatively clear. Transaction cost calculation can be based on the framework of Williamson (1985) and reference the conclusion related to the analysis of transaction cost estimation raised by Furubotn and Richter (2006), and was determined to consist of the following parts:

(1) Cost of information searches (C_1)

The cost of information searches (C_1) include costs of ecological restoration project planning (C_{11}), project feasibility demonstration (C_{12}), examination and approval (C_{13}), project breakdown and arrangement (C_{14}), and project publicity expenses (C_{15}) and can be calculated using Eq. (1):

$$C_1 = \sum_{i=1}^{5} C_{1i} \qquad (1)$$

(2) Cost of signing a contract (C_2)

The cost of signing a contract (C_2) include travel expenses to the project implementation area (C_{21}), printing cost of contracts (C_{22}), land area measurement fee (C_{23}), household publicity expenses (C_{24}), contract signing cost (C_{25}) and can be calculated as C_2 using Eq. (2):

$$C_2 = \sum_{i=1}^{5} C_{2i} \qquad (2)$$

(3) Construction and operating costs (C_3)

Construction and operating costs (C_3) include costs of central government organization and implementation (C_{31}), provincial government organization and implementation (C_{32}), implementation costs of the county government (C_{33}), operating expenses (C_{34}) and can be calculated as C_3 using Eq. (3):

$$C_3 = \sum_{i=1}^{4} C_{3i} \qquad (3)$$

(4) Cost of default supervision (C_4)

Cost of default supervision (C_4) include costs of provincial project acceptance (C_{41}), supervision cost for potential default by county government (C_4), monitoring and supervision expenses (C_{42}), project supervision fees by township government (C_{43}), full time administrator cost (C_{44}), default finding costs (C_{45}) and can be calculated as C_2 using Eq. (4):

$$C_4 = \sum_{i=1}^{5} C_{4i} \qquad (4)$$

(5) Compensation seeking cost for breach of contract cost (C_5)

Compensation seeking costs for breach of contract cost (C_5) include the cost of a breach of contract (C_{51}).

Transaction cost calculations may also involve other factors; however, they mainly include the above five aspects. Then, the total transaction cost and its variables in the implementation process of the ecological restoration project can be expressed by the Eq. (5):

$$TRC = \sum_{t=1}^{T} \beta_t (C_{1t} + C_{2t} + C_{3t} + C_{4t} + C_{5t}) \qquad (5)$$

whereβ is the discount rate andT is period of implementation of the ecological policy.

2.3. Definition and Measurement of Structure Index and Performance Index

The concept of transaction costs represents a historical theoretical innovation of institutional economics. Transaction cost theoryattaches importance to the research of the system itself. Based on the analysis of a market transaction contract, the overall cost of the entire "contracting" process is measured and the estimated transaction cost is used as the standard of the evaluation system. This largely solved the problem of the performance evaluation system, making a large step forward for the research system. However, using the size of the transaction cost as the evaluation standard for system performance has certain limitations. Transaction cost in the system of a vertical comparison is often effective, but has obvious shortcomingswhen used for a horizontal comparison among different systems. The size of the transaction costs of different ecological projects cannot be directly compared. For example, the average transaction cost during the implementation of the project in a certain region may be 500 yuan/hm^{-2}, while the average transaction cost of grassland grazing policy for the same period of 50 yuan hm^{-2}. However, this cannot be interpreted by saying that the grassland grazing policy is better than the policy of Returning Farmland to Forest. The comparison between them depends on the structure of transaction costs and the total cost structure.

In order to solve this problem, in this paper, separate structure and performance indices are established through the analysis of the structure of the comprehensive cost involved in the process of ecological restoration, so as to perform objective evaluations for different systems. The following three factors should be considered when constructing the structure index.

2.3.1. Endogenous transaction cost

Yang (2000) suggested that transaction costs can be divided into two parts, endogenous and exogenous transaction costs. Exogenous transaction costs are the direct or indirect costs which can be predicted before the transaction is implemented. The en-

dogenous transaction costs are the economic losses caused by the opportunistic behavior of the trading main body, meaning the realistic equilibrium deviation from an ideal equilibrium cost caused by the breaking of contracts by traders out of opportunism (Yang and Zhang, 2000; Lu and Zhu, 2012).

Under the perspective of endogenous transaction cost theory, opportunistic behavior is the behavior subject to ecological restoration policies, i.e., the government and farmers are the root of endogenous transaction costs. Farmers are direct participants in the policy of ecological restoration and owner of information that difficult for the government to access, which serves as the source of information asymmetry that directly leads to motivating opportunism among the farmers. However, ecological restoration projects are forced to make farmers change from a familiar mode of production. For example, herdsmen are not allowed to graze nor are the farmers are allowed to cultivate the land, causing a significant change of family income. These reasons induce farmers to violate the content of a contract, resulting in a deviation of the policy goals.

Endogenous and exogenous transaction costs have alternative relationships (Yang, 2002). People can increase the cost of searching for information, the cost of contracts and execution of contracts, thereby reducing endogenous transaction costs. The system performs best when these costs reach a state of equilibrium. In the process of ecological management, local government agencies manage ecological engineering by hiring managers and staff members while charging fines for any breach of contract. The long term management process is also a process of mutual understanding and can become a game between managers. Management becomes difficult once managers become familiar with each other: the management procedures become weakened from.

"compulsory punishment" to "occasional punishment", and weakened even further to giving an "oral warning." Therefore, the rigidity of endogenous transaction costs should be recognized. Even with an increase in exogenous transaction costs, endogenous transaction costs may not be reduced.

Thus, in an ecological restoration project, the endogenous transaction costs tend to dominate. The size of endogenous transaction costs can be regarded as a main clue related to the performance evaluation of an ecological restoration project. Directly comparing the proportion of endogenous or exogenous transaction costs accounted for in the total transaction costs is apparently better than only roughly evaluating those costs.

2.3.2. Farmers' investment in ecological restoration projects

Government agencies and farmers have always been the two main actors during the process of ecological restoration in China. They have different objectives in the process of ecological management because of their different roles. Farmers implement the concrete actions involved in ecological management, so their objectives of maximizing their economic benefits and minimizing their risk are reflected in their behavior (Kong, 1999; Hu, 1992; Han, 1995). In order to reduce risks, farmers will sacrifice some of the economic benefits. As in ecological management, the direct power farmers wield to implement afforestation and the restoration of vegetation comes from ecological compensation provided by the government. Therefore, the key to successful and sustainable management of ecological engineering projects is to provide a sufficient supply of ecological compensation that is more than or equal to the opportunity cost of ecological restoration provided by farmers (Fan et al., 2005; Shang et al., 2012; Zhang et al., 2012).

However, during the course of the implementation of ecological restoration projects in China, in order to reduce the cost of ecological restoration, most funding comes from the national level, while local governments supplement the funding.Farmers are required to invest or contribute human power to ecological restoration, and pay for the economic losses caused by the use of ecological restoration land. Farmers are paid little or no money to compensate for losses caused by ecological projects. As a result, when projects requiring the farmers to sacrifice their livelihood projects may face relatively strong resistance during implementation and this will usually result in poor performance of the project. For example, at the beginning of this century, six provinces/cities/regions including Beijing, Hebei, Inner Mongolia, Ningxia Qinghai and Shaanxi released a comprehensive grazing decision. A total of 1100 counties in 25 provinces in China completely or partially forbade grazing (herein, Grazing Prohibition) on land totaling up to 670,000 km^2. Under strict constraints from the government exerting more intensive environmental protection, the top-down mandatory prohibition policy led by the central government has heard a more supportive voice, which however, faced increasing resistance after years of forceful implementation. The increasingly difficult conditions indicated its transitional meaning (Song et al., 2004; Chai et al., 2009; Qi and Hu, 2006). It can be seen that the size of input to farmers is an important standard that

can be used to measure the policy of ecological governance.

2.3.3. Proportion of transaction cost

Transaction cost is an important variable of economic activity. From a historical point of view, transaction costs are economic growth constraints similar as switching costs (Wallis and North, 1986). Specifically, transaction costs affect not only the contractual arrangements, but also the number and types of goods and services that are produced and supplied in the market. Itcan even be said that the transaction costs fundamentally determine the type of economic production activities and market transactions, survival of organizations and professions, and future of certain individual or group in certain market (Furubotn and Richter, 2006).

New institutional economists regard the transaction cost as a type of system cost, or index judging the efficiency of a system. The higher the transaction costs, the lower the efficiency of the system, and vice versa. Lin (1994) suggested that the choice of institutional arrangements will include the calculation of costs and benefits. In the case of predetermined production and transaction costs, better institutional arrangements provided more services. In other words, for two institutional arrangements providing the same amount of service, the one that costs less should be regarded as more effective (Lin, 1994). The purpose of economic institutional change is to reduce transaction costs. Therefore, with the progress and perfection of the system, the transaction costs of each transaction will be reduced.

2.3.4. Structure index, performance index and weight

According to the above analysis, the structure index of an ecological restoration project should include the following three parts: the proportion of endogenous transaction costs in total transaction costs, the proportion of farmer's investment in production cost of an ecological restoration project, and the proportion of transaction costs in sum of transaction costs and production costs. The weighted average of the three factors constitutes the structural index.

Endogenous transaction costs and production cost of an ecological project are referred to as ENTRC and PROCOST, respectively. Within PROCOST, C_g, C_f refer to the government's and farmer's investment in the project, respectively. The ecological project total cost, cost structure index, and performance index are referred to as TOTCOST, TRCINDEX, and PFINDEX, respectively. The relationships among these indices are as follows.

$$ENTRC = C_{44} + C_{45} + C_5 \tag{6}$$

$$PROCOST = C_g + C_f \tag{7}$$

$$TOTCOST = TRC + PROCOST \tag{8}$$

$$TRCINDEX = \frac{1}{3} \times (\alpha_E \frac{ENTRC}{TRC} + \alpha_f \frac{C_f}{PROCOST} + \alpha_T \frac{TRC}{TOTCOST}) \tag{9}$$

$$PFINDEX = 1 - TRCINDEX \tag{10}$$

The weight in Formula (9) is determined as follows:

Let $\rho_E = \frac{ENTRC}{TRC}$, $\rho_f = \frac{C_f}{PROCOST}$, $\rho_T = \frac{TRC}{TOTCOST}$, then

$$\alpha_E = \frac{1}{\max\{\rho_{Ei}\}}, \ \alpha_f = \frac{1}{\max\{\rho_{fi}\}}, \ \alpha_T = \frac{1}{\max\{\rho_{Ti}\}}.$$

About calculation of proportion of transaction cost in overall cost ρ_T, Wallis and North

3. Four Types of Ecological Restoration Projects in Chicheng County, Hebei Province and Data Acquisition

3.1. General Conditions in Chicheng County

Chicheng County, Hebei Province is located north of the city of Beijing where the river basin of the Chaobai River serves as a drinking water source and provides ecological protective services in Beijing (Fig. 1). Chicheng County covers an area of 5287 km², and is comprised of nine towns, nine countries, 440 administrative villages, and

1318 natural villages. As of the end of 2011, the county had a population of 296,000 including an agricultural population of 243,000 or 81.8% of the total population. The GDP of Chicheng County was 5.612 billion yuan with a per capita GDP of 18,900 yuan.
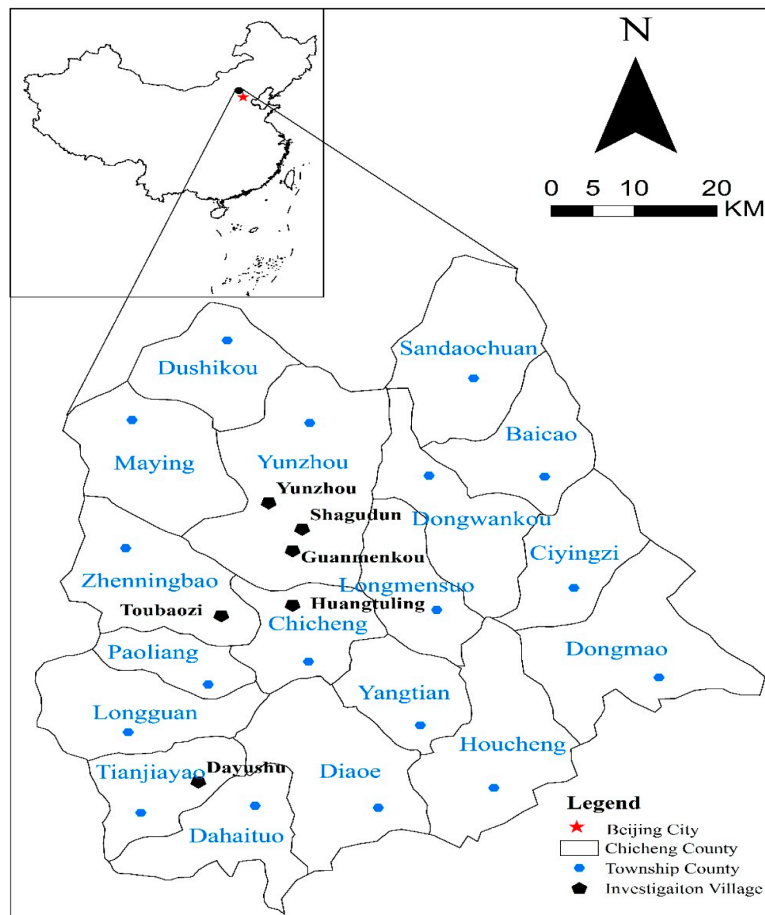

Fig. 1 – Geographical location of Chichen district

3.2. Implementation of Ecological Projects

Since the beginning of the 21ˢᵗ century, the government and people of Chicheng County mainly implemented the Beijing/Tianjin Sandstorm Source Control Project, Capital Water Resources Sustainable Use Project, and a Grazing Prohibition policy. From these three major projects, the present study analyzed three ecological restoration subprojects including Returning Farmland to Forest, the Small Watershed Management project, and a comprehensive Grazing Prohibition in terms of transaction cost and performance evaluation. Their implementation scope, time period and compensation policy are shown in (Table 2).

Table 2. Area, cost, and time periods of ecological restoration projects implemented in Chicheng County, Hebei Province, China, since the beginning of this century

Ecological restoration project	Area of implementation	Compensation policy	Period
Returning Farmland to Forest	16.6 thousand hectares	Compensation standard: 2400 yuan/hectare for each year, compensation for saplings: one-off grant 750 yuan/hectare	2002–2011
Small Watershed Management	22.4 thousand hectares	2000–2006, 2000 yuan/hectare; 2007–2011 yuan, 3000 yuan/hectare	2000–2011
Grazing Prohibition	328.7 thousand hectares	None	2003–2012

3.3. Survey Methods and Data Acquisition

Data acquisition steps are as follows: during October 2012 and July 2013, the author participated in a study group that conducted a site study with the Forestry Department of Hebei Province and the relevant units in Chicheng County. The object was to gain a detailed understanding of the specific implementation steps and results of ecological restoration projects.

In the Forestry Department of Hebei Province, the implementation steps, scope, area, ecological compensation and investment of the Returning Farmland to Forest project and Small Watershed Management project were investigated. Data collected and analyzed included project planning cost, project feasibility demonstration cost, examination and approval fees, project breakdown and arrangement, project publicity expenses, travel expenses to the project implementation area, agency costs paid by the provincial government, provincial project acceptance check cost, and penalties for breach of contract. The related data were decomposed into an average per unit area.

Several aspects of these projects were investigated by the Forestry Bureau of Chicheng County including the locations of the projects, area involved, annual implementation schedule, compensation to farmers, and problems that arose during the implementation process. Specific survey data included: annual implementation area of the above two projects, annual payments for ecological compensation, project breakdown and arrangements, printing costs of the contracts, land area measurement fees, farmer publicity expenses, contract signing costs, implementation costs paid by the county government, cost of investments made by farmers, cost of supervision and monitoring by the county government, project supervision fees, village administrator fees, default detecting costs, compensation costs after breach of contract, and penalties for breach of contract.

The Chicheng County brigade was responsible for implementing Grazing Prohibition. In the grazing brigade, coverage of the grazing policy, land area, annual implementation schedule, and issues faced during the implementation were investigated.

Two sample villages were studied: Shagutun Village in Yunzhou County and Huangtuling Village in Chicheng County. Shagutun and Huangtuling villages had 103 and 156 households with total populations of 500 and 470, respectively. Livestock income accounted for a relatively high proportion of farm income in Shagutun Village, making it the most important area for the Beijing and Tianjin sandstorm source of Small Watershed Management project, and GrazingProhibition. Planting was the main industry in Huangtuling Village. It was the most important area for the Returning Farmland to Forest project and Small Watershed Managementproject. In these two villages, 36 households were randomly selected in each village. An interview questionnaire survey was conducted in each of these household to measure the opinions the farmers held about the ecological projects, the participation of farmers in the projects and their satisfaction with the results.

4. Analysis of Transaction Cost and Performance

4.1. Analysis of Transaction Cost

Based on the data obtained from the above surveys, the average transaction costs for Returning Farmland to Forest project, Small Watershed Management, and Grazing Prohibition were calculated using Eqs. (1–5) (Table 3).

As Table 3 shows, the transaction cost of the Returning Farmland to Forest project was the highest, 474.49 yuan hm^{-2} a^{-1}, while the transaction cost for Grazing Prohibition was the lowest, 23.72 yuan hm^{-2} a^{-1}. Transaction costs fortheSmall Watershed Management project were 320.37 yuan hm^{-2} a^{-1}.

Table 3 .The transaction cost (TRC) and composition of ecological restoration project

Project	Period	TRC (Current price, yuan. hm^{-2} a^{-1})	TRC (Discounted price, yuan.hm^{-2} a^{-1})	C_1 proportion (%)	C_2 proportion (%)	C_3 proportion (%)	C_4 proportion (%)	C_5 proportion (%)
Returning Farmland to Forest	2002–2011	400.77	474.49	8.04	1.88	80.96	6.55	2.57
Small Watershed Management	2000–2011	240.75	320.37	2.82	3.49	17.61	76.04	0.00
Grazing Prohibition	2003–2012	18.44	23.72	11.71	5.02	0.00	77.28	5.98

Note: Discounted price refers to reference in 2012; discount rate was set 6%. Note: C1, search cost; C2, contracting costs; C3, construction and operating costs; C4, default supervision cost; C5, loss compensation cost.

The transaction costs of the construction of the four ecological restoration projects were analyzed. The construction and operation cost of the Returning Farmland to Forest project was highest, up to 80.96%. Meanwhile, the supervision breach cost for Small Watershed Management and Grazing Prohibition were higher at 76.04% and 77.28%, respectively. Because of a lack of ecological compensation and investment, farmers were poorly motivated to participate, making the supervision breach cost expectedly high. Engineering bidding was conducted for Small Watershed Management, through which the Water Affairs Bureau outsourced the project and contracted with an engineering company, which will be responsible for site construction. Therefore, the Water Affairs Bureau is no longer required to personally organize farmers

engaged in the soil and water conservation project, because they have transferred the responsibility for monitoring and supervision to the engineering company. This serves as the main reason for the high supervision cost.

For the three ecological restoration projects (Table 4), the proportion of transaction costs in the overall costs for Grazing Prohibition was the highest, up to 44.8%; while proportion of transaction costs in the overall costs for the Returning Farmland to Forest project was lowest (0.63%). As for the proportion of endogenous transaction costs in transaction cost, Grazing Prohibition was the highest, up to 80.245%, indicating that a large amount of the transaction cost was spent in preventing illegal grazing by participating farmers; the Returning Farmland to Forest project had the lowest proportion of endogenous transaction costs in transaction cost, 8.21%, indicating that the farmers participating in the project of Returning Farmland to Forest were more satisfied with the project and showed a lower tendency to conduct opportunistic behavior.

Table 4. The transaction cost (TRC) and the proportion of the internal structure of the ecological restoration project.

	Returning Farmland to Forest	Small Watershed Management	Grazing Prohibition
TRC/TOTCOST (%)	0.63	7.13	44.80
ENTRC/TRC (%)	8.21	60.07	80.24

Note: ENTRC, endogenous transaction costs; TOTCOST, total transaction cost.

4.2. Average Performance During the Implementation of Ecological restoration Projects

Performance during the implementation of ecological restoration projects can be reflected by a performance index. The performance index of Returning Farmland to Forest was 0.8625, placing it in the "good" category for performance index. The performance of Small Watershed Management was 0.6831 (categorized as "relatively good") while the performance of Grazing Prohibitionwas 0.1408 (categorized as "very poor").

The Small Watershed Management project was a child project of Beijing and Tianjinsandstorm source control project, with a national to local investment ratio of 2:1 (200 thousand/km^2 and 100 thousand/km^2 for central and local investment, respectively). This part of the investment was transferred to farmers by the local government. During the 11 years of project construction, total investment of farm households was up to 14.21 million yuan,

accounting for 20.70% of total investment. The enthusiasm of farmers who participated in the project was dampened by the labor required of them, causing the performance of the Small Watershed Management project to be lower.

4.3. Performance Changes During Project Execution

As a type of institutional arrangement, the process of changing the ecological management project involves two actions: farmers and the government pursue their own interests and ultimately achieve a balanced process of project implementation. Because the government develops the policies, the design of policies reflected primarily the interests of the government. Therefore, the change of ecological governance of project performance reflects the changing demand and pursuit of benefits by farmers during process of policy implementation for ecological management. Exploring the changes of the performance of ecological management projects not

only can let us understand the implementation process of the policy in detail, but also let us have a deep understanding of the interests of the two actors and their choices in different environments. This paper constructs an index structure to provide a convenient method used for this purpose.

The performance changes during the implementation period of the three ecological projects in Chicheng County were relatively stable (Fig. 2).

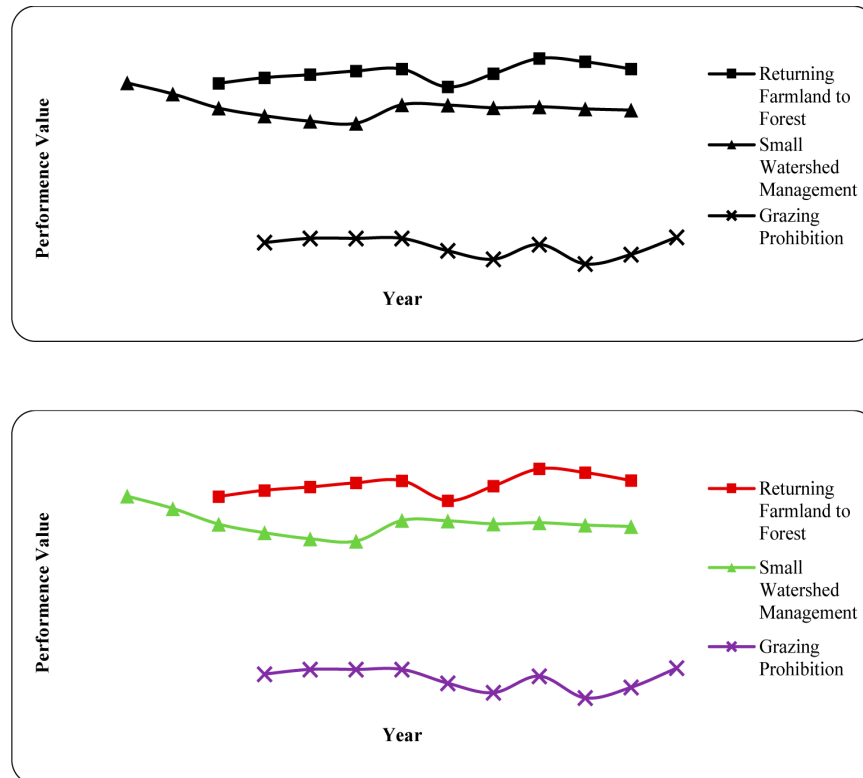The following section analyzes changes in the performance index for each project.

Fig. 2 – Comparison of performance changes of three environmental projects

In the implementation process of the Returning Farmland to Forest project, the performance index initially decreased to 0.7769 in 2002 and then gradually increased to 0.8326 in 2011. The increasing trend gradually slows down with all of the performance indices remaining satisfactory. The Returning Farmland to Forest project provides ecological compensation so that this has helped farmers to provide themselves with a livelihood, making the project more welcomed by the local people. After the project started in 2003, the policy has remained stable without significant change in engineering design, publicity, implementation, monitoring, practice, supervision, management and acceptance checks. The performance index increased from 2003 to 2006, but experienced a sudden drop in 2007 caused by the cessation of farmland reuse. Instead, only the remaining afforestation tasks were allowed. Farmers were not needed during afforestation efforts,

but were only employed to conduct some necessary forest management tasks. Over the next few years, the transfer of the rural labor force resulted in significant changes in household investment structure. Since 2008, the performance index of the Returning Farmland to Forest project has started to rise, and the performance level has been very good recently.

The performance index of the Small Watershed Management project has been maintained within a good range. At the beginning of the implementation of the project, farmers were required to invest a large amount of unpaid labor. During 2000 to 2005, the proportion of farmers' investment to the total investment of the project was as high as 33.47%. The number even increased to over 40% during years with intense engineering activities. The need to provide additional free labor dampened the enthusiasm of the farmers, who began to not work efficiently or failed to participate directly in the work, slow-

ing the implementation of the project. However, the government soon realized the root causes of the problem and quickly made adjustments. Starting in 2007, farmers were no longer required to work without compensation with funding fully recovered from the national level. This change had an immedi-

ate effect on the enthusiasm of farmers and the project went smoothly. Therefore, from the beginning of 2007, the performance index of small watershed governance projects rose from 0.6214 in 2005 to 0.6920 and has remained at a relatively high level ever since (Fig. 3).
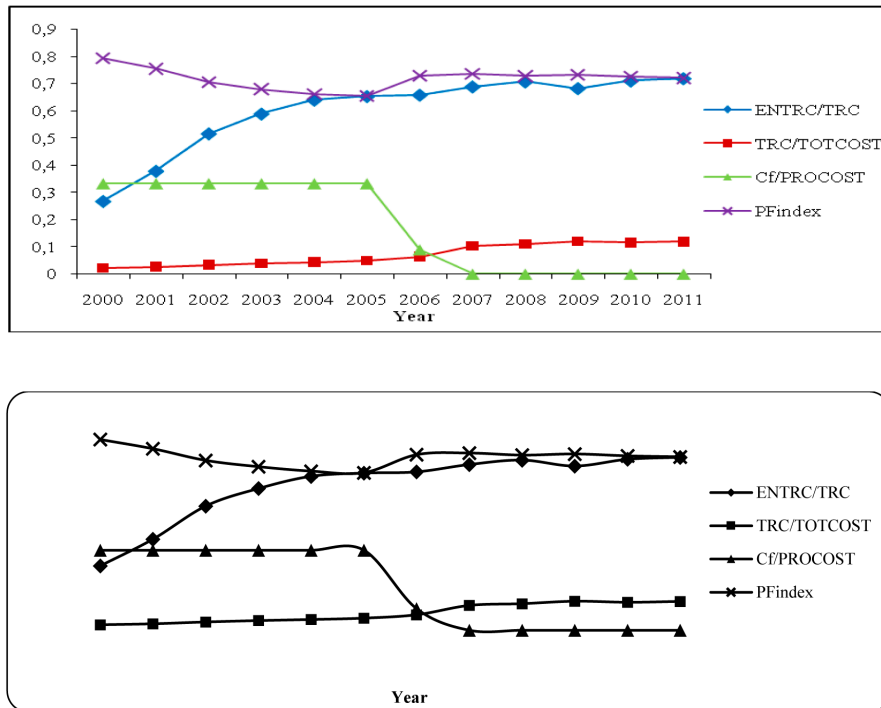

Fig. 3 – Comparison of the efficiency index of small water management projects

After its implementation in 2003, the performance index of Grazing Prohibition has been below 0.18, indicating an ecological project with poor performance. However, the performance index increased to 0.1499 starting in 2009 and an increasing trend was observed after a decrease in 2010. According to the definition of a performance index, its performance seemed to have already improved. However, our research revealed an opposite trend. The apparent increase of the performance index was caused by the stalemate related to Grazing Prohibition.

The policy of prohibiting grazing is a top-down ecological policy created at high levels of government that impose Grazing Prohibition on the lower levels of government as a political task, which strengthens the political efficiency of the project. During the early stage of policy implementation, the Chicheng County government invested a large amount of human and financial resources to publicize the project andenhance supervision. Later, the

police were no longer charged with implementing Grazing Prohibition and the task was transferred to the Forest Public Security Bureau. This changed Grazing Prohibition from a law enforcement/ political task to normal activity of the Forest Public Security Bureau. However, since 2009, with an increase in mutton prices, farmers were inspired with an unprecedented enthusiasm for raising sheep. With an expanding frequency and range of grazing and a strengthening of the consciousness of safeguarding rights, Grazing Prohibitionhas become more difficult to enforce. Under the action of multiplefactors, the government has now adopted more flexible grazing policies, which are mainly reflected as described below. The penalty for each sheep grazed despite Grazing Prohibitionwas changed from 10 yuan to 2–10 yuan. For lesser offenses when farmers admitted to grazing with a relatively good attitude, only oral warning may be given. Second, in time and space, the prohibition supervisor generally allowed villagers to graze at night and the monitoring in ar-

eas away from towns and roads weakened. Farmers were even notified of the inspection by managers and told to stay home at night during inspections. These changes, reflected in the transaction cost structure, resulted in a decrease in the transaction cost and finally increased the performance index. However, this type of change was not the result of system optimization designed to reduce the problems with grazing, but was the result of the lax implementation.

5. Conclusions and Discussion

The calculation of transaction costs and performance of an ecological restoration project provide an efficient method to discover whether the implementation of an ecological project has gone smoothly. It can be used not only to evaluate the performance of ecological restoration projects, but also provide a clear idea of how to improve the policies and provide an understanding of how the policies evolved. Undoubtedly, the design of ecological policies should start by considering how to reduce endogenous transaction costs and will fully respect the interests of farmers in ecological restoration efforts.

Analyzing the results of the implementation of ecological restoration projects through the transaction cost and performance index changes may pose a problem as described here related to Grazing Prohibition; this prohibition resulted in an increase in the performance index but came with a decrease in efficiency. This can be explained by the fact that the significant difficulty involved in the implementation of certain ecological projects may cause the endogenoustransaction costs to become high. If project monitoring and supervision of the external environment changes, the implementation by department responsible for the project may become lax, leading to distorted progress on implementation, and may gradually actually result in failure. Transaction cost analysis does not provide real data for such cases. This kind of defect can be solved through the structural analysis of the process performance of the same ecological restoration project, which will not be described in detail in this article.

From the results of the comparison of the three kinds of ecological restoration policies in typical areas, it is seen that the transaction cost and performance index method proposed in this paper is feasible, and will provide a new perspective for the comparison and performance evaluation of ecological restoration projects.

References

Allen, D., 1991. What are transaction costs? Res. Law Econ. 14, 1–18.

Bao, G.X., Wang, X.J., Larsen, G.L., Morgan, D.F., 2012a. Beyond new public governance: a value-based global framework for performance management, governance, and leadership. Administration & Society 45 (4), 443–467.

Bao, G.X., Wen, H., Wang, X.J., 2012b. The construction of government performance management discipline system based on public value. Chinese Public Administration 5, 98–104.

Barzel, Y., 1985. Transaction costs: are they just costs? J. Inst. Theor. Econ. 141 (1), 4–16.

Chai, H.F., Li, Q.X., Fu, R., Zuo, T., 2009. The impasse of grazing-ban policy and the future of pasture management. Issues in Agricultural Economy (1), 93–98.

Cheung, S., 1969. Transaction costs, risk aversion and the choice of contractual arrangements. J. Law Econ. 12 (1), 23–42.

Coase, R., 1937. The Nature of the Firm. Economica. 16 (4), 386–405.

Coase, R., 1960. The problem of social cost. J. Law Econ. (3), 1–44.

Coggan, A., Whitten, S.M., Bennett, J., 2010. Influences of transaction costs in environmental policy. Ecol. Econ. 69, 1777–1784.

Colby B., 1990. Transaction costs and efficiency in western water allocation. Am. J. Agric. Econ., 72, 1184–92.

Dahlman, C., 1979. The problem of externality. J. Law Econ. 11, 141–162.

Fan, S.Y., Ma, Y.H., Zhou, L.H., 2005. Response of households to eco-environment control policy in Minqin in recent years. Journal of Desert Research 25 (3), 397–403.

Fan, S.Y., Chen, Y.L., Xu, J., 2013a. Performance evaluation and comparison of ecological construction policies based on public value. Journal of Public Management 10 (2), 110–116.

Fan, S.Y., Lan, J., Xu, J., Chen, Y.L., 2013b. The comparison of transaction cost and structure of ecological construction policies. Journal of Glaciology and Geocryology 35 (5), 1283–1291.

Fan, S.Y., Zhang, H., Wu, R.G., 2011. Institutional analysis and performance evaluation on China's desertification control. Higher Education Press, Beijing, pp. 61–108.

Furubton E.G., Richter R., 2006. Institutions and economic theory: the contribution of the new institutional economics. Gezhi Press, Shanghai, pp. 67–82.

Han, Y., 1995. The produced behavior research of the Chinese peasant. Economic Review (5), 29–33.

Hu, J.L., 1992. The economic behavior research of the Chinese peasant. Chinese Agriculture Press, Beijing.

Kong, X.Z., 1999. The economic survey of Chinese peasant family. Chinese Agriculture Technology Press, Beijing.

Lai, Y.F., Zhu, Q.K., Zhang, Y.Q., Qin, W., Li, W.H., 2006. Valuing ecological effects of land conversion project in Wuqicounty. Journal of Soil and Water Conservation 20 (3), 83–87.

Lin, Y.F., 1994. Economic theory of institutional change. Property rights and institutional change: Property rights school and the new institutional school. Shanghai Triple Bookstore, Shanghai people's Publishing House, Shanghai, pp. 371–440.

Lu, X.X., Zhu, Q.L., 2012. Neoinstitutional Economics. Peking University press, Beijing, pp. 84, 163–168.

Man, M.J., Luo, J.C., 2006. Ecological benefit evaluation of returning farmland to forest project in Shaanxi province. Journal of Anhui Agriculture Science 34 (18), 4735–4737.

McCann, L., Easter, K.W., 1997. Transaction costs of policies to reduce agricultural phosphorous pollution in the Minnesota River. Land Econ. 75 (3), 402–414.

McCann, L., 2013. Transaction costs and environmental policy design. Ecol. Econ. 88, 253–262.

McCann, L., Colby, B., Easter, K.W.,Kasterine, A., Kuperan, K.V., 2005. Transaction cost measurement for evaluating environmental policies. Ecol. Econ. 52, 527–542.

McCann, L., Easter, K.W., 2000. Estimates of public sector transaction costs in NRCS programs. Journal of Agricultural and Applied Economics 32 (3), 555–563.

Moor, M.H., 1995. Creating public value: strategic management in government. Harvard University Press, Cambridge, MA.

North, D., 1990. Institutions, Institutional change and economic performance. Cambridge University Press.

Ofei-Mensa, A., Bennett, J., 2013. Transaction costs of alternative greenhouse gas policies in the Australian transport, energy sector. Ecol. Econ. 88, 214–221.

O'Flynn, J., 2007. From new public management to public value: paradigmatic change and managerial implications. The Australian Journal of Public Administration 66 (3), 353–366.

Osborne, S.P., 2010. The new public governance: Emerging perspectives on the theory and practice of public governance. Rout ledge, London.

Pannell, D.J., Roberts, A.M., Park, G., Alexander, J., 2013. Improving environmental decisions: A transaction-costs story. Ecol. Econ. 88, 244–252.

Qi, G.B., Hu, X.P., 2006. Research of the grazing behavior under the grazing ban policy—The research case of Yanchi county in Ningxia. Journal of China Agricultural University (Social Sciences Edition) (2), 12–16.

Shang, H.Y., Su, F., 2012. Impact of the ecological compensation pattern on livelihood capital of farmers. Journal of Glaciology and Geocryology 34 (4), 983–989.

Shen, M.H., 2004. On water right transaction and transaction cost. Yellow River 26 (7), 19–22.

Soloman, B., 1999. New directions in emission trading: The potential contribution of new institutional economics. Ecol. Econ. 30, 371–387.

Song, F.Q., Yang, G.H., Feng, Y.Z., 2007. Research and establishment of the multi-effect assessment index system of the returning farmland to forest project in different ecological zones of Loess Plateau. Agricultural Research in the Arid Areas 25 (3), 169–173.

Song, N.P., Zhang, F.R., Li, B.G., Chen, H.W., Yao, H.M., 2004. Prohibiting graze policy and its effect. Journal of Natural Resources 19 (3), 316–323.

State Environmental Protection Administration, 2011. Technical guidelines for environmental impact assessment – Ecological impact (HJ19-2011). China Environmental Science Press, Beijing.

State Forestry Administration, 2008. Indicators for monitoring and assessment of socio-economic impacts of sandification combating program for areas in the vicinity of Beijing and Tianjin. Forestry Industry Standard of the People's Republic of China LY/T 1758–2008, Beijing.

Wallis, J.J., North, D.C., 1986. Measuring the transaction sector in the American economy: 1870–1970, in long-term factors in American economic growth. University of Chicago Press, Chicago, pp. 96–120.

Wang, D.D., Wu, P.T., Zhao, X.N., 2010. Research progress on benefit evaluation of returning farmland to forest and grassland in Loess Plateau. Journal of Northwest Forestry University 25 (3), 223–228.

Wang, L.Q., Qiao, N., Kang, R.B., 2013. Review of the research on ecological effects and evaluation of sandstorm source control project in and around Beijing and Tianjin. Forest Economics 6, 13–17.

Wang, Z.N., Pan, L., Yu, X.B., Shi, Y.H., 2007. Research advances in evaluation on ecological benefits on "grain for green" program. Journal of Southwest Forestry College 27 (1), 91–96.

Williamson, O.E., 1981. The economics of organization: the transaction cost approach. Am. J. Sociol. 87 (3), 548–577.

Williamson, O.E., 1985. The economic institutions of capitalism: firms, markets, relational contracting. Free Press, New York.

Yang, M.H., 2002. The evolution of agricultural industrialization management organization form: a theoretical explanation based on endogenous transaction costs. Rural Economy in China (10), 11–15, 20.

Yang, X.K., Zhang, Y.S., 2000. Neoclassical economics and inframarginal analyses. Peking University press, Beijing, pp. 98–102.

Zhang, L., Zhao, X.Y., Hou, C.C., Jiang, J.D., 2012. Effect of ecological compensation on farmer-household livelihood capital–A case study in the Yellow River water supply area in Gannan. Journal of Glaciology and Geocryology 34 (1), 186–195.