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A Preliminary Exploration of the Functional Value Assessment of Ecosystem Services in Aral City

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ABSTRACT

Using the principles and methods of eco-economics as the research object, Aral City comprehensively expounds the ecological service functions such as ecosystem regulation of climate, carbon sequestration, soil conservation, water conservation and purification environment, and evaluates its economic value. The total value of the estimated 2021 is 1303.65 million yuan. At the same time, the importance of ecological service functions of urban ecosystems, from large to small, is to sequester carbon and release oxygen, purify the environment, maintain soil, conserve water sources, regulate the climate. The ecosystem service function which needs to be paid attention to in the concept of ecological construction and restoration of the next stage of ecological construction in Aral City.

1. Introduction

Ecosystem service function refers to the important role that the ecosystem plays to the outside in the ecological process of energy flow and material flow. The ecosystem not only provides food, medicine, and raw materials for industrial and agricultural production and other products necessary for human survival, but also maintains the life support system that humans rely on for survival and development. It is generally believed that ecosystem service functions mainly include ecological integrity; regulation of ecosystem services; provision of ecosystem services and cultural ecosystem services. This article mainly focuses on the second category of urban ecosystem

functions, namely, regulation of ecosystem services to evaluate.

The natural conditions in Alar are severe and threatened by sandstorms and salinity. In recent years, the ecological vulnerability has been increasing due to various influences. As a life support system, the ecosystem provides services for the survival and development of human beings. Its service functions play an irreplaceable role as a natural barrier for maintaining the ecological balance of the desert and promoting social and economic development. Therefore, this article will combine the physical geography and socio-economic conditions of Alar City, and use the principles and methods of ecological economics to explain the basis of the ecological functions

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of the ecosystem, such as climate regulation, carbon fixation and oxygen release, soil conservation, water conservation, and environmental purification. Above, quantitatively evaluate the economic value of the urban ecosystem service functions of Alar City in 2021, with a view to providing help for the sustainable ecological development of Alar City.

2. Research Progress on Ecosystem Service Functions

At present, the quantitative evaluation of the economic value of ecosystem services has become the frontier field of the current research on ecology and resource economics, environmental economics and ecological economics. In this field, domestic and foreign scholars have conducted relatively extensive research. Costanza et al. [1] took forest ecosystems as the research object and estimated the annual economic value of global ecosystem service functions. The publication of this article made the research on ecosystem service functions one of the hotspots of international sustainable development related research. With the introduction of foreign research theories and methods into the country, Chinese scholars have also launched research on ecosystem service functions, explored related concepts, and used scientific evaluation methods to conduct research on the value of ecosystem service functions in different regions.

The research process of the definition of ecosystem services. In 1997, Costanza et al. proposed: Ecosystem services refer to the life support products and services that humans obtain indirectly or directly from the ecosystem; Daliy [2] proposed in the same year: Ecosystem services refer to the formation of ecosystems and ecological processes to maintain human survival. In 1999, Ouyang Zhiyun and Wang Rusong in my country proposed the same definition as Daliy; then in 2005, MA proposed that ecosystem service functions refer to the benefits that humans obtain from the ecosystem. So far, scholars have focused on this content. The research basically reached agreement.

Ecosystem service value evaluation techniques and methods. Technology is divided into two categories: alternative market technology and analog market technology. The methods are divided into the following categories: conditioned value method (using market research methods to consult people's willingness to pay, and use it to express the economic value of ecological service functions); expense method (expressed by people's expenditure on a certain ecological service function); Market value method (first calculate the quantitative value of a certain type of ecosystem service, then study its "shadow price" [3-4], and then calculate the total economic

value); opportunity cost method (from production costs, use costs and external costs) Composition) and so on.

3. Evaluation Method of Ecosystem Service Function Value

3.1 Principle of the Method

The estimation of ecosystem service functions is affected by many factors, and most of the current work is to estimate the average regional ecosystem service value. Costzana et al. provided a method for reference: first, classify the ecosystems in the study area according to certain standards; second, calculate the unit area capital of each part of the ecosystem services according to different measurement methods; finally, Calculate the total capital and summarize the structure table [5]. Therefore, the total value of regional ecosystem services is:

$$X = \sum_{i=1}^m \sum_{j=1}^n D_{ij} S_i$$

formula X The total value of serving the regional ecosystem, D_{ij} Represents the unit value of the ecosystem service function of the i -th ecosystem, S_i Represents the area of the i -th type of ecosystem.

3.2 Estimation of Ecological Service Value

The evaluation of the service value of urban ecosystems generally includes the evaluation of the value of ecological service functions such as climate regulation, carbon fixation and oxygen release, soil conservation, water conservation, and environmental purification:

Adjust the climate. The city of Alar is located in a warm temperate zone, and the adjustment of the urban climate mainly relies on wetlands. The cooling effect in summer can reduce the use of urban air-conditioning, so this function can be measured by the alternative cost method, that is, reducing the electricity consumption of air-conditioning.

Carbon fixation and oxygen release. Using afforestation cost method and carbon tax method [6], the value of carbon sequestration in Alar City is evaluated; while the value of oxygen released by the ecosystem is calculated by afforestation method and shadow price method of industrial oxygen production. The calculation formula and parameters description are shown in (Table 1).

Maintain the soil. Firstly, the difference between the amount of soil erosion without vegetation cover and the actual erosion amount of forest land and grassland is used to estimate the annual reduction of soil erosion of forest land and grassland; The value of wind and sand disasters in 4 aspects.

Table 1. Calculation formula and parameter description

Conserve water	<p>$W=A \times D=A \times (h \times P)$; $W=(I+Gv) \times A=(P \times V+P \times G) \times A$; $U_{han}=W \times (C \text{ capacity}+C \text{ net})$</p> <p>In the formula, W is the moisture coefficient, P is the average annual rainfall (10-3 m), I is the plant canopy interception (10-3 m), V is the plant interception rate (%), and Gv is the condensation water (mm), G is the ratio of condensed water to precipitation (%); U culvert is the value of annual water conservation (yuan/a), W is the average water conservation, C capacity is the unit storage cost (yuan/m³), and C is net water Purification cost (yuan/m³)</p>
Soil protection	<p>$S \text{ soil fixation}=G \text{ soil fixation}/\rho h$; $U \text{ soil fixation}=G \text{ soil fixation}/\rho h \times C \text{ excavation}=A(X2-X1)/\rho h \times C \text{ soil} \times P \text{ forest}$</p> <p>In the formula, S soil fixation is the annual reduction of land loss area, U soil fixation is the annual soil fixation value of the forest stand (yuan/a), G soil fixation is the annual soil fixation amount of vegetation (t/a), and ρ is the soil bulk density of the forest land (t/m³), h is the average thickness of cultivated soil (m), C soil is the cost of digging and transporting the earth (yuan/m³), X1 and X2 are respectively the soil erosion modulus of forest land and non-forest land, and P forest is Normal income per unit area of forest land (yuan/hm²·a)</p> <p>G nitrogen = ANB year; G phosphorus = APB year; G potassium = AKB year; U fertilizer = G soil consolidation (NC1/R1+PC1/R2+KC2/R3+ MC3)</p> <p>In the formula, G nitrogen, G phosphorus, and G potassium are respectively the amount of fixed nitrogen, fixed phosphorus, and fixed potassium (t/a); U fertilizer is the accumulation value of tree nutrients (yuan/a); B year is broad-leaved forest Net productivity (t/hm²·a); N, P, K are the nitrogen content, phosphorus content, and potassium content of forest trees (%); R1, R2, C1 are nitrogen and phosphorus content of diammonium phosphate fertilizer, respectively Quantity (%) and price (yuan/t); R3 and C2 are the potassium content (%) and price (yuan/t) of potassium sulfate fertilizer respectively; M is the forest stand soil organic matter content (%)</p> <p>$Sd=24\%G \text{ soil consolidation}$; $Vd=24\%G \text{ soil consolidation} \times P \text{ library}$</p> <p>In the formula, Sd is to reduce the amount of sedimentation, Vd is the value of reducing the amount of sedimentation, P reservoir is the storage capacity cost, G soil fixation is the annual reduction of soil erosion of the forest stand</p>

Conserve water sources. The average value of the water balance method, the canopy interception method and the atmospheric condensation water conveyance method are used to estimate the water conservation.

Purify the environment. The substitution cost method is adopted, and the cost of other environmental pollution control measures is used to replace the value of the ecological system to purify the environment.

Part of the evaluation methods mainly refer to the evaluation formula (Table 2) in the "Standards for Evaluation of Forest Ecosystem Service Functions" (LY/T 1721-2008) such as Bai Yuan.

Table 2. Ecological value assessment formula

Carbon fixation and oxygen release	<p>G carbon sequestration by vegetation = 1.63R carbon×A×B years; G soil carbon sequestration=A×F soil; U carbon=A×(1.63R carbon×B years+F soil)×C carbon=(G vegetation carbon sequestration + G soil carbon sequestration) × C carbon</p> <p>G oxygen = 1.19AB year; U oxygen = 1.19C oxygen AB year</p> <p>In the formula, G vegetation carbon fixation, G soil carbon fixation, and G oxygen are the annual vegetation carbon fixation, soil annual carbon fixation, and annual oxygen release (t/a); U carbon and U oxygen are the annual forest stand fixation. Carbon and its release value (yuan/a); R carbon is the carbon content in CO₂, B year is the net productivity of the forest stand (t/hm²·a), F soil is the carbon sequestration per unit area of the forest stand soil (t/hm²·a), C carbon is the price of carbon fixation (yuan/t)</p>
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4. Valuation of Ecosystem Service Function in Alar City

According to the land survey data of Alar City in 2021, its natural ecosystem is divided into five categories: grassland, woodland, wetland, natural reserve, and water area. The total grassland area is 27121 hm², the forest land is 157091 hm², the wetland is 9000 hm².

However, the reserved area is 128120 hm² and the water area is 48710 hm².

4.1 The Value of Climate Regulation

Based on research at home and abroad, greening can reduce the temperature in some areas by 3-5 °C, with a maximum reduction of 20 °C, and about 10 °C in areas with buildings^[7].

The temperature adjustment effect of a large tree evaporating for a day and night is equal to 1046 KJ, which is equivalent to 10 air conditioners working for 20 hours. The power consumption of indoor air conditioners is 0.735 kWh/unit, and the electricity bill is 0.39 yuan/kWh, totaling 57.33 yuan. Taking 80 trees/hm² in woodland and using air conditioners for 60 days per year, the economic value of the climate regulation function of the ecosystem in Alar City is:

$$157091 \text{ (hm}^2\text{)} \times 80 \text{ (plants/hm}^2\text{)} \times 57.33 \text{ (yuan)} \times 60 \text{ (day)} = 4.32 \text{ million yuan}$$

4.2 The Value of Carbon Fixation and Oxygen Release

The city is a concentrated place, and the amount of O₂ absorption and CO₂ emissions are both large. On the one hand, human respiration, the burning of energy, and the reproduction of microorganisms all need to consume a large amount of O₂; on the other hand, the urban industry burns coal, oil and natural gas, the respiration of animals and plants, and the decomposition of microorganisms release a large amount of CO₂. Cities mainly rely on the photosynthesis and respiration of the original ecosystem to maintain the dynamic balance of carbon and oxygen in the atmosphere^[8].

If an adult consumes about 0.55 kg O₂ and releases 0.56 kg CO₂ every day, an urban resident can achieve a dynamic balance of O₂ and CO₂ with average woodland or grassland above. An average of 20 square meters of woodland or grass above 100 square meters can get a dynamic balance of carbon and oxygen.

4.2.1 The Fixed Value of CO₂

According to the query, each hectare of woodland absorbs 1,000 kg of CO₂ per day, and it is calculated that the forest land in Alar City absorbs 157091 tons of CO₂ per year; each hectare of grassland absorbs 0.6 kg of CO₂ per day, and it is calculated that the grassland of Alar City absorbs 16 tons of CO₂ per year.

According to the afforestation cost method, the total economic value of the fixed CO₂ of the ecosystem of Alar City is 303.24 million yuan per year, and the carbon tax method is estimated to be 151.4 million yuan, and the average value is 45.64 million yuan to represent the value of the fixed CO₂ of the ecosystem of Alar City.

4.2.2 The Release of O₂ Generates Value

According to the query, each hectare of forest land releases 730 kg O₂ per day. It is calculated that the forest

land in Alar City releases 114676 tons of O₂ per year; each hectare of grassland releases 0.9 kg O₂ per day, and it is calculated that the grassland in Alar City releases 24 tons of O₂ per year.

The value assessment was made according to the afforestation cost method and the carbon tax method, and the average value was 681.96 million yuan to represent the value of O₂ released by the ecosystem of Alar City.

Adding the value of the fixed CO₂ of the ecosystem and the value of the release of O₂, the total economic value of the ecosystem service of Alar City for carbon fixation and oxygen release is 1,136,600,000 yuan.

4.3 Conserve the Value of Soil

The protection of soil in natural ecosystems mainly achieves its economic value through four interconnected ecological processes, including reduction of topsoil loss, protection of soil fertility, reduction of sedimentation disasters, and reduction of wind-sand disasters.

4.3.1 Forest Land and Grassland Reduce the Total Amount of Soil Erosion Every Year

Potential soil erosion. Potential soil erosion refers to the maximum amount of soil erosion without any vegetation cover. The amount of soil erosion between forested and unforested land under different types of soil is very different. Therefore, a systematic comparison of the amount of erosion for different soil types should be carried out to estimate the potential amount of soil erosion. In this paper, referring to the calculation standard of Ouyang Zhiyun et al.^[9], the moderate erosion depth of soil without forest land is 15-35 (mm/a), and the erosion modulus^[10-12] is 150-350 m³/(hm²·a), respectively, the low limit of erosion modulus is 192 t/(hm²·a), the high limit is 447.7 t/(hm²·a) and the average value is 319.8 t/(hm²·a) to estimate (Table 3).

Annual soil erosion in woodland and grassland covered areas. The amount of soil erosion under different

Table 3. Annual potential soil erosion of woodland and grassland in Alar City

Erosion modulus	woodland		grassland		Total potential soil
m ³ /(hm ² ·a)	Area hm ²	Potential erosion amount 10 ⁷ t	Area hm ²	Potential erosion amount 10 ⁴ t	Erosion amount 10 ⁷ t
192	157091	1.67	27121	1.34	1.67
447.7		3.41		2.84	3.41
319.8		2.54		2.09	2.54

vegetations is different. The erosion modulus is 0.15 and 0.16 respectively. It is estimated that the average annual soil erosion amount of woodland and grassland in Alar City is 78174 t and 78177 t respectively, totaling 156351 t.

Annual reduction in soil erosion of woodland and grassland. According to the comparison estimation of the above-mentioned potential soil erosion amount and actual soil erosion amount of forest land and grassland, it can be obtained that the lowest soil loss of forest land and grassland in Alar City is reduced by 1.67 (10^7 t), the highest by 3.41 (10^7 t), and the lowest by 2.54 (10^7 t) each year.

4.3.2 Estimation of Loss of Forest Land and Grassland due to Reduced Soil Erosion

The consequences of soil erosion mainly include the reduction of arable land, loss of soil fertility (nutrients), and sedimentation of rivers and lakes. Woodland and grassland reduce the loss of soil erosion by conserving the soil.

Woodland and grassland reduce the area of land loss and its indirect value every year. Calculate the amount of land area reduction based on the amount of soil erosion and the average thickness of the soil tillage layer. The average thickness of cultivated soil in my country is 0.15 m as the soil layer thickness of woodland and grassland. If the average annual soil conservation amount of forests and grassland in Alar City is calculated by 2.54 (10^7 t) soil density of 113 g/cm³, it is possible to maintain soil every year. The area is 3894501 (hm²).

The opportunity cost of land is used to estimate the economic value of forest and grassland reduction. In 2020, the average income of forestry and animal husbandry production will be 208,100 yuan and 167,000 yuan, respectively. Using the opportunity cost of production for woodland and grassland, the economic value of the annual reduction of land waste area of forest and grassland is estimated to be 301,000 yuan.

Reduce the indirect value of soil fertility loss. Soil erosion takes away a lot of soil nutrients, mainly soil organic matter, nitrogen, phosphorus and potassium. The contents of organic matter, total nitrogen, total phosphorus and total potassium in different soils are quite different. According to the average value of the organic matter and total nitrogen, total phosphorus and total potassium content of main woodland soil and grassland soil, and the annual reduction of soil erosion of woodland and grassland, the least reduction of organic matter loss and nitrogen and phosphorus of woodland and grassland each year Estimation of the loss of elements such as potassium, potassium, etc. [13-15], with the average price of chemical

fertilizers in my country at 2,341 yuan/t, the economic value of the loss of the ecosystem due to the reduction of soil nitrogen, phosphorus and potassium can be estimated every year, calculated as Alar City The indirect value of the ecosystem to reduce the loss of soil fertility is about 156,000 yuan.

Reduce the economic value of sedimentation. According to the law of sediment movement in major river basins in my country, 24% of the sediment lost by soil erosion generally accumulates in reservoirs, rivers, and lakes. This part of the sediment directly caused the decline in the storage capacity of reservoirs, rivers, and lakes, and increased to a certain extent. As a result of droughts and floods, another 33% stayed and 37% entered the sea. This article only considers 24% of the siltation in reservoirs, rivers and lakes, that is, the economic value of reducing 39.14 million tons of sedimentation every year.

The silt lost by soil erosion is deposited in reservoirs, rivers, and lakes, which reduces the accumulation of effective surface water. Therefore, the value of the loss can be calculated based on the cost of water storage. The annual reduction of sediment from woodland and grassland in Alar City is equivalent to a storage capacity of 4112×106 m³. According to related research, the cost of a reservoir with a storage capacity of 1 m³ in my country is 0.218 yuan. Therefore, the economic value of the annual reduction of sediment deposition in my country's woodland and grassland is 860,000 yuan. Based on the above analysis, the total economic value of soil maintained by the terrestrial ecosystem of Alar City, dominated by woodland and grassland, is 14.04 million yuan each year.

4.4 The Value of Water Conservation

Vegetation has a large amount of live ground cover and a humus layer formed by accumulating a large amount of litter, which can maintain and conserve a large amount of water, and can increase the speed of water infiltration into the soil layer. At the same time, vegetation plays a role in redistribution of vertical precipitation, thereby changing the distribution, flow and velocity of precipitation, and preventing precipitation from producing a large amount of surface runoff. The land covered by vegetation infiltrates quickly and takes a long time, so the infiltration volume is more than that of bare land, and the flow rate is smaller than that of bare land. Vegetated land receives more rainwater than bare land, and soil water storage capacity is naturally greater.

When evaluating the functional value of water conservation, domestic scholars Yang Liwen, et al. [16], Qin Shan [17], and Yu Xinxiao [18] mostly used the water

balance method to estimate water conservation, and the runoff coefficient (h) was 0.44, 0.35, and 0.4, respectively. In view of the natural conditions of dry climate, low rainfall and strong evaporation in the study area, when evaluating the function value of water conservation, this paper mainly adopts the average value of the water balance method and the canopy interception method and the atmospheric condensation water transfer method to estimate the water conservation. The runoff coefficient (h) is 0.3, the interception rate (V) is 28.92%, and the ratio (G) of the condensed water of the desert ecosystem to the annual precipitation is 17.5%, which is more in line with local actual conditions. Through calculation, the value of total water conserved in the urban ecosystem of Alar City is 8.62 million yuan.

4.5 The Value of Purifying the Environment

The role of green plants in purifying the atmosphere has two main aspects. One is to absorb CO₂, release O₂, etc., to maintain the balance of the chemical composition of the atmosphere; the other is to reduce sulfide, nitrogen, and sulfide in the air through absorption within the plant resistance range. The content of harmful substances such as halogens.

4.5.1 The Value of Absorbing SO₂

According to the inquiry, the absorption capacity of SO₂ per hectare of forest land is 8165 kg. It is calculated that the forest land in Alar City absorbs 1282648 tons of SO₂ per year. Based on the cost of SO₂ treatment of 3,000 yuan per ton, if there is no SO₂ absorption by forest land, the cost of eliminating SO₂ is 38.47 million yuan.

4.5.2 The Value of NO_x Absorption

At present, the cost of denitrification treatment of automobile exhaust is 1.16 million yuan per ton. One hectare of forest land can absorb 2,380 kg of nitrogen oxides a year, and it can be calculated that the functional value of nitrogen oxides absorbed by existing forest land in Alar City is 101.6 million yuan.

Therefore, the total economic value of ecological services in Alar City to purify the environment is 140.07 million yuan.

4.6 Total Value of Ecosystem Service Functions

This study combines the physical geography and socio-economic conditions of Alar City, and uses the method of ecological economics to initially calculate the economic value of some ecological service functions of the ecosystem in Alar City (Table 4). The results show that the total economic value of the ecosystem service function of Alar City is 1.3365 million yuan. From this incomplete estimate, it can be found that the ecological service function of the ecosystem of Alar City has huge ecological and economic benefits.

From the above calculation results, it can be seen that the total value of the ecosystem service function in Alar City in 2021 is as follows: carbon fixation and oxygen release, environmental purification, soil conservation, water conservation, and climate regulation.

5. Conclusions

Comprehensive consideration of the ecosystem service function of the ecological environment of Alar City has huge ecological benefits. Its urban environment is prominent in the ecosystem service functions of soil protection, climate regulation, and water conservation, which can reduce soil erosion, inhibit land salinization and desertification, improve local climate, and alleviate water shortages. It plays a vital role. From a long-term perspective, it will not only alleviate the fragile ecological environment of the study area, but also improve the local economic benefits.

In the area structure of grassland, wetland, woodland, natural reserve and water area, although the area of wetland is the smallest, the value of ecological service function is second only to grassland. Due to the large area of natural reserve, its indirect service value is still inferior to grassland, woodland and wetland. Through research, it is found that the effective use of ecosystem service function value is not only related to the distribution area, but also has an important relationship with the material quality and value equivalent of the protection of the ecological environment. This requires full consideration of the actual nature of the research area in the process of measuring the ecological value. Environmental conditions to improve the accuracy of the measurement results.

Table 4. The total value of ecosystem services in Alar City

Function type	Regulate the climate	Carbon fixation and oxygen release	Conserve the soil	Conserve water	Purify the environment
Total value (ten thousand yuan)	432	113660	1404	862	14007

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