sustainability

MDPI

Article

Evaluation Methods and Application of Adaptability of Ecological Product Development and Utilization—Taking Jizhou District, Tianjin City, as an Example

Enxiang Zhang [1], Xinting Gao [1], Shuo Lei [1], Qin Qiao [1], Yuping Zheng [1,2], Lixiang Liu [1] and Yongwei Han [1,*]

[1] Chinese Research Academy of Environmental Sciences, Beijing 100012, China; eddieyu@yeah.net (E.Z.)
[2] School of Ecology, Lanzhou University, Lanzhou 730199, China
* Correspondence: hanyw@craes.org.cn

Abstract: Ecological products refer to the natural elements crucial for sustaining life support systems, ecological regulation functions, and environmental comfort. These products encompass clean air, water, pollution-free soil, lush forests, and maintaining favorable climates. In this study, we assessed the spatial distribution of ecosystem service functions in the Jizhou District of Tianjin using the suitability evaluation method, InVEST model calculations, and ArcGIS spatial visualization analysis. This study operates within the framework of "ecological industry selection", involving suitability evaluations for ecological product development, and formulates industrial development planning and control strategies. To construct the evaluation index system for exploiting and utilizing ecological products in the Jizhou District, three key aspects were considered: ecosystem services, land use, and limiting factors. Leveraging the district's resource endowments, this study conducted a quantitative analysis of the spatial distribution pattern of ecological product exploitation potential. The findings revealed a regional aggregation characteristic in the development potential of ecological products. The appropriate direction for developing eco-agriculture, eco-industry, eco-health, and eco-compensation products in the Jizhou district is influenced by the spatial distribution of ecosystem service functions. Building upon the analysis, specific types of ecological products suitable for development in the Jizhou District were further identified. By evaluating the suitability of ecological product development and utilization and verifying the results through industrial model division, the mechanism for comprehending the value of ecological products was realized. This study contributes to the realization of the "two mountains" ideology, wherein the transformation of green water and green mountains into assets of economic value is emphasized, thus fostering sustainable development practices.

Keywords: ecological products; suitability assessment; ecosystem services; development and utilization; spatial planning

check for updates

Citation: Zhang, E.; Gao, X.; Lei, S.; Qiao, Q.; Zheng, Y.; Liu, L.; Han, Y. Evaluation Methods and Application of Adaptability of Ecological Product Development and Utilization—Taking Jizhou District, Tianjin City, as an Example. *Sustainability* **2024**, *16*, 3438. https://doi.org/10.3390/su16083438

Academic Editors: Dina M.R. Mateus, Henrique J.O. Pinho and Petre Brețcan

Received: 4 March 2024
Revised: 12 April 2024
Accepted: 16 April 2024
Published: 19 April 2024

Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Ecological products encompass both resources and services derived from natural ecosystems or produced in conjunction with human activities and contribute to the enhancement of human well-being [1–5]. The concept of ecological products was extensively elaborated in the 2010 "National Main Functional Zone Planning" document, which stated that "Ecological products play a vital role in improving the quality of residents' lives and maintaining the human living environment" [6]. This notion was further emphasized in the 20th National Congress of the Communist Party of China of 2022, which proposed to "establish a mechanism for realizing the value of ecological products and improve the compensation system for ecological protection" [7]. The documents highlight that a pristine ecological environment serves as a fundamental pillar for fostering economic progress. Therefore, the development and utilization of ecological resources, alongside ensuring the sustainable supply of ecosystem services and promoting economic and social development, have emerged as pressing challenges [8].

China has made significant strides in researching the mechanisms to realize the value of ecological products as ecosystem services, experiencing rapid development and notable progress. However, the general categories of ecological products and diversified value realization paths are copious. This underscores the urgent need to build a set of ecological industry development suitability assessment frameworks in order to connect ecological products with industrial development. At present, domestic ecological product value assessment and realization lack a spatial basis, especially in the case of small-scale regions. In practice, ecological product development and utilization models for localized areas and a comprehensive classification of the products are still lacking. Balancing the ecological and economic benefits of ecological products and implementing the value realization mechanism of ecological products with regard to the local regions in China are important issues that need resolution. Therefore, conducting an ecological product suitability assessment based on Jizhou District's excellent ecological background advantages is of great practical significance and scientific demand. Nevertheless, research on evaluating the suitability of developing and utilizing ecological products is still inadequate. This study addresses the gap by leveraging insights from previous studies, integrating the concept of adaptability, consolidating recent research advancements, and incorporating real-world cases to explore methods for evaluating the feasibility of ecological product development and utilization. The study mainly aims to furnish decision-makers with the necessary support to choose pathways that effectively enhance the value of ecological products.

Existing research advances in the related field can be broadly categorized into two main directions: first, proposing the fundamental concept of suitability assessment for ecological product development and ecological product utilization and exploring the potential for the development and use of ecological products. Second, designing a suitable evaluation index system tailored to a special region or project, grounded in ecosystem services, and delineating its detailed content and application [9–11]. Previous studies provide valuable theoretical and practical insights for developing and utilizing eco-products; however, recent research has several shortcomings, especially in the application of specific methods and indicator systems for suitability assessment.

In summary, although research in the field of suitability assessment for the development and utilization of eco-products is progressing gradually, more empirical studies and case studies are needed to enrich and improve the existing theoretical framework and evaluation methods. Future studies should focus on developing more comprehensive and detailed evaluation index systems, as well as emphasize the application of these systems to actual projects to promote the sustainable development of ecological products. Thereby, based on the relationship between industry division and ecosystem service function, this study proposes an evaluation index system for the development and utilization adaptability of ecological products, analyzes the spatial distribution pattern of ecosystem service function, investigates the influencing factors of the development and utilization adaptability of ecological products, and offers a scientific basis for realizing the value of ecological products [12–15].

Ecological products possess multi-level values, which not only fulfill people's production and living needs but also uphold ecological stability [16–19]. Therefore, it is imperative to fully explore the potential value embedded within ecological products and leverage their important status to foster their sustainable development [20]. This study delves into both theoretical and practical challenges surrounding the development and utilization of ecological products, especially the exploration of strategies to convert ecological advantages into various other forms of advantage, such as leveraging capital and technology and improving the living standards of the population. Additionally, this study investigates avenues for conducting industrial development in different gradients, extending the industrial chain, and improving the added value of products.

The evaluation process of the suitability of ecological product development and utilization includes four key steps:

(1) Establishing suitability evaluation standards for ecological product development and utilization.
(2) Selecting an appropriate evaluation index system and dividing the evaluation indicators into primary and secondary index factors that correspond to different evaluation objectives and evaluation elements.
(3) Utilizing the suitability evaluation method to calculate and score the evaluation indicators [9–11]. Following the "Guidelines for the Evaluation of Resource and Environmental Carrying Capacity and Land Space Development Suitability (Trial)" issued by the Ministry of Natural Resources in 2020, this study conducts empirical analysis, choosing the Jizhou District in Tianjin City as an important ecological functional area in the Beijing–Tianjin–Hebei region, as the research site. Additionally, this study analyzes the local location factors and ecosystem service functions and constructs a suitability evaluation index system to evaluate the suitability of the development and utilization of ecological products [11,15].
(4) Determining which ecological products or methods are suitable for development (combined with the suitability assessment results) to effectively promote the value-added premium of ecological products.

2. Case Selection and Research Framework

2.1. Overview of the Study Area

Jizhou District, situated in the northernmost part of Tianjin City, China (Figure 1), has a total area of 1590.22 km^2. In 2022, approximately 795,500 people inhabited the district, and the regional GDP reached 250.40 billion yuan, with the three industries contributing to a ratio of 19.2:21.8:59. Geographically, Jizhou District lies at the convergence of the Yanshan Mountains and North China Plain. The terrain gradually ascends from north to south, resulting in a difference in altitude of 1076.70 m and forming a tiered distribution pattern. Additionally, the district boasts rich historical and cultural heritage, featuring 23 scenic spots within its territory. Notable attractions include one 5A-level scenic spot, the Panshan Scenic Area, and five 4A-level scenic spots, such as the Huangyaguan Great Wall, a World Cultural Heritage site, the ancient Dule Temple, Limutai Scenic Area, Jizhou Karst Cave, and Guojiagou Scenic Area. Moreover, there are seven 3A-level scenic spots. Recognized as one of Tianjin's significant ecological functional zones and a core area for the coordinated development of Beijing, Tianjin, and Hebei, Jizhou District boasts abundant natural resources, including forest, mineral, and water resources. Furthermore, the areas surrounding the district have poor resources, and the ecological resources are highly damaged. Only Jizhou District has a superior ecological environment and rich biodiversity, which has the potential to repair and maintain the balance of the ecosystem of the Beijing–Tianjin–Hebei urban agglomeration. Additionally, research on the development and utilization of ecological products in the district can also present Chinese solutions based on Chinese wisdom to protect and develop other similar super-large urban agglomeration ecosystems globally.

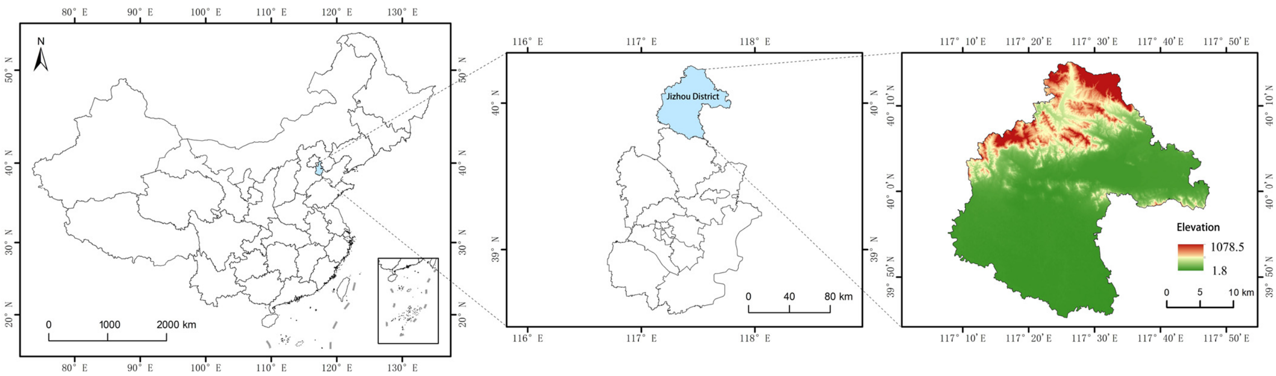

Figure 1. Location of Jizhou District, Tianjin City.

2.2. Data Sources

In this study, the following six ecosystem service functions were selected and quantitatively analyzed: carbon storage, vegetation oxygen release, water conservation, soil and water conservation, water quality purification, and habitat quality. Spatial refinement analysis was conducted using the InVEST model in conjunction with ArcGIS Map 10.8.2, with 2021 set as the assessment year. Land cover data were sourced from the National Catalog Service for Geographic Information, while water quality data were obtained from the Jizhou District Water Quality Status Survey. Air quality data were taken from the "Jizhou District 2021 Statistical Yearbook", while information on product influence and industrial development status was gathered from relevant internet sources and through field surveys. Policy support data were sourced from township government documents, and land use data were obtained from the Chinese Academy of Sciences Resource and Environmental Science and Data Center Database. The vector base map of the Jizhou District has a spatial resolution of 30 m. Table 1 presents the data sources and websites.

Table 1. Data source.

	Data Sources
DEM digital elevation	Geospatial Data Cloud (https://www.gscloud.cn/home) (accessed on 6 November 2023)
Land cover data	National Catalogue Service for Geographic Information (https://www.webmap.cn/main.do?method=index) (accessed on 6 November 2023)
Land use data	Chinese Academy of Sciences Resource and Environmental Science and Data Center Database (https://www.resdc.cn/) (accessed on 6 November 2023)
Meteorological data	National Meteorological Science Data Center (http://data.cma.cn/) (accessed on 6 November 2023)
Remote sensing, leaf area index, NPP data	Global Change Scientific Research Data Publishing System (http://www.geodoi.ac.cn/) (accessed on 8 December 2023)
NDVI data	National Ecosystem Science Data Center (http://www.geodoi.ac.cn/) (accessed on 8 December 2023)

Note. DEM: Digital Evaluation Model, NPP: Net Primary Productivity, NDVI: Normalized Difference Vegetation Index.

(1) Carbon storage [21]

The carbon storage in the study area is calculated using the Carbon module of the InVEST model. The estimation of carbon stored in the current landscape was derived from land use type data and the storage values of four carbon pools. The formula is as follows:

$$C = C_{above} + C_{below} + C_{dead} + C_{soil}$$

where C is the total carbon stock; C_{above}, C_{below}, C_{dead} and C_{soil} correspond to aboveground carbon storage, underground carbon storage, plant and animal residue carbon storage, and soil carbon storage, respectively.

(2) Vegetation oxygen release [22]

The oxygen release service is evaluated using the Net Primary Productivity (NPP) conversion formula. According to the plant photosynthesis process, for every gram of dry matter produced by the vegetation ecosystem, approximately 1.20 g of oxygen (O_2) is released. Therefore, the oxygen release amount can be calculated using the following formula:

$$G_o = NPP_j \times 32 \div 12$$

where G_o is the oxygen release amount per unit area of the grid in the study area(kg/m^2), and NPP_j is the net primary productivity of vegetation in grid j in the study area (kg/m^2).

(3) Water conservation [23]

Ecosystems comprising different land use types have different ecological service supply capabilities. The amount of water conserved in the study area is calculated based on vegetation type classification.

$$G_{water} = M \times N \times (R_0 - R_c)$$

where G_{water} is the water conservation amount per unit area of the study area (m^3); M is the total annual average rainfall in the study area (m); N is the proportion of runoff-generating rainfall in the total rainfall in the study area; R_0 is the bare land under runoff-generating rainfall conditions Rainfall runoff rate (dimensionless); and R_c is the rainfall runoff rate (dimensionless) of grassland, forest and farmland under runoff-producing rainfall conditions. A significant negative correlation exists between the rainfall runoff rate and the vegetation coverage of grassland, forest, and farmland.

(4) Soil conservation [24]

The Revised Universal Soil Loss Equation (RUSLE) is commonly used to calculate the amount of soil conservation (potential soil erosion rates) in a given area. The equation is as follows:

$$A = R \times K \times LS \times C \times P$$

where A is the amount of soil loss ($t \cdot hm^2 \cdot a^{-1}$); R is the rainfall erosion factor [$(MJ \cdot mm)/(hm^2 \cdot h \cdot a)$]; K is the soil erosion factor [$(t \cdot hm^2 \cdot h)/(MJ \cdot mm \cdot hm^2)$]; L and S are slope length and slope factor, respectively; C represents vegetation coverage and management factors; and P is a factor for engineering measures.

(5) Water purification [25]

If the amount of pollutant discharge in water exceeds the self-purification capacity of the aquatic ecosystem, leading to obvious water pollution, the self-purification amount of the ecosystem will be used as the functional quantity of water purification services. Conversely, if there is no obvious water pollution, the amount of pollutant discharge will be used as a functional quantity of water purification service. The evaluation method is as follows:

$$Q_{jwp} = \mathrm{Min}\left[W_j, \sum_{i=1}^{I} A_i QW_{ij}\right]$$

where Q_{jwp} is the amount of water purification service function of W_j (t/a); W_j is the discharge amount of the type of water pollutant(t/a); A_i is the area of the type of ecosystem (km^2); QW_{ij} is the purification amount of the QW_{ij}j-th water pollutant by the i-th ecosystem per unit area (t/km^2); j is the type of water pollutant, j = 1, 2, 3; i is the ecosystem type, i = 1, 2, . . ., dimensionless.

(6) Ecosystem quality [26]

The Ecosystem quality module of the InVEST model facilitates the assessment of various habitat types or vegetation types within a specific area, as well as the degree of degradation associated with each of these types. The formula is as follows:

$$Q_{xj} = H_j\left[1 - \frac{D_{xj}^z}{D_{xj}^z + K^z}\right]$$

where Q_{xj} is the habitat quality index of grid x on habitat type j; H_j is the habitat suitability of habitat type j; D_{xj} is the level of threat to grid x in habitat type j; k is the half-saturation constant, which usually takes the value of 0.5, that is, half of the maximum habitat quality index; and z is a normalization constant, usually taking the value of 2.5.

2.3. Ecological Industry Selection

The demand for the development of ecological industries and environmentally sensitive industries, and the natural background conditions of the Jizhou District, such as topography, geomorphology, soil fertility, water environment quality, climatic conditions, and air quality, provide favorable external conditions for the supply of ecological products [27–29]. Based on the National Economic Industry Classification (GB/T 4754-2017) [30], developable ecological industries and environmentally sensitive industries are identified to provide industrial direction for future ecological product development in the Jizhou District. For instance, Jizhou District's steep terrain, abundant forest resources, and relatively good soil fertility create conducive conditions for the supply of ecological agricultural products and aquatic ecological products, such as specialty fruits and vegetables (watermelon, fine peaches of the Outer Touling, etc.), forest mushrooms, and the cultivation of grains, nursery plants, and flowers. Thus, cereal planting, melon and fruit planting, aquaculture, edible mushrooms, and agricultural and foodstuffs processing industries can be selected for inclusion in the direction of eco-agriculture development [11]. Furthermore, after years of environmental treatment, the water environment and air quality of the Jizhou District have significantly increased. This reduces the purification costs for industries with high requirements on air and water quality, such as pharmaceutical manufacturing, special equipment manufacturing for electronics and electrical machinery, computer and communication equipment manufacturing, and instrumentation manufacturing industries. Hence, such industries can be selected for inclusion in the direction of eco-industrial industry development [31]. Additionally, with its rich historical and cultural resources, temperate and suitable climate, sufficient oxygen release, strong water conservation, and intact landscape pattern, Jizhou District is well-suited for the development of ecological industries such as eco-recreation and eco-tourism. These sectors can leverage the district's natural and cultural assets to attract tourists and promote sustainable development [32,33]. Table 2 presents specific details.

Table 2. Existing ecological product development directions in Jizhou District.

Development Scope	Ecological Product Categories	Ecological Product Subcategory	Development Nature	Development Direction
Existing ecology products	Ecological agricultural products	Grains (such as wheat)	Direct development	Grain planting, fruit planting
		Fruits (Ma Shenqiao blueberries, Sangzi watermelon, Tuoutuling premium peaches, etc.)	Direct development	
		Aquatic products (such as Yuqiao Reservoir ecological fish)	Direct development	Aquaculture
		Seedling flowers	Direct development	Seedling cultivation base
		Edible fungi	Direct development	Edible fungi industry base
		Agricultural and sideline foods	Direct development	Agricultural and sideline food deep processing industry
	Ecological industrial products	Water purification	Participate in development	Special equipment manufacturing, ecological health care, ecological tourism
		Fresh air	Participate in development	Pharmaceutical development, ecological health care, ecological tourism
		Oxygen release	Participate in development	Ecological wellness, ecotourism
		Environmental quality	Participate in development	Ecological wellness, ecotourism
	Eco-Compensation products	Water conservation	Direct development	Ecological wellness, ecotourism
	Eco-cultural products	Landscape value	Direct development	
		Travel and rest	Participate in development	
		Healthy Recuperation	Participate in development	

2.4. Index System Construction

While assessing the suitability evaluation of ecological product development in the Jizhou District, it is crucial to recognize that various factors collectively influence the overall impact. Therefore, the geographical characteristics of the study area, including topography, climate environment, water environment conditions, and land use types, must be considered. Additionally, ecological environment protection requirements, such as biodiversity, carbon sinks, and water source conservation, should also be considered. Furthermore, attention should also be paid to the interrelationships between different types of ecological product suitability evaluation index systems to establish a comprehensive evaluation system. This requires adhering to the principles of objectivity, globality, and differentiation when constructing the index evaluation system [34–39]. The selection of the evaluation index system for the suitability of ecological product development and utilization should be based on the evaluation objectives and the characteristics of the evaluation object. Additionally, the reliability and accuracy of the evaluation index system should be ensured.

This study selects the Jizhou District as the research area owing to its proximity to the outskirts of Beijing and its significant role as an ecological functional area within the Beijing, Tianjin, and Hebei regions, boasting rich ecosystem service functions [40]. Drawing from relevant research and documents such as the "Technical Guidelines for Accounting of Gross Terrestrial Ecosystem Product" jointly issued by the Environmental Planning Institute of the Ministry of Ecology and Environment and the Ecological Environment Research Center of the Chinese Academy of Sciences, and considering the unique ecological characteristics of the Jizhou District, we construct ecosystem services evaluation model. There are three target layers of land use type and restriction factors. At the ecosystem service functions level, the Jizhou District primarily provides six types of regulating services, including carbon storage, oxygen release from vegetation, water conservation, soil conservation, water purification, and ecosystem quality [22,25,40,41]. Considering the current status of land development and utilization and the influence of locational advantages on ecological products, three indicators are selected at the land use level: proportion of cultivated land, construction land, and transportation location [42–45]. At the level of limiting factors, the study focuses on the impact of ecological protection lines on agriculture and tourism development, with ecological red lines selected as indicators [46,47]. Furthermore, this study examines the comprehensive impact of Jizhou District's digital evaluation model elevation, slope, tourism resource supply area, and status of land space development and utilization area to understand the development and utilization of ecological products (Figure 2).

Considering the three defined types of ecological products and the distinctiveness of ecological goods, alongside the integration of industries within the Jizhou District, the industrial model can be categorized into four main sectors: ecological agricultural products, ecological industrial products, ecological health care products, and ecological compensation products.

After constructing the evaluation index system, it is necessary to assign a certain weight to each index to characterize the importance of the index. This stage holds critical importance as it directly impacts the objectivity and accuracy of the evaluation outcomes. Currently, various methods exist for determining the weights of indicators, encompassing both subjective and objective approaches. Subjective evaluation methods include the Delphi method and hierarchical analysis method, and objective evaluation methods include the entropy weight method (EWM), correlation coefficient method, and fuzzy comprehensive evaluation method. Each method has its own advantages and disadvantages.

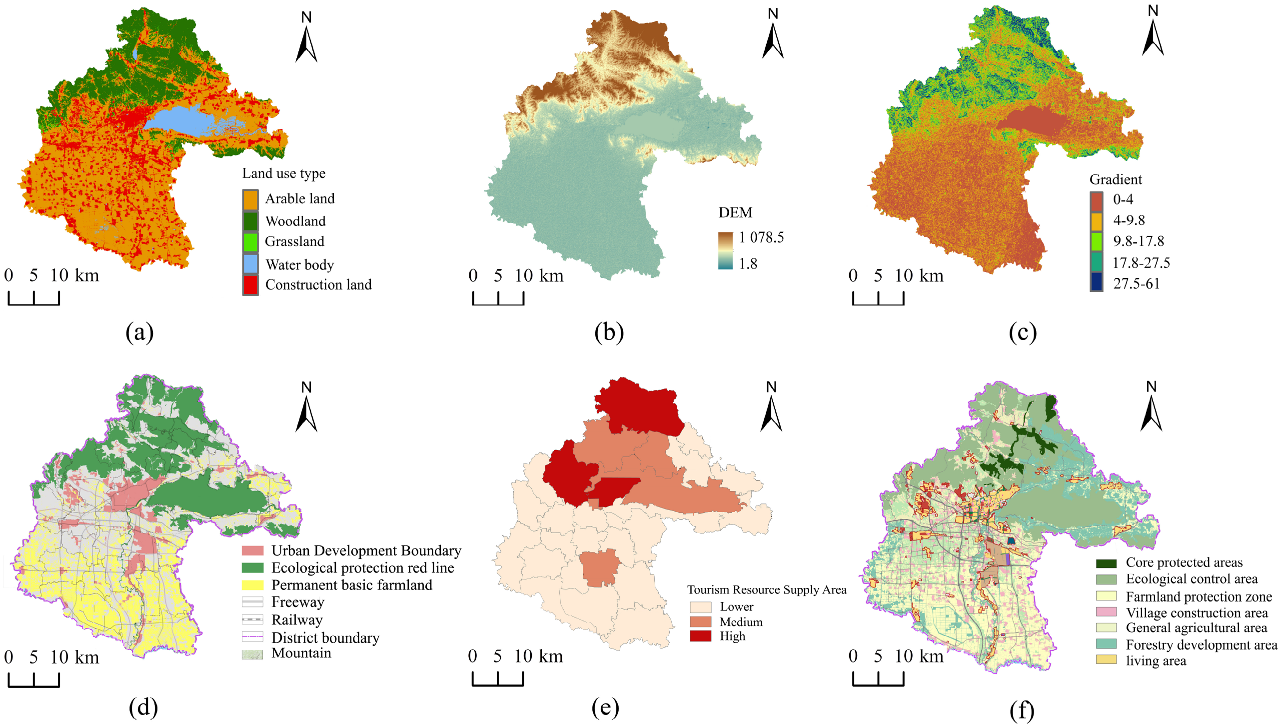

Figure 2. (**a**) Land use types in Jizhou District, (**b**) Elevation of Jizhou District, (**c**) Slope of Jizhou District, (**d**) Territorial spatial control line planning map of Jizhou District, (**e**) Tourism resource supply area of Jizhou District, (**f**) Territorial spatial functional zoning planning map of Jizhou District.

This study introduces ecological service functions into the suitability evaluation assessment, marking an innovative exploration in the field. While differences exist between indicators, specific reference values are not readily available in published literature. Therefore, the EWM was employed to determine the weights of the indicators, enhancing the credibility of the evaluation process. In general, indicators with more discrete data have lower information entropy, signifying that they contain more information and should thus be assigned higher weights. Table 3 shows the calculation results of indicator weight.

Table 3. Evaluation index system and weight of suitability for development and utilization of ecological products.

	Index	Ecological Agriculture	Ecological Industry	Ecological Wellness	Ecological Compensation
Ecosystem services	Carbon sequestration services	0.025	0.35	0.150	0.138
	Vegetation releases oxygen	0.028	0.045	0.028	0.173
	Water conservation	0.105	0.052	0.032	0.154
	Soil conservation	0.132	0.048	0.044	0.194
	Water purification	0.048	0.049	0.083	0.096
	Habitat quality	0.117	0.051	0.054	0.049
Land use status	Proportion of cultivated land	0.363	0.171	0.045	0.135
	Construction land	0.038	0.023	0.227	0.016
	Traffic location	0.12	0.155	0.227	0.016
Limiting factor	Ecological red line	1	0	0	1

To ensure intuitive, concise, and easy to analyze results, EWM is used to calculate the weight coefficients so that their values are between 0 and 1. The specific formula is as follows:

$$X'_{ij} = \frac{X_{ij} - \min_{X_{ij}}}{\max_{X_{ij}} - \min_{X_{ij}}}$$

where X_{ij} represents the normalized value of the j-th evaluation factor in cell i, and $max_{X_{ij}}$ and $min_{X_{ij}}$ are the values of the j-th evaluation factor, respectively.

2.5. Research Framework

The general framework for evaluating the suitability of ecological product development can be formulated according to the following scheme: ecological products are divided into high-quality ecological products (developed to a certain extent and possessing development value) and potential ecological products (not yet developed). Considering the natural background and ecosystem conditions in the region, the quality and supply of ecological products are evaluated to determine the range of existing high-quality ecological products and potential ecological products to complete the screening process of ecological products. Subsequently, according to the characteristics of different eco-products, the main ways and methods of their development are clarified, and the interactions between high-quality eco-products, potential eco-products, eco-industries, and environmentally sensitive industries are constructed. Next, a variety of relevant development factors are introduced, and a complete set of evaluation index systems, measurement methods, and assessment rules are established. Then, the suitability of developing eco-products is assessed, and the specific development direction is clarified. This provides a basis for rational regional planning and evaluation of implementation paths, aiming to maximize the value of ecological products and optimize the layout of related industries.

Additionally, this study divides existing ecological products into four distinct types [17]. Ecological agricultural products are directly obtained from the ecosystem and include agricultural, forestry, animal husbandry, and fishery products, as well as herbal medicines and undergrowing bacteria [32]. Ecological industrial products encompass benefits that indirectly arise from the services provided by the ecosystem, such as water purification, which offers high-quality water sources for industrial production in specific regions [17]. Ecological health products and ecological compensation products refer to the economic benefits derived directly from the services provided by the ecosystem, including tourism, leisure, and health care [17]. The indicator system in this study comprehensively considers the characteristics of ecological products, development conditions, policies, and regulations. By integrating the evaluation results, the study aims to determine the product types and utilization methods suitable for development to enhance the value-added premium of ecological products.

As shown in Figure 3, on the basis of clarifying the scope of eco-product development, this study proposes a methodological framework for evaluating the appropriateness of eco-product development and utilization, which can be divided into three advancement modules, “eco-product development appropriateness assessment framework”, “eco-industry selection”, “industrial development planning and regulation strategy”. The steps are as follows: First, divide the existing eco-industries into eco-materials, eco-industry, eco-recreation, and eco-compensation, and evaluate their suitability for development to determine the leading industrial areas suitable for development. Second, classify the high-quality eco-products in the study area, analyze the classification of eco-products, industrial forms, nature of development, and direction of development, and derive a comprehensive assessment of eco-industries and an industrial development catalog by combining the results of the suitability evaluation. Third, based on the results of the comprehensive assessment, construct the industrial development catalog, implement control measures, and provide industrial development planning and control references for decision-makers.

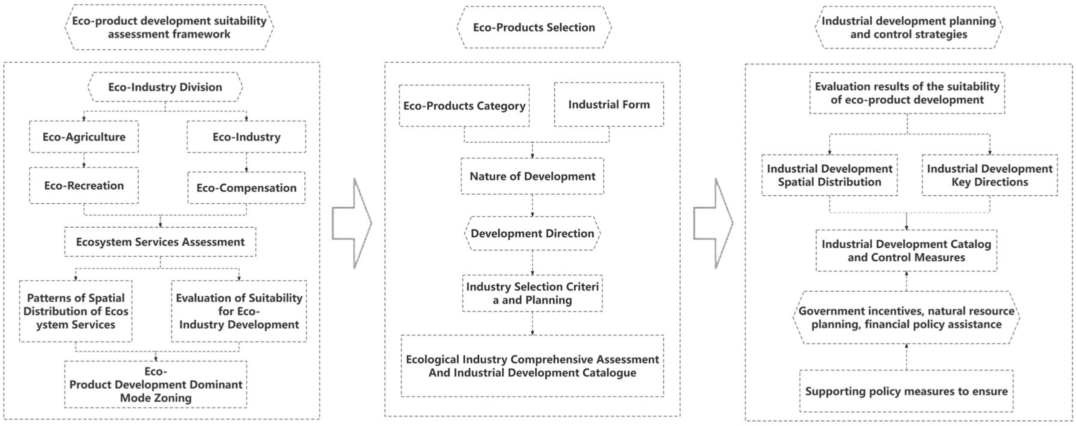

Figure 3. Ecological product development and utilization path and suitability evaluation framework.

3. Results and Analysis

3.1. Spatial Distribution Pattern of Ecosystem Services

This study evaluated the spatial division pattern of six ecosystem service functions in the Jizhou District and identified two distinct characteristics:

(1) Several ecosystem services, such as carbon sequestration, oxygen release, water conservation, soil conservation, and habitat quality, exhibit similar spatial distribution patterns. This can be attributed to natural topography and vegetation cover.

(2) High-value areas of ecosystem regulation services are concentrated in mountainous regions characterized by fertile vegetation, whereas low-value areas are concentrated in southern basins where human activities are more frequent (Figure 4).

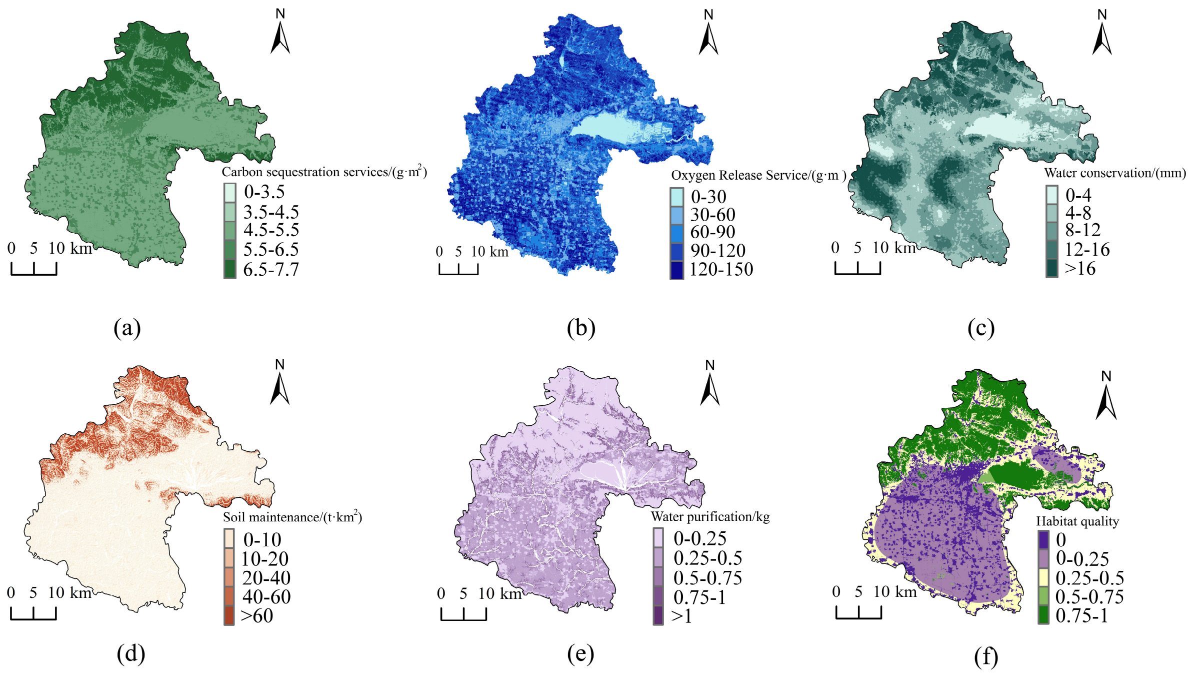

Figure 4. (**a**) Thistle carbon storage, (**b**) Oxygen release from Thistle vegetation, (**c**) Thistle water conservation, (**d**) Thistle soil conservation, (**e**) Thistle water purification, and (**f**) Thistle ecosystem quality.

Based on the spatial distribution analysis of the six ecosystem services in the Jizhou District, the following conclusions are drawn (Table 4). In general, areas with higher vegetation coverage exhibit higher quality ecosystem services, whereas areas with frequent human activities often display relatively weaker ecosystem service capabilities.

Table 4. Distribution of ecosystem service functions in Jizhou District.

Carbon Fixation and Oxygen Release	Water Conservation	Soil Conservation	Water Purification	Ecosystem Quality
Vegetation net productivity plays a dominant role in the spatial distribution of carbon fixation and oxygen release services. In areas with higher forest productivity, such as in the mountainous regions of northern Jizhou, carbon fixation and oxygen release service levels are higher.	Water conservation capacity is closely related to local precipitation, evapotranspiration, and soil properties. The mountainous region in the northern Jizhou District exhibits high water conservation capacity and is considered an important water conservation area.	Topography and vegetation are the main factors affecting soil conservation services. High-value areas are mainly located at higher altitudes and steep terrain in Jizhou. Soil conservation services are vital in maintaining regional soil stability and protecting water quality.	Water quality purification is affected by several factors, including vegetation cover, wetland presence, biodiversity, soil characteristics, water flow rates, and human activities.	Good habitat quality supports the survival and reproduction of various biological species, maintains ecological balance, and promotes the stability and healthy development of the ecosystem. The mountainous area in the northern part of Jizhou District and the Yuqiao Reservoir area exhibit good habitat quality.

3.2. Suitability Evaluation for Industrial Development of Ecological Products

The suitability score is the product of the weighted average of ecosystem services, land use, and limiting factors [9]. The formula is:

$$S_i = R_i \times \sum_{j=1}^{n} (w_i \times \text{indicator}_i)$$

where S_i is the score value of the i-th suitable model; R_i is the constraint condition of the i model; w_i is the number of weights; indicatorr_i represents the current status of ecosystem services and land use; i is a type of adaptive model; and j is the number of evaluation indicators. Figure 5 displays the suitability evaluation scores for four types of industries in the Jizhou District. Based on the spatial distribution patterns of ecosystem services and the suitability scores obtained in Section 3.1, a suitable development model is selected. This selection process considers the development potential and resource endowment of each sector, as well as local demand for ecological products and market trends.

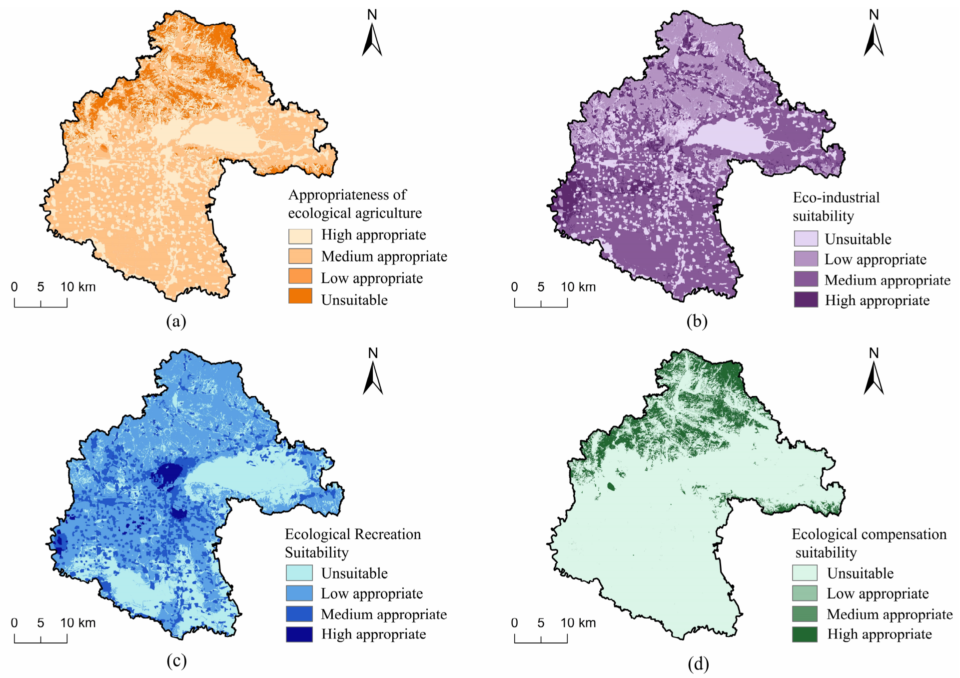

Figure 5. (**a**) Suitable Development Zones for Eco-Agricultural Products, (**b**) Suitable Development Zones for Eco-Industrial Products, (**c**) Suitable Development Zones for Eco-Recreation Products, (**d**) Suitable Development Zones for Eco-Compensatory Products.

Based on the analysis of the suitability results for the ecological product development industrial model in the Jizhou District, the spatial distribution of suitability for the four major industries is as follows:

(1) Ecological agriculture: According to the suitability evaluation results, the low-lying areas in the east and south of the Jizhou District are highly suitable. Some towns and urban residential areas in the northern mountainous area also include scattered suitable plots. These areas are conducive to the transformation of the value of ecological agricultural products through initiatives such as promoting specialty agricultural products, establishing brands, and conducting market operations.

(2) Ecological industry: The key to developing the ecological industry is to meet the needs of industries with strict standards for environmental conditions. For example, biopharmaceuticals require local materials, large storage requires temperature adjustment service functions, and high-precision manufacturing requires high standards for environmental conditions. According to the evaluation results, the highly suitable areas for ecological industry in the Jizhou District are primarily distributed in Sangzi Town and Dongzhaogezhuang Town in the southwest Jizhou District, and parts of Yuyang Town and Limingzhuang Town in the central region of the district.

(3) Ecological Health: The health industry, an important type of ecological product development and utilization, combines leisure tourism with health care. It positively impacts human health through services such as local temperature control, negative oxygen ion release, humidity control, and pollution control. The evaluation results show that highly suitable areas for this service are present in regions of Jizhou District with superior ecological environments and ample land for construction and development. These areas include northern tourist regions and a few towns and villages in the southern plain.

(4) Ecological compensation: Ecological compensation activities are mainly concentrated in areas with strong regional ecological service functions. Due to the restrictions on mining rights imposed by environmental protection regulations, these places mainly realize the value of environmental products through government procurement services and environmental compensation. According to the evaluation results, the northern mountainous area, aligning with ecological red-line boundaries, constitutes the largest proportion of ecological compensation areas. Areas with medium suitability are mainly distributed in the surrounding regions south of Yuqiao Reservoir.

3.3. Ecological Product Development Leading Model Zoning

To determine the dominant model of ecological product development, this study utilizes a grid-based evaluation approach to assess the suitability of four industrial models: ecological agriculture, ecological industry, ecological health care, and ecological compensation industry. The model with the highest score within each grid is considered the dominant model for that particular area. Industrial model (ESZoning) [9].

$$\mathrm{ESZoning} = \max\left(S_{agri}, S_{inds}, S_{health}, S_{compe}\right)$$

where S_{agri} represents the suitability evaluation score of ecological agriculture; S_{inds} represents the suitability evaluation score of ecological industry; S_{health} represents the suitability evaluation score of ecological health care; and S_{compe} represents the suitability evaluation score of ecological compensation [9].

Based on the zoning of each industrial model, among the four leading models, the ecological agriculture-led industrial model encompasses the largest and most widespread implementation locations, covering approximately 45% of the total area of Jizhou District. Conversely, the eco-industry-led industrial model has relatively fewer locations. The proportions of ecological health care and ecological compensation regions are approximately equal, each accounting for about 15% of the total area (Figure 6).

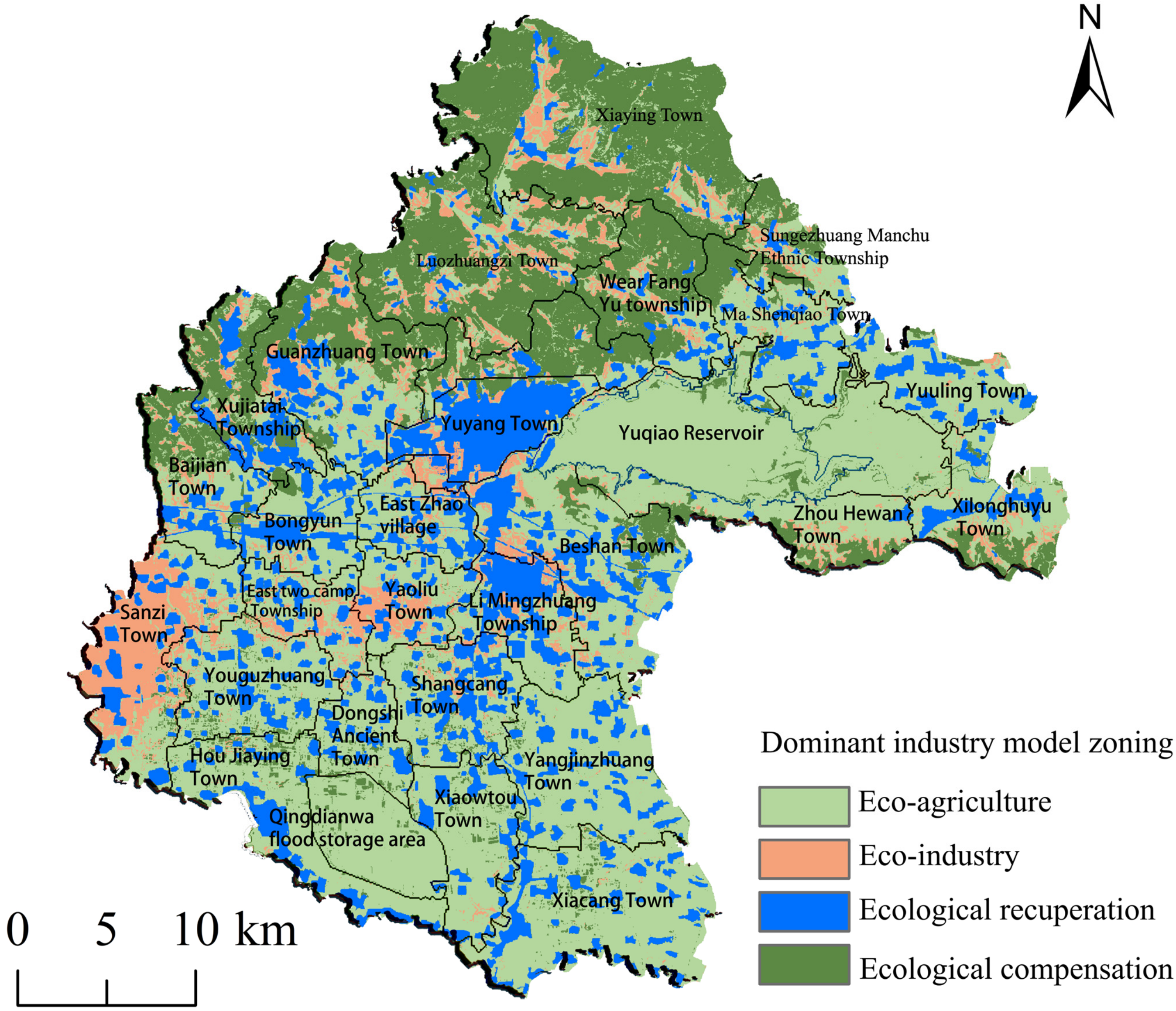

Figure 6. Jizhou District ecological product value realization leading model zoning.

Given the spatial variability of eco-products, it is important to recognize that the same plot of land may be suitable for multiple types of development, such as both eco-agricultural production and eco-recreation industries. To determine the most suitable development path, various adaptability assessments are necessary while considering the differences in suitability levels for different industrial models. The dominant implementation model does not imply the exclusive approach to application, nor does it hinder the development of other models in the region. Instead, it serves as a guiding principle for regional planning and execution. By focusing on the dominant model, regional planning can be more centralized and effectively executed, facilitating the formulation of land use and management policies tailored to the specific needs and opportunities of the region.

3.3.1. Ecological Agriculture Leading Industrial Model Realization Area

This area is primarily distributed in the southern and eastern regions of the Jizhou District, along with some northern mountainous areas. The southern area, in particular, has higher suitability evaluation scores and presents better development potential. This region boasts relatively abundant farmland resources and a favorable ecological environment, laying a solid foundation for the development of the ecological agriculture industry.

Additionally, the socioeconomic conditions in this area are relatively superior, providing robust support for the growth of the ecological agriculture industry.

Regarding spatial distribution, the areas where the ecological agriculture-led industrial model is realized are primarily concentrated in the following regions:

(1) Eastern plain area: This area exhibits high suitability evaluation scores, primarily due to its flat terrain, fertile land, and abundant water resources. These factors make it conducive to the development of fruit, vegetable, and edible fungi cultivation industries. Moreover, the strong agricultural science and technology base and industrialization foundation further enhance the development prospects for the ecological agriculture industry in this area.

(2) Southern area: The suitability evaluation for this area is relatively high, largely attributed to its ample water resources and high-quality soil. This region is well-suited for the development of specialized ecological agricultural industries, such as aquaculture as well as fruit and vegetable cultivation, especially varieties requiring abundant water, such as mulberries.

(3) Northern mountainous area: This region is suitable for scattered regional distribution of ecological agriculture activities. The predominant mountainous and hilly terrain makes large-scale planting industries impractical. However, the area presents opportunities for the cultivation of specialty agricultural products tailored to regional characteristics, including under-story fungi, specialty fruit cultivation, and other mountain-specific crops.

The Jizhou District possesses unique natural resources and an advantageous ecological environment, making it well-suited for the development of diverse ecological agricultural industries. Leveraging these strengths, the development of ecological agricultural industries can be integrated with the Jizhou District's abundant agricultural resources, encompassing a wide range of crops, agricultural products, and agricultural cultural heritage.

3.3.2. Eco-Industry-Led Industrial Model Realization Area

Areas that develop eco-industry should meet four conditions: good resource conditions, technical conditions, policy support, and industrial chain advantages. According to the zoning of the eco- industry-led industrial model in the Jizhou District, the spatial distribution of the eco-industry-led industrial model exhibits noticeable regional disparities. This model is primarily concentrated in the northern and western regions of the Jizhou District. These areas are characterized by relatively flat terrain and favorable transportation conditions, providing a solid foundation for the development of the ecological industry.

The realization areas of the eco-industry-led industrial model are primarily concentrated in industrial parks such as the Economic Development Zone and High-tech Industrial Park within the Jizhou District. These parks boast excellent infrastructure and resource conditions, making them attractive destinations for ecological industrial enterprises to establish and expand their operations. Moreover, these industrial parks offer policy support and public services, further facilitating the development of the ecological industry within the district. Additionally, certain mountainous and semi-mountainous areas within the Jizhou District also exhibit promising potential for ecological industrial development. These areas are endowed with abundant natural resources and a favorable ecological environment, providing unique foundational conditions for the growth of the ecological industry. For instance, some mountainous regions are well-suited for the development of niche industries such as green food processing and Chinese herbal medicine processing, leveraging the region's natural resources and ecological advantages.

Regarding specific spatial distribution, areas in close proximity to Sangzi Town, Dongzhao Gezhuang Township, Yuyang Town Government, and certain scattered regions in the northern mountain are suitable for the development of ecological industry. Several factors contribute to the suitability of these areas for the eco-industry-led industrial model. First, these areas possess abundant natural resources and advantageous geographical locations, offering favorable conditions for developing eco-industry-led industrial models.

These resources encompass the natural environment, climate conditions, land resources, water resources, and ecological assets. Second, these areas benefit from a certain level of technological accumulation and talent advantages in the field of eco-industry, providing robust technical support for industry development. Third, local governments demonstrate a strong commitment to fostering the development of the ecological industry, evidenced by the formulation of supportive policies and measures. These policies span various domains, including fiscal policy, tax policy, financial policy, and land policy, offering substantial support for industry advancement. Finally, this area has established a certain degree of industrial chain advantages within the ecological industry domain. These advantages cover multiple aspects such as resource development, production and manufacturing, warehousing and logistics, and marketing, laying a solid industrial foundation for eco-industry development.

3.3.3. Ecological Health Care Leading Industrial Model Realization Zone

The implementation areas of Jizhou District's ecological health care leading industrial model are primarily situated in the southern and eastern regions of the district. These areas are characterized by several factors that foster the development of the ecological health care industry. Additionally, these areas are characterized by good transportation conditions and infrastructure, which support the rapid development of the ecological health care industry. In terms of specific spatial distribution, this area is mainly concentrated in the following areas:

(1) Panshan area: The Panshan area, renowned as a prominent tourist destination in the Jizhou District, stands out for its unique natural resources and ecological environment, rendering it an ideal locale for fostering the ecological health care industry. Leveraging its existing tourism resources and well-established infrastructure, the region can embark on the development of a broader array of health tourism products and initiatives. By diversifying its offerings, the area can cater to tourists seeking comprehensive health services and immersive wellness experiences.
(2) Areas along the Zhou River: The areas along the Zhou River boast breathtaking natural landscapes and abundant cultural heritage. These attributes provide a fertile ground for developing health tourism projects and ecological agriculture initiatives. Additionally, opportunities exist for establishing health care communities and elderly care facilities, catering to the needs of older adults and offering them a comfortable and convenient environment for healthy aging.
(3) Jizhou City: Jizhou City, serving as the political, economic, and cultural hub of the Jizhou District, holds significant potential for advancing the ecological health care industry. Through urban renewal and revitalization efforts, the city can create health-themed parks, fitness centers, and wellness communities. These initiatives aim to enhance the overall well-being of urban residents, providing them with a healthier and more enjoyable living environment.

3.3.4. Ecological Compensation Leading Industrial Model Realization Area

The spatial distribution of areas where the ecological compensation-led industrial model is realized exhibits notable regional variations. While the overall suitability of the ecological compensation-led industrial model in this region is relatively high, there are discernible differences in the suitability levels across different areas.

From a spatial perspective, the implementation areas of Jizhou District's ecological compensation-led industrial model are primarily concentrated in the northern mountainous regions and certain regions of the southern plains. The concentration of implementation areas in the northern mountainous regions can be attributed to the region's distinctive natural resources and ecological conditions. These areas boast extensive natural landscapes, including forests, lakes, and rivers, providing a solid foundation for the development of industries related to ecological compensation. Moreover, these regions tend to be relatively isolated, experiencing minimal human interference and thereby enhancing the prominence of their ecological value. In contrast, the implementation of the ecological compensation-led industrial model in the southern plains appears more scattered, influenced by both natural and socioeconomic factors. The flat terrain of the southern plains favors agricultural activities and urban development. However, frequent human activities in these areas have led to significant environmental degradation, limiting suitable areas for ecological compensation-related industries. Furthermore, the southern plains benefit from better transportation infrastructure and higher population densities, necessitating careful consideration of local socioeconomic conditions when devising policies and plans related to ecological compensation.

In summary, the spatial distribution of implementation areas for the ecological compensation-led industrial model in the Jizhou District exhibits notable regional disparities. The northern mountainous regions, characterized by abundant natural resources and pristine landscapes such as forests, lakes, and rivers, are well-suited for the development of ecological compensation-related industries. Conversely, the southern plains require focused efforts on ecological environment protection and restoration amid urbanization, necessitating coordinated development with local socioeconomic conditions to promote ecological compensation effectively.

3.4. Comprehensive Evaluation and Industrial Development Catalog

To create a comprehensive development map (as shown in Figure 7) for ecological products, we need to integrate the evaluation results of various ecological product categories and their spatial distribution. This involves overlaying the suitability evaluation scores for ecological agriculture, ecological industry, ecological health, and ecological compensation. The mountainous areas (townships) in the northern part of the Jizhou District exhibit better ecological environments and stronger ecological product supply capacity. They are highly suitable for developing ecotourism and environmentally sensitive industries. Towns such as Xiaying Town, Luozhuangzi Town, Chuanfangyu Town, Guanzhuang Town, and Xujiatai Town are particularly suitable owing to their good air and water environment quality and vegetation coverage. Zhouhewan Town, Yuyang Town, and Xilonghuyu Town also have good air and water environment quality, with Yuyang Town having well-developed transportation facilities. They are highly suitable for industrial development, focusing on ecological health care, eco-tourism, pharmaceutical manufacturing, agricultural and sideline food processing, and aquaculture. Despite the relatively poor air quality, Ma Shenqiao Town, Chutouling Town, Dongzhao Gezhuang Town, and Yangjinzhuang Town are highly suitable for development in three industrial directions: eco-tourism, grain and fruit planting, ecological health care, and other industries. Sangzi Town and Dongshi Ancient Town have good industrial foundations and pharmaceutical and medical manufacturing foundations and are highly suitable for pharmaceutical manufacturing, as well as agricultural and sideline food processing. Bangjun Town, Baijian Town, Dongerying Town, Limingzhuang Town, Youguzhuang Town, Xiacang Town, and Xiawotou Town have at least one highly suitable development industry direction. Despite lacking highly suitable development industry directions, Sungezhuang Manchu Township has three suitable development industry directions, two sub-suitable development industry directions, and three unsuitable development industry directions.

Based on the zoning implementation methods of various leading models, this study clarifies the main characteristics of each leading industrial area and proposes the development direction and spatial control measures of four types of ecological products (Table 5).

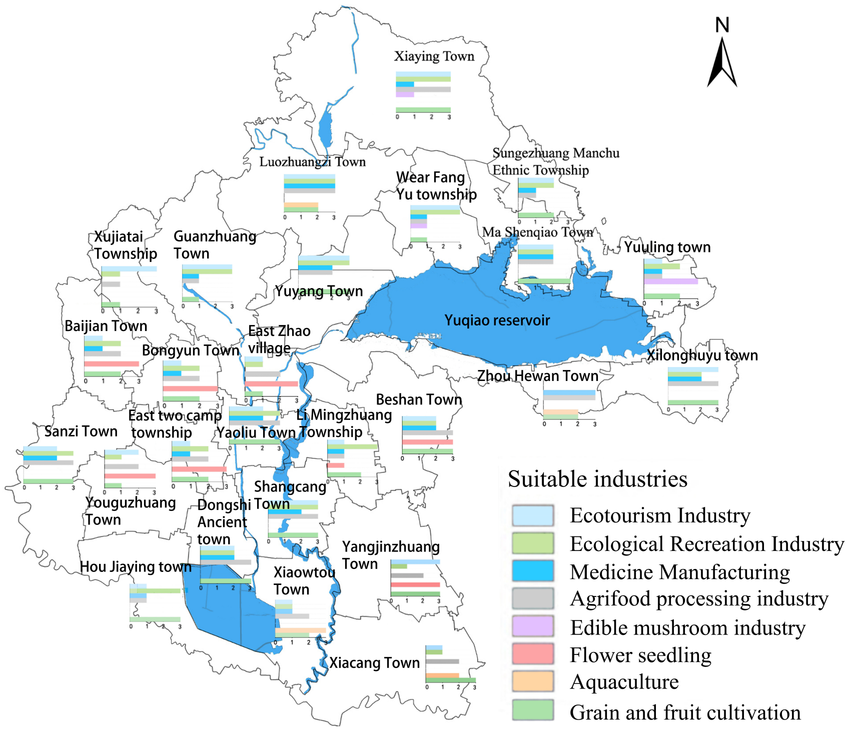

Figure 7. Comprehensive development map of existing ecological products in Jizhou District (Note: The bar chart is assigned values according to suitability, highly suitable 3, suitable 2, sub-suitable 1, unsuitable 0).

Table 5. Development direction and management and control measures of the leading industrial model zoning of ecological product development in Jizhou District.

Dominant Industrial Model Zoning	Feature	Direction of Development	Space Control Measures
Ecological agriculture industrial model	Farmland agglomeration, agricultural product diversity, pesticide safety	Develop organic agriculture and agricultural diversification: achieve diversified development of the agricultural industry and improve comprehensive agricultural benefits, combine agriculture with tourism to develop eco-tourism agriculture	Reasonably plan agricultural land, strengthen farmland protection, promote ecological planting technology, establish ecological agriculture demonstration areas, strengthen rural environmental governance, promote the integrated development of primary, secondary, and tertiary industries, and improve the comprehensive benefits of agriculture
Ecological industrial model	Rich ecological background resources and a good industrial foundation	Develop enclave economy and realize industrial agglomeration; promote the application of green production technologies and processes; reduce environmental pollution and damage and achieve clean production; and green manufacturing	Reasonably plan space layout, promote the application of green buildings and green energy
Ecological health care industrial model	Excellent natural environment, high management and service levels, and qualified construction conditions	Construct ecological health care base; develop ecological health care products, ecological health care tourism: develop ecological health care tourism	Formulate a scientific spatial plan for the ecological health care industry and clarify the industrial development layout and functional zoning
Ecological compensation-led industrial model	High ecological importance, high ecological service value, ecological red line area	Strengthen ecological protection and restoration, including soil and water conservation, vegetation restoration, and ecological reconstruction, and provide necessary protection and restoration for the ecosystem and provide a basis for ecological compensation	Strengthen the protection of ecological red lines, implement zoning control according to the planning plan of the ecological compensation-led industrial model

4. Discussion

The evaluation of the suitability of ecological product development and utilization plays a crucial role in understanding the natural ecological conditions of the study area and assessing the potential benefits of ecosystems for human well-being. By spatializing the evaluation results, decision-makers can obtain a macroscopic view of ecosystem potential to understand various aspects of natural resource management and ecological protection [48,49]. In other words, ecological product suitability assessment can provide a useful reference for assessing the complexity of ecosystems as well as the diversity of ecosystem services.

(1) In contrast to previous research endeavors, this study is uniquely centered on an applied project, offering a departure from theoretical frameworks to practical implementation. By employing suitability assessment methods alongside ecosystem services theory, this study provides a robust approach to evaluate the local natural foundation, market dynamics, and infrastructural landscape. Moreover, it enhances the pragmatic guidance for ecological product development, offering valuable insights for decision-makers navigating the spatial realization of ecological product value. In essence, this study not only enriches the theoretical discourse but also serves as an exploratory endeavor, furnishing decision-makers with actionable research for informed strategies in ecological product development [50,51].

(2) Regarding practical applications, previous studies often lean towards theoretical and idealistic frameworks, engaging with multiple layers encompassing environment, society, and economy. However, there is a dearth of empirical studies, which can sometimes render existing research abstract. Therefore, studies grounded in real-world cases are needed. Such studies can offer specific insights derived from on-the-ground experiences, bridging the gap between theory and practice more effectively [10,52]. The Jizhou District study area provides an example of a successful ecological product value realization model for other regions globally. As an ecological conservation development zone in the Beijing–Tianjin–Hebei region, Jizhou District's efforts and achievements in ecological protection and realizing the value of ecological products provide a useful reference for other mega-urban agglomeration areas and present a successful case of how to balance economic development and ecological protection. Empirical evidence shows that through scientific and reasonable planning and implementation, the value transformation of ecological products and economic development can be achieved along with protecting the ecological environment.

(3) While this study delves into established ecological products of interest, potential ecological products, such as those that enhance supply capacity through ecological restoration efforts, have not been considered. Subsequently, the development potential and categories of these potential ecological products are analyzed based on the condition of the natural ecosystem. The screening of potential ecological products is different from the screening of high-quality ecological products as this study mainly considers the characteristics of "ecological depression" as well as the direction of restoration. For example, ecological restoration of agricultural soils reduces soil pollution and improves soil properties, making high-quality ecological agricultural products potential ecological products; ecological restoration of mines, such as vegetation re-greening, increases the supply of regulating services, such as air purification and carbon fixation, some of which can also be used as ecological landscapes for leisure and tourism development. We construct a system of evaluation indexes (Evaluation index system) to assess the appropriateness of development for potential ecological products as follows: (1) clarifying the scope of the corresponding "ecological depression" and the direction of ecological protection and restoration, (2) identifying the possible direction of industrial development based on the path of ecological restoration and value-added premium realization of ecological products, and (3) combining the natural background conditions, cost-effectiveness, and the market environment required for the industry. Additionally, we select reasonable

industrial directions and incorporate them into the future suitability assessment to enrich the scope of the assessment and gain a more comprehensive understanding of the development potential of ecological products [53,54].

Furthermore, this study provides suggestions for decision-makers in various regions, that is, how decision-makers can reasonably choose the development direction of ecologically-led industries based on the suitability of different industrial models.

Specialized planning within the territorial spatial planning system to facilitate the actualization of ecological product value and enhance the pertinence of territorial spatial planning can be undertaken in future studies. By leveraging the results of development suitability evaluations, this approach can elucidate primary types and mechanisms, thereby fostering the holistic allocation of ecological products.

5. Conclusions

This study uses the Jizhou District in Tianjin City as a case study to develop a comprehensive framework for ecological product development and utilization. The framework comprises three key components: "ecological industry selection-ecological product development", "suitability evaluation-industrial development planning", and "management and control strategy". Through this framework, the study constructs a suitability evaluation index system to assess the feasibility of four value realization models: ecological agriculture, ecological industry, ecological health care, and ecological compensation. The research findings indicate that the eco-agriculture-led industrial model exhibits the highest number of implementation locations and the widest distribution, covering over 45% of the total area of the Jizhou District. In contrast, areas suitable for the eco-industry-led industrial model comprise approximately 20% of the district's total area. The proportions of ecological health care and ecological compensation industrial models are roughly equal, each accounting for about 15% of the total area. Through case verification, the study validates the evaluation method for the adaptability of ecological product development and utilization. Moreover, integrating the development and utilization direction of these ecological products with land spatial planning not only offers a theoretical foundation for the high-quality development of "Two Mountains" but also provides valuable insights and directions for the advancement of ecological industries.

Despite advancements, uncertainties remain in the suitability assessment of ecological product value realization due to the intricate nature of ecosystems and the varied ecosystem service functions. Moreover, in practical implementation, there remains a need to further explore methods to equitably distribute benefits, ensuring that the development and utilization of ecological products genuinely fulfill societal needs. This study provides preliminary insights into adjusting the spatial realization of ecological product value. Furthermore, it is imperative to consider factors such as local ecological environment characteristics, economic and social development levels, and industrial development trends to formulate targeted strategies for ecological product value realization. Corresponding management measures for ecological products should also be developed in tandem with these strategies.

Author Contributions: Conceptualization, E.Z. and S.L.; methodology, E.Z. and Y.Z.; software, E.Z.; validation, X.G., Q.Q. and E.Z.; formal analysis, E.Z.; investigation, E.Z.; resources, E.Z.; data curation, E.Z.; writing—original draft preparation, E.Z.; writing—review and editing, X.G.; visualization, E.Z.; supervision, Y.H.; project administration, Y.H.; funding acquisition, Y.H. and L.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data underlying this article will be shared upon reasonable request to the corresponding author.

Acknowledgments: We would also like to express our gratitude to the anonymous reviewers and editor.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Zhang, L.B.; Yu, H.Y.; Li, D.Q.; Jia, Z.Y.; Wu, F.C.; Liu, X. Connotation and value implementation mechanism of ecological products. *Trans. Chin. Soc. Agric. Mach.* **2019**, *50*, 173–183. (In Chinese)
2. Huang, R.L. Discussion on the value assessment of ecological products. *China Popul. Resour. Environ.* **2015**, *25*, 26–33.
3. Zhang, L.B.; Yu, H.Y.; Hao, C.Z.; Wang, H.; Luo, R.J. Redefinition and connotation analysis of ecosystem product. *Res. Environ. Sci.* **2021**, *34*, 655–660.
4. Yang, W.; Tao, J.J.; Lu, Q. Methodologies of human well-being assessment from the ecosystem service perspective. *Acta Ecol. Sin.* **2021**, *41*, 730–736.
5. Zhang, S.; Wang, H.; Fu, X.; Tang, M.; Wu, D.; Li, S.; Wu, G. Analysis of the effect of ecosystem services and urbanization on human well-being in inner mongolia province. *Sustainability* **2023**, *15*, 16021. [CrossRef]
6. Zhang, Z.; Xiong, K.; Chang, H.; Zhang, W.; Huang, D. A review of eco-product value realization and ecological civilization and its enlightenment to karst protected areas. *Int. J. Environ. Res. Public Health* **2022**, *19*, 5892. [CrossRef] [PubMed]
7. Sun, B.W. Establishing an ecological product value realization mechanism: «Five Difficulties» issues and optimization paths. *Tianjin Soc. Sci.* **2023**, 87–97. [CrossRef]
8. Gao, X.L.; Lin, Y.Q.; Xu, W.H.; Ouyang, Z. Research progress on the value realization of ecological products. *Acta Ecol. Sin.* **2020**, *40*, 24–33.
9. Wu, S.H.; Hou, X.R.; Peng, M.X.; Cheng, M.; Xue, J.B.; Bao, H.J. Suitability assessment and zoning of value realization for ecological regulation services: A case study of Lishui City, Zhejiang Province. *China Land Sci.* **2021**, *35*, 81–89.
10. Zhao, Y.; Zhou, Q.; Zhou, W.; Li, X.; Yu, L. Suitability evaluation and guidance strategy of ecological product development: A case study of Yancheng City, Jiangsu Province. *Planners* **2023**, *39*, 32–39.
11. Shi, J.J.; Su, Z.L.; Ma, P.L.; Zhou, W.; Fan, Z.L.; Zhou, H.W.; Li, L.; Hao, X.X. Design and application of suitability evaluation technical framework for ecological products development: Case study of Jiangyin city, Jiangsu Province. *Chin. J. Agric. Resour. Reg. Plan.* **2023**, *8*, 1–15.
12. Liu, X.B.; Wang, Y.K.; Li, M. Theory, method and technological application of territorial spatial development suitability evaluation. *J. Geo-Inf. Sci.* **2021**, *23*, 2097–2110.
13. Li, H.T.; Wang, L. Study on selection and regionalization of agricultural industry in Qidong city based on eco-fitness. *Guangdong Agric. Sci.* **2013**, *40*, 200–203.
14. Zhou, K.; Fan, J.; Sheng, K.R. Research on methods and approaches of spatial governances. *Geogr. Res.* **2019**, *38*, 2527–2540.
15. Su, Z.L.; Shi, J.J.; Fan, Z.L. Preliminary study on the framework of ecological product development suitability evaluation. *Environ. Prot.* **2024**, *52*, 36–41.
16. Zhang, W.M. Improving the value realization mechanism of ecological products—Based on the research of Fujian Forest Ecological Bank. *Macroecon. Manag.* **2020**, 73–79. [CrossRef]
17. Li, Z.; Liu, Z.Y. Ideas for constructing ecological product quality assessment system. *Macroecon. Manag.* **2020**, 13–19. [CrossRef]
18. Chen, Q.; Li, Z.; Xie, H.; Wu, M.; Pan, Y.; Luo, S. How can ecological product value realization contribute to landscape sustainability? *Landsc. Ecol.* **2024**, *39*, 15. [CrossRef]
19. Xu, Y.S.; Zhao, W.W.; Zhang, Z.J. The practice of nature-based solutions in China: Ecosystem product value realization. *Curr. Opin. Environ. Sci. Health* **2023**, *36*, 100514. [CrossRef]
20. Wang, K.; Liu, P.; Sun, F.; Wang, S.; Zhang, G.; Zhang, T.; Chen, G.; Liu, J.; Wang, G.; Cao, S. Progress in realizing the value of ecological products in China and its practice in Shandong province. *Sustainability* **2023**, *15*, 9480. [CrossRef]
21. Yang, J.; Zhou, P.Q.; Yuan, S.J.; Tan, X.; Lou, Z.F. Land ecosystem service functions for dongting lake ecological economic zone based on InVEST model. *Bull. Soil Water Conserv.* **2022**, *42*, 267–272+282.
22. Liu, Y.Y.; Ren, H.Y.; Zhou, R.L.; Basang, C.M.; Zhang, W.; Zhang, Z.Y.; Wen, Z.M. Estimation and dynamic analysis of the service value of grassland ecosystem in China. *Acta Agrestia Sin.* **2021**, *29*, 1522–1532.
23. Pang, L.H.; Chen, Y.M.; Feng, C.Y. Assessment of ecological products supplying capacities of natural reserve-A case of Hulun Buir Hui River Reserve. *J. Arid. Land Resour. Environ.* **2014**, *28*, 110–116.
24. Lang, Y.; Liu, N.; Liu, S.R. Changes in soil erosion and its driving factors under climate change and land use scenarios in Sichuan-Yunnan-Loess Plateau region and the Southern Hilly Mountain Belt, China. *Acta Ecol. Sin.* **2021**, *41*, 5106–5117.
25. Song, C.S.; Ouyang, Z.Y. Gross ecosystem product accounting for ecological benefits assessment: A case study of Qinghai province. *Acta Ecol. Sin.* **2020**, *40*, 3207–3217.
26. Ran, X.; Li, Y.; Guo, Y.L.; Wei, H. Ecosystem services assessment and trade-off synergy relationships in Qianjiangyuan National Park based on InVEST model. *Resour. Environ. Yangtze Basin* **2023**, *32*, 1932–1948.
27. Hna, X.J.; Wang, J.J.; Zhao, X.C.; Wang, C.Y.; Xia, Y. The potential of agricultural eco-economic system and the spatial distribution of its industry in suburban township: A case study of the Hezhuangping Town, Yan'an City. *Acta Ecol. Sin.* **2021**, *41*, 4720–4731.

28. Tan, W.W.; Wen, L.Z.; Huang, M.L. The ecosystem service function on ecological industry cluster. *Ecol. Econ.* **2012**, 132–136. [CrossRef]
29. Geng, A.; Zhang, G.J.; Xu, L.; Zhang, P.T. Design of compound industry model based on ecosystem service value cluster taking fuping county in Hebei province as an example. *Res. Soil Water Conserv.* **2024**, *31*, 417–426+439.
30. *GB/T 4754-2017*; Industrial Classification for National Economic Activities. Chinese Standard: Beijing, China, 2017.
31. Qin, S. Analysis on the development model of circular economy based on industrial ecosystem. *Sci. Technol. M Anagam Ent Res.* **2009**, *29*, 378–380.
32. Hu, J.Y.; Liu, L.Y.; Dai, Q.L.; Yang, B.; Zhou, W.J. Evaluation of ecotourism suitability based on AHP-GIS: Taking Xiaoxiangling area of the Giant Panda National Park and the surrounding communities as an example. *Chin. J. Appl. Ecol.* **2024**, 1–11. [CrossRef]
33. Zhou, B.; Zhou, Y.H.; Huang, Y.; Liao, Y. Study on ecotourism suitability and landscape pattern of suburban reservoir water conservancy scenic spot: A case study of Xianhai National Water conservancy scenic area in Sichuan province. *Chin. Landsc. Archit.* **2023**, *39*, 50–56.
34. Wu, C.; Chen, W. Indicator system construction and health assessment of wetland ecosystem—Taking Hongze Lake Wetland, China as an example. *Ecol. Indic.* **2020**, *112*, 106164. [CrossRef]
35. Yu, D.; Lu, N.; Fu, B. Establishment of a comprehensive indicator system for the assessment of biodiversity and ecosystem services. *Landsc. Ecol.* **2017**, *32*, 1563–1579. [CrossRef]
36. Wang, Y.; Liu, G.; Cai, Y.; Giannetti, B.F.; Agostinho, F.; Almeida, C.M.; Casazza, M. The ecological value of typical agricultural products: An emergy-based life-cycle assessment framework. *Front. Environ. Sci.* **2022**, *10*, 824275. [CrossRef]
37. Hall, Y.W.; Gao, X.T.; Gao, J.X.; Xu, Y.M.; Liu, C.C. Typical ecosystem services and evaluation indicator system of significant eco-function areas. *Ecol. Environ. Sci.* **2010**, *19*, 2986–2992.
38. Hu, X.Y.; Yu, F.W.; Xu, X.B.; Niu, K. Accounting of copland ecosystem services: Indicator system construction and its application. *Ecol. Econ.* **2023**, *39*, 111–121.
39. Fu, M.D.; Liu, W.W.; Li, B.Y.; Ren, Y.H.; Li, S.; Bai, X.; Li, J.S.; Zhu, Y.P. Construction and application of an evaluation index system for ecological and environmen tal protection effectiveness of national parks. *Chin. J. Ecol.* **2021**, *40*, 4109–4118.
40. Xiao, L.; Jiang, Q.O.; Wang, M.L.; Lv, K.X. Coupling coordination and prediction analysis of ecological infrastructure, habitat quality and industrial development in the Beijing-Tianjin-Hebei region of northern China. *J. Beilin For. Univ.* **2021**, *43*, 96–105.
41. Ouyang, Z.Y.; Lin, Y.Q.; Song, C.S. Research on gross ecosystem product (GEP): Case study of Lishui city, Zhejiang province. *Environ. Sustain. Dev.* **2020**, *45*, 80–85.
42. Liu, J.; Ma, S.; Gao, J.; Zou, C.; Wang, J.; Liu, Z.; Wang, L. Delimiting the ecological conservation redline at regional scale: A case study of Beijing-Tianjin-Hebei region. *China Environ. Sci.* **2018**, *38*, 2652–2657.
43. Wang, L.X.; Zou, C.X.; Wang, Y.; Lin, N.F.; Wu, D.; Jiang, H.; Xu, D.L. Methods to identify the boundary of ecological protection red line regions using GIS: A case study in Changping. *Acta Ecol. Sin.* **2017**, *37*, 6176–6185.
44. Ma, B.Y.; Huang, J.; Li, S.C. Optimal allocation of land use types in the Beijing-Tianjin-Hebei urban agglomeration based on ecological and economic benefits trade-offs. *Prog. Geogr.* **2019**, *38*, 26–37.
45. Chen, J.; Lu, F. Location advantage and accessibility evaluation on Beijing–Tianjin–Hebei metropolitan area. *Geogr. Geo-Inf. Sci.* **2008**, *24*, 53–56.
46. Zhang, C.; Lin, D.; Wang, L.; Hao, H.; Li, Y. The effects of the ecological conservation redline in China: A case study in Anji County. *Int. J. Environ. Res. Public Health* **2022**, *19*, 7701. [CrossRef] [PubMed]
47. Zhou, Y.; Yao, J.; Chen, M.; Tang, M. Optimizing an urban green space ecological network by coupling structural and functional connectivity: A case for biodiversity conservation planning. *Sustainability* **2023**, *15*, 15818. [CrossRef]
48. Yu, H.; Shao, C.; Wang, X.; Hao, C. Transformation path of ecological product value and efficiency evaluation: The case of the Qilihai Wetland in Tianjin. *Int. J. Environ. Res. Public Health* **2022**, *19*, 14575. [CrossRef] [PubMed]
49. Hao, C.; Wu, S.; Zhang, W.; Chen, Y.; Ren, Y.; Chen, X.; Wang, H.; Zhang, L. A critical review of Gross ecosystem product accounting in China: Status quo, problems and future directions. *J. Environ. Manag.* **2022**, *322*, 115995. [CrossRef] [PubMed]
50. Terzi, F.; Tezer, A.; Turkay, Z.; Uzun, O.; Köylü, P.; Karacor, E.; Okay, N.; Kaya, M. An ecosystem services-based approach for decision-making in urban planning. *J. Environ. Plan. Manag.* **2020**, *63*, 433–452. [CrossRef]
51. Wang, J.; Zhao, F.; Yang, J.; Li, X. Mining site reclamation planning based on land suitability analysis and ecosystem services evaluation: A case study in Liaoning province, China. *Sustainability* **2017**, *9*, 890. [CrossRef]
52. Zhu, J.; Ke, X.; He, L.; Zhou, T.; Wang, Q.; Ren, Y. Theoretical analysis of the value realization mechanism of ecological products based on the value chain theory. *Ecol. Environ. Sci.* **2023**, *32*, 421–428.
53. Smith, L.M.; Reschke, E.M.; Bousquin, J.J.; Harvey, J.E.; Summers, J.K. A conceptual approach to characterizing ecological suitability: Informing socio-ecological measures for restoration effectiveness. *Ecol. Indic.* **2022**, *143*, 109385. [CrossRef] [PubMed]
54. Yan, Y.; Zhou, R.; Ye, X.; Zhang, H.; Wang, X. Suitability evaluation of urban construction land based on an approach of vertical-horizontal processes. *ISPRS Int. J. Geo-Inf.* **2018**, *7*, 198. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.