Chapter 7

Concepts: Key Terms in Ecological Product Value Realization

(1) Ecological Products

(2) Ecological Compensation

(1) Ecological Products

(a)Connotations of Ecological Products

Ecological products refer to the conditions and material resources provided by ecosystems for human survival, production, and livelihood. They can be categorized into three major types: (1) material ecological products, including food, timber, water resources, ecological energy, raw materials, etc.; (2) regulating service products, such as water conservation, carbon sequestration and oxygen release, air purification, flood mitigation, soil retention, windbreak and sand fixation, coastal protection, noise reduction, etc.; (3) cultural service products, primarily encompassing ecotourism, natural landscapes, aesthetic experiences, literary and artistic inspiration, knowledge education, and mental well-being, etc. The Gross Ecosystem Product (GEP)quantifies the monetary value of these three categories of ecological products, translating the contributions of ecosystems into economic terms. GEP is a great breakthrough and serves as the scientific foundation for integrating ecological benefits into socio-economic development evaluations. GEP can be utilized to assess the effectiveness of ecological conservation efforts, describe the overall status of ecosystems, and characterize ecological linkages between regions. It is also used to reveal the contributions of ecosystems to human well-being and their supporting role in economic and social development.

While academic consensus on the precise definition of ecological products remains incomplete, scholars largely agree on their fundamental characteristics. The commonly recognized attributes of ecological products include: (1) Public Good Nature: Due to their non-rivalrous and non-excludable properties, ecological products are widely regarded as public goods in scholarly discourse. (2) Holistic Provision: This manifests in their delivery mechanism—ecological products are typically provided simultaneously to all inhabitants within a given geographical area, inherently involving economic externalities. (3) Regional Specificity: Ecological products predominantly function within defined spatial boundaries, a feature some researchers term “scope priority.” (4) Multidimensional Value: These products exhibit diverse value attributes spanning economic, cultural, and livelihood dimensions, encompassing both use and non-use values, as well as economic and non-economic values. (5) Unquantifiable and Inseparable Nature: Unlike tangible commodities, freely accessible benefits such as clean air, pleasant environments, and favorable climatic conditions resist precise measurement and division through conventional market mechanisms.

References: Changsu Song, Zhiyun Ouyang. *Theoretical Connotation and Practical Applications of Gross Ecosystem Product (GEP)* [J]. People's Tribune · Academic Frontiers, 2023, (18): 92-95.

(b)Value Composition of Ecological Products

Ecological products exhibit substantial typological diversity, and also diverse value compositions that encompass both use and non-use values, manifesting across ecological, ethical, political, social, cultural, and economic dimensions. This multidimensional value system primarily seeks to unify ecological, social, and economic benefits. Given the enormous scale of ecological product values—with forest ecosystems alone theoretically providing around 4 trillion yuan worth—systematic classification becomes essential for practical valuation and accounting. However, not all theoretical value can be realized, leading scholars to develop different classification approaches based on realization potential. Nie Binhan and Jin Lifei distinguish between theoretical value and potential realizable value, with the latter comprising both the fundamental value of ecological products and the value-added components generated through human activities—currently the focal point of value realization efforts. Alternatively, Li Yuansheng approaches valuation through the dual lenses of ecological service value and ecological exchange value. He observes that although substantial ecological service values are difficult to incorporate into national economic transactions, exchange value assessment provides a more practical implementation path. Other scholars adopt a four-part framework of direct use value, indirect use value, choice value, and intrinsic value, acknowledging the current challenges in realizing option and intrinsic values. The valuation discussion necessarily extends to human welfare impacts, as ecosystems fundamentally influence wellbeing. This expanded perspective incorporates ecological capital value, product use value, incentive value of political performance, and employment stimulation value—dimensions particularly relevant for advancing ecological civilization. Some studies operationalize this approach by equating ecological product value with aggregated ecosystem service values, and effectively categorizing value according to welfare impacts. This methodological orientation emphasizes humans as primary beneficiaries and consumers of ecosystem services, thereby framing valuation through the lens of welfare contribution.

(c)Valuation of Ecological Products

Ecological products may originate either from natural ecosystem processes or from human interventions involving labor input (or forgone development opportunities). Given that their inherent values are categorized differently across various research frameworks, appropriate valuation methods must be selected based on product typology. This assessment requires integrated analysis of both ecosystem dynamics and ecological product market transactions to monitor comprehensive value fluctuations. Such multidimensional evaluation ultimately generates accurate price signals for market reference, facilitating informed economic decision-making.

For instance, some scholars categorize

ecological products by their distinct types - specifically dividing them into regulating service value, cultural service value, and material product value - then calculate each category's value separately before aggregating them. The valuation for each type can be derived by multiplying specific ecological functions by their corresponding prices. Currently, the primary valuation methods include: (1) the direct market approach, applicable to tradable ecological products with clearly defined property rights; (2) alternative market method, where a comparable region's ecological product value is first assessed before applying it to the target region; and (3) the contingent valuation method, which directly evaluates ecological product value through willingness-to-pay surveys. Different assessment purposes require different valuation approaches, meaning ecological product valuation cannot rely solely on static evaluation. It must incorporate considerations of production capacity and impacts on human well-being. Consequently, scholars have developed various valuation frameworks and methodologies tailored to different assessment objectives. These approaches primarily employ the three aforementioned valuation methods while adapting them to specific evaluation contexts and needs.

From the perspective of ecosystem service value assessment, Xing Zhang proposed a gradient-extended dynamic valuation mechanism that integrates “assessment-pricing-trading” throughout the lifecycle of different ecosystem types and their various service functions. This tripartite approach establishes distinct valuation indicators at every basic level to quantitatively evaluate the value flows and net gains or losses of ecosystem services based on ecological product variations. However, some scholars argue that ecological product valuation primarily assesses service values, which presents significant challenges for direct market implementation. They contend that value realization should instead focus on exchange value accounting to reflect labor inputs, rather than attempting to monetize ecosystem service values directly. Following this approach, Zhang Ying and colleagues developed a dual pricing system that incorporates production costs (including labor and profit margins) while treating ecological service values as external costs in sales transactions. This framework establishes separate pricing mechanisms for both purchasing and selling ecological products.

China has conducted extensive research on the application of ecological product valuation. Ouyang Zhiyun's team evaluated the service functions of terrestrial ecosystems nationwide, calculating their total economic value at 148 trillion yuan. Xie Gaodi's research group developed an equivalent factor table for ecosystem service valuation through questionnaire surveys, estimating the Qinghai-Tibet Plateau's annual ecological service value at approximately 900 billion yuan based on domestic and international assessment methodologies. The "Ecological Product Development Research in Dapeng New District, Shenzhen" project team comprehensively assessed 14 functional indicators encompassing both physical quantity values and ecological service values, determining the region's natural resource ecological value at 72.602 billion yuan.

Hu Ping and Yang Lijing investigated coastal ecological valuation methods, selecting eight service elements including air regulation, recreational value, and biodiversity conservation to evaluate a section of coastline in the Guangdong-Hong Kong-Macao Greater Bay Area, with results showing an annual ecological value of 20.984 million yuan. Yu Huiyi and Zeng Xiangang examined valuation imperatives for Shandong's forestry ecological products and their relationship with forest ecosystem service assessments, though their study did not produce specific quantitative results.

(d)Technical Methods for Realizing the Value of Ecological Products

The assertion that "lucid waters and lush mountains are invaluable assets" underscores that natural ecosystems not only provide abundant ecological products and services with significant ecological benefits, but also that their ecological value can be translated into economic benefits for human welfare. Conducting value accounting for ecological products and services serves as the foundation for recognizing ecological value and transforming it into economic gains.

(e)Gross Ecosystem Product (GEP)

Gross Ecosystem Product (GEP) represents the aggregate monetary value of all final goods and services that ecosystems provide to human society within a defined region and time period. It quantifies the total economic contribution of regional ecosystems to human well-being by encompassing both tangible products and intangible services. Ecosystem goods and services constitute the fundamental conditions and material resources that ecosystems and ecological processes furnish for human survival, production, and daily life. These include ecosystem material products, ecosystem regulation services, and ecosystem cultural services.

(f)GEP Accounting Methodology

The functional quantity of ecological products and services refers to the physical measurements or functional outputs that humans obtain directly or indirectly from ecosystems, including timber production volumes, water conservation capacity, pollution purification levels, soil retention amounts, windbreak and sand fixation quantities, carbon sequestration rates, as well as visitor numbers attracted by natural landscapes. While these physical metrics offer intuitive advantages by providing concrete, quantifiable data on ecological outputs, their inherent limitation lies in the incompatibility of measurement units across different ecosystem services - preventing their simple aggregation. Consequently, relying solely on physical indicators makes it impossible to derive the total output of ecosystem goods and

References:
[1] Liu Jiangyi, Mu Degang. Research Progress on Ecological Product Value and Its Realization Mechanism [J]. Ecological Economy, 2020, 36(10): 207-212.
[2] Gao Xiaolong, Zheng Hua, Ouyang Zhiyun. Research on the Vision, Objectives and Pathways of Ecological Product Value Realization [J]. China Land and Resources Economics, 2023, 36(5): 50-55.

services for a given region or nation over a specified timeframe. To calculate the Gross Ecosystem Product (GEP), it is necessary to use pricing mechanisms to convert the quantities of different ecological products and service functions into monetary units representing their outputs. The values of ecological material products, ecological regulation service products, and ecological cultural service products are then aggregated to obtain the total Gross Ecosystem Product (GEP).

(g)Ecological Assets

Natural resource assets include mineral resources, land resources, climate resources, and ecological resources, among others. Ecological assets constitute a vital component of natural resource assets. Specifically, ecological assets refer to those natural resource assets capable of generating ecological products and services for human benefit. This category includes both pristine natural ecosystems—such as forests, shrublands, grasslands, wetlands, and deserts—along with their associated wildlife and plant resources, as well as human-managed ecosystems that operate on fundamental natural ecological processes. The latter group comprises agricultural fields, plantation forests, cultivated grasslands, reservoirs, and urban green spaces.

(h)Methodology for Ecological Asset Accounting

Ecological asset accounting encompasses both physical stock and monetary valuation components. The physical stock refers to the resource inventory of various ecosystems such as forests, grasslands, and wetlands, while monetary valuation involves converting these physical quantities into monetary terms through appraisal methods. Importantly, ecosystem quality directly determines the provision of ecosystem services—forests, grasslands, and wetlands of different quality grades exhibit significant variations in their capacity to deliver services like soil retention, water conservation, and water purification. Consequently, ecological assets should be accounted for by segregating both physical stock and monetary value according to their respective quality grades. To comprehensively assess the integrated quantity and quality characteristics of ecological assets like forests, grasslands, and wetlands, the Ecological Quality Index (EQ) can be employed. This index is calculated as the ratio of the sum of physical quantities of ecological assets multiplied by their respective quality grade indices to the product of the total ecological asset area and the highest quality grade index.

References: Ouyang Zhiyun, Lin Yiqing, Song Changsu. "Research on Gross Ecosystem Product (GEP) Accounting: A Case Study of Lishui City, Zhejiang Province" [J]. Environment and Sustainable Development, 2020, 45(6): 80-85. DOI: 10.19758/j.cnki.issn1673-288x.202006080.

(2) Ecological Compensation

(a)Definition of Ecological Compensation

The concept of ecological compensation should be understood from two complementary dimensions. First, it entails compensation to nature—restoring and rehabilitating already degraded ecosystems while protecting those under threat of destruction. This includes initiatives like farmland-to-forest conversion, pollution control, natural forest conservation, and endangered species protection. Second, it involves compensation to humans—providing economic incentives or policy benefits (or conversely, penalties and prohibitions) to stakeholders engaged in ecological conservation efforts. Examples include grain and cash subsidies for farmers participating in reforestation programs, pollution discharge fees levied on mining operators, and tax reductions for environmentally friendly industries.

(b)Forms of Compensation

Ecological conservation compensation represents an incentive-based institutional arrangement that provides remuneration to organizations and individuals engaged in ecological protection activities in compliance with established regulations or agreements. This comprehensive system operates through multiple mechanisms, including vertical fiscal compensation from central to local governments, horizontal compensation between different regions, and market-based compensation approaches. The compensation modalities are diverse and adaptable, encompassing direct financial compensation, paired regional assistance programs, industrial relocation initiatives, professional training programs, joint development of ecological parks, and procurement of ecological products and services.

(c)Watershed Ecological Compensation

Watershed ecological compensation represents an expansion of ecological compensation applications, focusing specifically on water ecosystems as the medium to address compensation issues arising from gains and losses among different regions within a watershed caused by water-related factors. Activities by various stakeholders within the watershed influence hydrological cycles and sediment processes, impairing water ecosystem services. These impacts are then transmitted through the water ecosystem to affect other stakeholders,

References: Sun Xinzhang, Xie Gaodi, Zhang Qizi, et al. "Practices and Policy Orientation of Ecological Compensation in China" [J]. Resources Science, 2006, 28(4): 25-30. DOI: 10.3321/j.issn:1007-7588.2006.04.010.
Source: The Official Website of the Chinese Government | Regulations on Ecological Conservation Compensation (State Council Decree No. 779 of the People's Republic of China) (2024-04-06)
https://www.gov.cn/gongbao/2024/issue_11306/202404/content_6947725.html

necessitating benefit coordination between those causing and those affected by the impacts. From a more intuitive perspective, watershed ecological compensation serves to regulate imbalances in interregional benefit relationships within the watershed. These imbalances result from human activities that intensify the circulation of biological and material components, energy flows, and information exchanges between upstream, midstream, and downstream areas.

(d)Ecological Compensation for Cultivated Land

Ecological compensation for cultivated land can be understood from both narrow and broad perspectives. In the narrow sense, it refers specifically to economic compensation for ecological protection behaviors and associated losses related to cultivated land, known as cultivated land ecological protection compensation. However, given the unique characteristics of cultivated land protection policies and the importance of realizing the value of its ecological products, the broad sense of cultivated land ecological compensation should encompass all compensation activities associated with cultivated land ecological protection. This includes compensation for ecological damage to cultivated land, economic compensation for protective behaviors and related losses, as well as compensation for the ecosystem service values generated by these lands. Based on the nature of compensation, cultivated land ecological compensation can be categorized into three types: compensation for ecological damage to cultivated land, compensation for ecological protection of cultivated land, and compensation for the ecological value of cultivated land.

Tourism ecological compensation has evolved by integrating regional environmental compensation perspectives with applied expansions in ecological compensation research. Its conceptual framework encompasses three key dimensions: First, the targeted regions primarily consist of nature-based tourism destinations with diverse typologies. These areas—where ecological/environmental functions are predominantly utilized for tourism—include forest recreation sites, mountain tourism zones, urban natural heritage areas, and agricultural heritage landscapes. Among these, forest-based tourism destinations have received particular attention. Second, community interests form a central consideration. As tourism development inevitably involves local community participation and imposes opportunity costs on residents, community stakeholders emerge as vital beneficiaries in tourism ecological compensation mechanisms. Third, the scope extends beyond

References: Zhao Yinjun, Wei Kaimei, Ding Aizhong, Li Aihua. 2012. "Theoretical Exploration of Watershed Ecological Compensation" [J]. Ecology and Environmental Sciences, 21(5): 963-969.
References: Zhou Wei, Shi Jijin, Su Zilong, et al. "Research on the Connotation, Classification and Related Issues of Cultivated Land Ecological Compensation" [J]. China Land, 2022, (09): 46-49. DOI: 10.13816/j.cnki.ISSN1002-9729.2022.09.14.

merely compensating for ecological/environmental damages. It actively incorporates compensation for constructive ecological enhancements and critical ecosystem conservation efforts tied to tourism. This broader focus distinguishes tourism ecological compensation from related concepts like tourism resource ecological compensation or conventional resource user fees.

References:

components, energy flows, and information exchanges between upstream, midstream, and downstream areas.

(d)Ecological Compensation for Cultivated Land

Ecol mechanisms. Third, the scope extends beyond merely compensating for ecological/environmental damages. It actively incorporates compensation for constructive ecological enhancements and critical ecosystem conservation efforts tied to tourism. This broader focus distinguishes tourism ecological compensation from related concepts like tourism resource ecological compensation or conventional resource user fees.

References: Liu Min, Liu Chunfeng, Hu Zhongzhou. "Tourism Ecological Compensation: Conceptual Exploration and Scientific Issues" [J]. Tourism Tribune, 2013, 28(2): 52-59.