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Research on ecological compensation in Anhui Province of China based on ecological footprint and ecosystem service value

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Abstract: *As an "ecological barrier", Anhui Province of China plays an important ecological role in the construction of ecological integration in the Yangtze River Delta. Taking Anhui Province of China as the research object, this paper quantitatively analyzes the status of various ecosystems, analyzes the factors affecting the balanced development of ecology and economy, and provides a basis for Anhui Province to coordinate local interests and protect the ecological environment. Specific results: (1) In 2019, the total value of ecosystem services in Anhui Province was 509.287 billion yuan. Water area, forest and grassland are the key ecosystems to be protected. (2) In 2019, the total ecological footprint of Anhui Province far exceeded the total ecological carrying capacity, and the ecological environment was in an unsustainable state of development. (3) The ecological overload index of Anhui Province in 2019 was - 7.85, which was a serious overload. The amount of ecological compensation payable was about 2302.436 billion yuan.*

Keywords: *Ecological footprint; Ecological carrying capacity; Ecosystem service value; Ecological compensation; sustainable development*

1. Introduction

The essence of "ecological compensation" is to compensate for the value of ecosystem services. It is the payment compensation behavior of the beneficiaries of ecosystem services to the providers. The fundamental purpose is to coordinate the interests of environmental protection subjects, balance the relationship between environmental protection and economic development among regions through economic compensation, and maintain and improve the ecosystem.

With the gradual promotion of the national strategy of regional integration in the Yangtze River Delta, Anhui Province of China will usher in major development opportunities, but its ecological security will face serious challenges while promoting high-quality development. What is the difference between the supply and demand of ecosystem services in Anhui Province? Does the ecological footprint exceed the ecological carrying capacity? Is ecological development sustainable? How to achieve sustainability in the future? In view of the above problems, the article analyzes and calculates the ecosystem service value, ecological carrying capacity, ecological footprint, and ecological security status of Anhui Province, providing reference for the improvement of the ecological compensation mechanism in Anhui Province, and has practical significance to ensure that Anhui Province plays a green barrier role in the construction of ecological integration in the Yangtze River Delta.

2. Overview and data sources of the study area

2.1. Overview of the research area

The geographical location of Anhui Province in China has the unique characteristics of connecting the east to the west and connecting the south to the north. It is the place of "Wu Tou Chu Wei" and the hinterland of the Yangtze River Delta. It is part of the national strategy of regional integration in the Yangtze River Delta. Anhui has a temperate and subtropical monsoon climate. The annual average temperature is about 14-17 ℃, and the annual average precipitation is about 773-1670 mm. Chaohu Lake has the largest area among more than 500 lakes in the province and is an important ecological function area.

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2.2. Data sources

Ecosystem service value accounting: the area of each ecological type is derived from the 2020 China Statistical Yearbook; The grain output and area are derived from the 2020 China Statistical Yearbook and Anhui Statistical Yearbook; The grain price data is from the National Development and Reform Commission Price Monitoring Center.

The calculation of ecological footprint account includes biological resource footprint and energy resource footprint. The population data is from Anhui Statistical Yearbook in 2020; The per capita consumption of some biological resources comes from the 2020 China Statistical Yearbook, and the consumption of other resources comes from the Ministry of Agriculture and Rural Affairs - import and export trade of key agricultural products; The output and area of various biological resources come from the 2020 Anhui Statistical Yearbook and the forestry professional knowledge service system; The per capita consumption of raw coal, gasoline and other raw materials is derived from the Anhui Statistical Yearbook in 2020.

Ecological carrying capacity data: all types of land areas are derived from the 2020 China Statistical Yearbook and China Agricultural and Rural Statistical Abstract.

The Engel coefficient of rural and urban areas and the urbanization rate of Anhui are from the 2020 Anhui Statistical Yearbook; The energy and resource footprint conversion coefficient uses the research results of Wackemagel and other researchers in 1999, which are widely recognized at home and abroad.

3. Research method

3.1. Accounting method of ecosystem service value

Refer to the value equivalent table of ecosystem services per unit area in 2015 by Xie Gaodi and others[1]. It is adjusted by localization as shown in Table 1.

Table 1: equivalent factors of ecosystem service value in Anhui Province

Ecosystem classification		Supply services			Regulation service				Support Services		Cultural services	
Primary classification	Secondary classification	Food production	Production of material	Water supply	Gas conditioning	Climate regulation	Clean the situation	Hydrological regulation	Soil conservation	Maintain nutrient cycle	Bio diversity	Aesthetic landscape
Farmland	Dry land	0.85	0.40	0.02	0.67	0.36	0.10	0.27	1.03	0.12	0.13	0.06
	Paddy field	1.36	0.09	-2.63	1.11	0.57	0.17	2.72	0.01	0.19	0.21	0.09
Forest	Coniferous forest	0.22	0.52	0.27	1.70	5.07	1.49	3.34	2.06	0.16	1.88	0.82
	Broadleaved forest	0.29	0.66	0.34	2.17	6.50	1.93	4.74	2.65	0.20	2.41	1.06
	Shrubwood	0.19	0.43	0.22	1.41	4.23	1.28	3.35	1.72	0.13	1.57	0.69
Grassland	Grassland	0.10	0.14	0.08	0.51	1.34	0.44	0.98	0.62	0.05	0.56	0.25
	Other grassland	0.30	0.445	0.245	1.555	4.115	1.36	3.015	1.895	0.145	1.725	0.76
Wetland	Wetland	0.51	0.50	2.59	1.90	3.60	3.60	24.23	2.31	0.18	7.87	4.73
Desert	Land used for building	0.00	0.00	0.00	0.02	0.00	0.10	0.03	0.02	0.00	0.02	0.01
Waters	Waters	0.80	0.23	8.29	0.77	2.29	5.55	102.24	0.93	0.07	2.55	1.89
Garden plot	Garden plot	0.58	0.42	-0.36	1.41	3.35	0.99	2.88	1.49	0.16	1.24	0.54

3.1.1. Value coefficient of ecosystem services

The unit area value of ecosystem services refers to the economic value generated by the natural grain output of 1 hectare of farmland each year[2]. At the same time, the research shows that the value of the original ecological services provided by the natural ecosystem without artificial inputs is one-seventh of the market value of food production provided by the unit area of farmland with artificial inputs[3]. Therefore, the formula is:

$$Ea = \frac{1}{7}\sum_{i=1}^{n}\frac{m_i \times p_i \times q_i}{M}$$

Where, Ea values per unit area serving the ecosystem; n values 3 represents the type of grain. The article selects wheat, rice and corn; i is the selected grain type; m_i is the regional planting area of grain; p_i is the average price of the first grain in the country; q_i is the yield per unit area of grain; M is the total planting area of grain.

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The value per unit area is calculated according to the formula, and the results are shown in Table 2.

Table 2: Value per unit area of ecosystem services in Anhui Province

Grain type	Seeded area(ha)	Total output(t)	Yield per unit(kg/ha)	Average price(yuan/kg)	Market value of grain output per unit of farmland(yuan/ha)	Economic value of grain output per unit of farmland(yuan/ha)
Unhusked rice	2509040	16300100	6496.55	2.70	15778.42	2254.06
Wheat	2835600	16568900	5843.17	2.44		
Corn	1196450	6427900	5372.48	2.92		

In 2019, the unit area value of ecosystem services in Anhui Province was 2254.06 yuan/ha. Based on this, the value coefficient of ecosystem services can be obtained, as shown in Table 3.

Table 3: Ecosystem service value per unit area in Anhui Province

Ecosystem classification		Supply services				Regulation service			Support Services			Cultural services
Primary classification	Secondary classification	Food production	Production of material	Water supply	Gas conditioning	Climate regulation	Clean the situation	Hydrological regulation	Soil conservation	Maintain nutrient cycle	Bio diversity	Aesthetic landscape
Farmland	Dry land	1915.95	901.62	45.08	1510.22	811.46	225.41	608.60	2321.68	270.49	293.03	135.24
	Paddy field	3065.52	202.87	-5928.18	2502.01	1284.81	383.19	6131.04	22.54	428.27	473.35	202.87
Forest	Coniferous forest	495.89	1172.11	608.60	3831.90	11428.08	3358.55	7528.56	4643.36	360.65	4237.63	1848.33
	Broad-leaved forest	653.68	1487.68	766.38	4891.31	14651.39	4350.34	10684.24	5973.26	450.81	5432.28	2389.30
	Shrubwood	428.27	969.25	495.89	3178.22	9534.67	2885.20	7551.10	3876.98	293.03	3538.87	1555.30
Grassland	Grassland	225.41	315.57	180.32	1149.57	3020.44	991.79	2208.98	1397.52	112.70	1262.27	563.52
	Other grassland	676.22	1003.06	552.24	3505.06	9275.46	3065.52	6795.99	4271.44	326.84	3888.25	1713.09
Wetland	Wetland	1149.57	1127.03	5838.02	4282.71	8114.62	8114.62	54615.87	5206.88	405.73	17739.45	10661.70
Desert	Land used for building	0.00	0.00	0.00	45.08	0.00	225.41	67.62	45.08	0.00	45.08	0.01
Waters	Waters	1803.25	518.43	18686.16	1735.63	5161.80	12510.03	230455.10	2096.28	157.78	5747.85	1.89
Garden plot	Garden plot	1307.35	946.71	-811.46	3178.22	7551.10	2231.52	2.88	1.49	0.16	1.24	0.54

3.1.2. Calculation of ecosystem service value

The calculation formula of ecosystem service value is[4]:

$$Ae_{ij} = e_{ij} \times Ea \times A_j$$

Where, Ae_{ij} is the total value of the ith ecological service function of the jth ecosystem, billion yuan; e_{ij} is the equivalent factor of ecosystem service function of ecosystem j and ecosystem i; I is the type of ecological service function; J is the type of ecosystem; A_j is the area of ecosystem type j.

3.2. Ecological footprint accounting

3.2.1. Ecological footprint of biological resources

To calculate the footprint of biological resources, consumption items should be divided first. According to the actual resources of Anhui Province, the consumption items are divided into Table 4:

Table 4: Consumption items of biological resources in Anhui Province

Bioproductive land type	Throughput	Consumption items
Cultivated land	Provide agricultural products	grain (raw grain), wheat, corn, soybean, oil, cotton, vegetables, pork, poultry, eggs
Woodland	Provide forest products	tea, fruit, camellia oleifera seeds, dried bamboo shoots, wood
Grassland	Provide livestock products	beef, mutton, milk, honey
Waters	Provide aquatic products	aquatic product

The calculation formula of ecological footprint of biological resources is:

$$EF = N \times ef = N \times \sum r_i \times \left(c_i / p_i\right)$$

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Where, EF is the total footprint of biological resources, hectares; ef is the per capita ecological footprint, ha/person; N is the total population, people; i indicates the category of consumption items; p_i is the average production capacity of the consumption item, kg/ha; c_i is the per capita consumption of consumption item, kg/person; r_i is the equilibrium factor. The equilibrium factor refers to the research results of Liu Sucheng and other scholars[5] namely, 1.15 cultivated land, 0.87 forest land, 0.48 pasture land, 0.38 water area and 1.15 construction land.

3.2.2. Ecological footprint of energy resources

The accounting of ecological footprint of energy resources can be classified into fossil energy land and construction land. See Table 5 for consumption items:

Table 5: Energy and resource consumption projects in Anhui Province

Bioproductive land type	Throughput	Consumption items
Land for fossil energy	Absorb carbon dioxide released by fossil energy combustion	Raw coal, coke, crude oil, fuel oil, gasoline, diesel
Land used for building	Provision of infrastructure	Power

The calculation formula of ecological footprint of energy resources is:

$$EF = N \times ef = N \times \frac{t \times r}{E \times N}$$

Where, EF is the total footprint of energy resources, hectares; ef is the per capita ecological footprint, ha/person; N is the total population, people; t is the regional energy consumption; r is the energy conversion coefficient; E is the global average energy footprint, joules per hectare, of which the global average energy footprint and conversion coefficient[6] are shown in Table 6.

Table 6: Global average energy footprint and conversion factor

Bioproductive land type	Type of energy	Global average energy footprint(GJ/hm²)	Conversion factor(GJ/t)
Land for fossil energy	Raw coal	55	20.934
	Coke	55	28.474
	Crude oil	71	41.868
	Fuel oil	71	50.2
	Gasoline	71	43.124
	Diesel oil	71	42.705
Land used for building	Power	1000	36

Note: The unit of power conversion coefficient is GJ/10^4kwh

3.3. Ecological carrying capacity accounting

The ecological carrying capacity represents the supply capacity of the ecological environment. The calculation formula of ecological carrying capacity is:

$$EC = N \times ec = N \times \sum (y_j \times r_j \times a_j)$$

Where, EC is the total ecological carrying capacity,hectare; N is the total population, people; ec is the per capita ecological carrying capacity,Hectare/person; y_j is the yield factor; r_j is the equilibrium factor; a_j is the per capita land area,Hectare/person. Among them, the yield factors refer to the research results of Liu Mocheng and others[7], namely cultivated land 1.02, forest land 0.95, grassland 1.68, water area 1.68, and construction land 1.02. In addition, 12% of the reserved area of biodiversity needs to be deducted from the ecological carrying capacity accounting, that is, the final ecological carrying capacity of the region is 88% EC.

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3.4. Quantitative model of ecological compensation

3.4.1. Determination of obtaining or paying ecological compensation

The judgment formula for the region to obtain or pay ecological compensation is:

$$I = EC - EF$$

In the formula, I means to obtain or pay ecological compensation; EF is the total ecological footprint; EC is the total ecological carrying capacity. In theory, when $EC > EF$, it is expressed as an ecological surplus state, it should receive ecological compensation; When $EC < EF$, it is indicated as ecological deficit, ecological compensation shall be paid; When $EC = EF$, it means ecological balance, and the region neither pays nor receives compensation.

3.4.2. Ecological overload index

The ecological overload index reflects the relationship between regional resource supply and demand[8]. The specific formula is:

$$EFI = \frac{EC - EF}{EC}$$

When $EFI > 0$, it means that the regional resources are in good use and there is an ecological surplus; When $EFI < 0$, it means that the regional resources are overused and the ecological overload is serious; When $EFI = 0$, it means that the utilization and supply of regional resources are balanced and the ecological environment is good.

3.4.3. Ecological compensation correction coefficient

The ecological compensation coefficient needs to be revised[9]. The specific formula is:

$$l = \frac{1}{1 + e^{-(\frac{1}{En} - 3)}}$$

$$En = Ec \times \theta + Ex \times (1 - \theta)$$

Where, l represents the ecological compensation correction coefficient; En represents the urban and rural comprehensive Engel coefficient, e is a constant; Ex is the rural Engel coefficient; Ec is the Engel coefficient of cities and towns, and θ is the level of urbanization.

3.4.4. Calculation of ecological compensation

The specific formula of ecological compensation is:

$$Aec = Ae \times EFI \times l = Ae \times \frac{EC - EF}{EC} \times l$$

Where, Aec represents the amount of ecological compensation to be paid or obtained, in hundred million yuan; Ae is the total value of ecosystem services, billion yuan; EFI is the ecological overload index; l is the ecological compensation correction coefficient; EC is the ecological carrying capacity; EF is ecological footprint.

4. Research results and analysis

4.1. Ecosystem service value

The value of various ecosystem services is shown in Table 7 below.

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Table 7: Total value of ecosystem services in Anhui Province in 2019

Primary function	Secondary function	Farmland	Forest	Grassland	Wetland	Desert	Waters	Garden plot	Subtotal	Total
Supply services	Food production	162.99	19.49	11.24	4.27	0.00	12.09	4.53	214.61	225.75
	Production of material	22.15	44.97	16.68	4.18	0.00	3.48	3.28	94.74	
	Water supply	-260.18	23.22	9.18	21.66	0.00	125.33	-2.81	-83.60	
Regulation service	Gas conditioning	132.24	147.47	58.28	15.89	0.91	11.64	11.01	377.44	3937.59
	Climate regulation	68.43	441.07	154.24	30.11	0.00	34.62	26.16	754.63	
	Clean the situation	20.17	130.79	50.98	30.11	4.54	83.90	7.73	328.22	
	Hydrological regulation	278.70	313.40	113.01	202.68	1.36	1545.66	22.49	2477.30	
Support Services	Soil conservation	35.04	179.52	71.03	19.32	0.91	14.06	11.64	331.52	745.62
	Maintain nutrient cycle	22.81	13.71	5.43	1.51	0.00	1.06	1.25	45.77	
	Bio diversity	25.13	163.57	64.66	65.83	0.91	38.55	9.68	368.33	
Cultural services	Aesthetic landscape	10.91	71.70	28.49	39.57	0.45	28.57	4.22	183.91	183.91
Total		518.39	1548.91	583.22	435.13	9.08	1898.96	99.18	5092.87	5092.87

4.1.1. Value of different ecosystems

The total value of ecosystem services in Anhui Province in 2019 was about 509.287 billion yuan. The value contribution of ecosystem services is mainly water, forest, grassland and wetland.

4.1.2. Value of different ecological service functions

The regulation service function plays an important role in the ecosystem service function. However, the value proportion of the four major ecological service functions is slightly unbalanced. In the future, we should pay attention to improving the value of support, supply and cultural service functions. In addition, the market value accounts for 4.43% of the total value, while the non-market value accounts for 95.57% of the total value. Since then, the ecological strategy formulated by Anhui Province cannot be too market-oriented, and the overall situation of the ecosystem must be considered.

4.1.3. Value of various ecosystems and different ecological services

Regulation service is the primary service function of the ecosystem. Hydrology, climate and gas regulation are also the main functions of each ecosystem in addition to its own value. It again shows that water, forest, grassland and wetland are ecosystems that need to be protected.

4.2. Ecological footprint and ecological carrying capacity

4.2.1. Ecological Footprint Analysis

4.2.1.1. Ecological footprint of biological resources

The accounting process of biological resource footprint is shown in Table 8 below:

Table 8: Ecological footprint of biological resources in Anhui Province in 2019

Consumption items	Total consumption (t)	Total production (t)	Per capita consumption (kg)	Average production (kg/hm^2)	Equilibrium factor	Per capita ecologicl footprint (hm^2)	Total ecological footprint (hm^2)	Land type
Foodstuff	9377118	40540000	147.3	5563.33	1.15	0.0304	1935264	Cultivated land
Wheat	16598557	16568900	260.74	5843.17	1.15	0.0513	3265758	Cultivated land
Corn	6507934	6427900	102.23	5372.48	1.15	0.0219	1394154	Cultivated land
Soybean	987774	957200	15.52	1504.46	1.15	0.0119	757554	Cultivated land
Oil	1714915	1613800	26.94	3055.57	1.15	0.0101	642966	Cultivated land
Cotton	73796	55500	1.16	920.40	1.15	0.0014	89124	Cultivated land
Vegetables	22065254	22136100	346.61	32423.40	1.15	0.0123	783018	Cultivated land

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Pork	1311396	1977976	20.6	337.15	1.15	0.0703	4475298	Cultivated land
Poultry	935802	1745945	14.7	297.60	1.15	0.0568	3615888	Cultivated land
Eggs	795750	1687029	12.5	287.56	1.15	0.050	3183000	Cultivated land
Subtotal						0.3164	20142024	
Beef	146418	94879	2.3	189758	0.48	0.0582[a]	370.50	Grassland
Mutton	57294	188275	0.9	376550	0.48	0.0115[b]	73.21	Grassland
Milk	763920	337551	12	675102	0.48	0.0853[c]	543.02	Grassland
Honey	17924	17924	0.28	35848	0.48	0.0375[d]	238.73	Grassland
Subtotal						0.1925[e]	1225.46	
Tea	61980	121980	0.97	652.10	0.87	0.0013	82758	Woodland
Fruits	3409286	3503738	53.55	21861.61	0.87	0.0021	133686	Woodland
Camellia oleifera seeds	94096	94096	1.48	640	0.87	0.0020	127320	Woodland
Dried bamboo shoots	41228	41228	0.65	106.26	0.87	0.0053	337398	Woodland
Wood	509.7[1]	509.7[2]	0.08[3]	2.72[4]	0.87	0.0256	1629696	Woodland
Subtotal						0.0363	2310858	
aquatic product	967632	2314603	15.2	4792.12	0.38	0.0012	76392	Waters
Subtotal						0.0012	76392	
Total							22530499.46	

Note: The unit of 1 and 2 in the table is ten thousand cubic meter, the unit of 3 is cubic meter, and the unit of 4 is cubic meter/hectare; The units of a, b, c, d and e are 10^{-4} hectare.

4.2.1.2. Ecological footprint of energy resources

The accounting process of energy resource footprint is shown in Table 9 below:

Table 9: ecological footprint of energy resources in Anhui Province in 2019

Consumption items	Global average energy footprint (GJ/hm^2)	Conversion factor(GJ/t)	Total regional population	Energy consumption(t)	Per capita ecological footprint (hm^2)	Total ecological footprint(hm^2)	Land type
Raw coal	55	20.934	63660000	183303000	1.0960	69771360	Land for fossil energy
Coke	55	28.474	63660000	11607000	0.0944	6009504	
Crude oil	71	41.868	63660000	6606500	0.0612	3895992	
Fuel oil	71	50.2	63660000	219000	0.0024	152784	
Gasoline	71	43.124	63660000	6570000	0.0627	3991482	
Diesel oil	71	42.705	63660000	6898500	0.0652	4150632	
Subtotal					1.3819	87971754	
Power	1000	36[1]	63660000	22995000[2]	0.0130	827580	land used for building
Subtotal					0.0130	827580	
Total						88799334	

Note: In the table, the unit of conversion coefficient of 1 is $GJ/10^4 kwh$, and the unit of consumption of 2 is $10^4 kwh$.

4.2.2. Analysis of ecological carrying capacity

The results of ecological carrying capacity are shown in Table 10 below:

Table 10: ecological carrying capacity of Anhui Province in 2019

Land type	the measure of area (hm^2)	Per capita area(hm^2)	Equilibrium factor	Yield factor	Per capita ecological carrying capacity(hm^2)	Actual per capita ecological carrying capacity(hm^2)
Cultivated land	5866800	0.0922	1.15	1.02	0.1082	0.0952
Woodland	4493300	0.0706	0.87	0.95	0.0584	0.0514
Grassland	500	0.0785[1]	0.48	1.68	0.0633[2]	0.0557[3]
Waters	483002	0.0076	0.38	1.68	0.0049	0.0043
Land used for building	2014900	0.0317	1.15	1.02	0.0372	0.0327
Land for fossil energy	0	0	0.87	0	0	0
Total					0.2087	0.1836

Note: The units of 1, 2 and 3 in the table are 10^{-4} hectare.

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4.2.3. Analysis of ecological surplus and ecological deficit

The ecological development status is shown in Table 11:

Table 11: Summary of ecological footprint of Anhui Province in 2019

Land type	Per capita ecological footprint(hm^2)	Per capita ecological carrying capacity(hm^2)	Per capita ecological surplus/deficit(hm^2)	Ecological state
Cultivated land	0.3164	0.0952	-0.2212	Ecological deficit
Woodland	0.0363	0.0514	0.0151	Ecological surplus
Grassland	0.1925[1]	0.0557[2]	-0.1368[3]	Ecological deficit
Waters	0.0012	0.0043	0.0031	Ecological surplus
Land used for building	0.0130	0.0327	0.0197	Ecological surplus
Land for fossil energy	1.3819	0	-1.3819	Ecological deficit
Anhui as a whole	1.7488	0.1836	-1.5652	Ecological deficit

Note: The unit of data 1, 2 and 3 in the table is 10^{-4} hectare.

4.3. Analysis of ecological compensation results

The ecological compensation amount of Anhui Province in 2019 is summarized in Table 12 below.

Table 12: Ecological compensation in Anhui Province in 2019

Index	Total value of ecosystem services (million yuan)	Total ecological footprint(hectare)	Total ecological carrying capacity(hectare)	Ecological overload index	Compensation correction factor	Ecological state	Compensation status	Total compensation (million yuan)
Total	5092.87	111329833.5	11687976	-8.53	0.53	Ecological deficit	payment	-23024.3560

5. Conclusion

a) The ecological value of water, forest and grassland in Anhui Province is higher than that of farmland, which is an ecosystem that needs to be protected. However, mountains, rivers, forests, fields, lakes and grasses are ecological communities, which should be protected as a whole. Therefore, the ecological governance work should implement the project of "returning farmland to forests and lakes" at the bottom of the farmland ecological red line, and select the priority ecosystem to be protected under the guidance of the Yangtze River Delta ecological integration policy, so as to achieve a virtuous cycle of ecology.

b) The value of ecosystem services in Anhui Province is mainly non-market value. Therefore, when formulating the ecological development strategy in Anhui Province, we should not be too market-oriented, and must comprehensively consider the overall situation of the ecosystem to avoid the destruction and degradation of the ecological environment.

c) Anhui Province is in ecological deficit. The deficit of fossil energy land is the most serious, followed by arable land and grassland, and the remaining land is in ecological surplus. In the future ecological management, it is necessary to reasonably plan the use of fossil energy land and arable land to achieve the balance of various ecosystems.

d) The ecological overload index of Anhui Province in 2019 was -7.85, which was a serious overload situation. The supply and demand of resources in the province were seriously unbalanced, and the external output of negative environmental benefits should pay ecological compensation, with the compensation amount of 2302.4356 billion yuan.

6. Discussion

a) In 2019, the ecological environment of Anhui Province was in an overloaded state, which was mainly related to the short release time of relevant policies, and the policy effect was not reflected for the time being. For example, the integration of the Yangtze River Delta rose to the national strategy in

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2018, and the ecological integration demonstration zone was established in May 2019, with the aim of realizing the ecological integration of the Yangtze River Delta. Each province is in the exploration stage of ecological construction. At the same time, the data used in the article is in 2019. The effect of relevant environmental protection policies and measures cannot be immediate. In the future, it is also necessary to adhere to regional ecological policies, adjust industrial structure, reverse the ecological deficit, and finally achieve ecological sustainable development.

b) In 2019, the fossil energy land and cultivated land in Anhui Province were both ecological deficit, which was the key factor affecting the determination of ecological compensation. Fossil energy is mainly caused by unreasonable energy consumption structure and excessive reliance on coal, gasoline, oil and other polluting energy. The cultivated land is caused by urbanization construction and extensive operations such as pesticides and fertilizers. Therefore, it is necessary to adjust the ecological status of fossil energy land and cultivated land, realize the ecological surplus of both, and improve the overall ecological benefits.

c) Anhui Province will pay a large amount of ecological compensation in 2019, so it is necessary to establish a reasonable and effective ecological compensation system. First, strengthen the publicity of environmental protection throughout the province to improve the ecological protection awareness of residents throughout the province; Secondly, formulate supporting ecological compensation laws and regulations to provide institutional guarantee for ecological compensation; Establish the ecological compensation leading group again to encourage local governments to do well in ecological construction by means of rewards or punishment; Finally, the amount of ecological compensation funds is large, and the government needs to carry out diversified financing to ensure the implementation of the funds.

References

[1] Xie Gaodi, Zhang Caixia, Zhang Leiming, Chen Wenhui, Li Shimei. (2015).Improvement of ecosystem service valuation method based on unit area value equivalent factor [J]. Journal of Natural Resources, 30 (08): 1243-1254.

[2] Xie Gaodi, Zhang Caixia, Zhang Changshun, Xiao Yu, Lu Chunxia.(2015). The value of ecosystem services in China [J]. Resource Science, 37 (09): 1740-1746.

[3] Huang Muyi, Fang Bin, Yue Wenze, Feng Shaoru. (2019). Geographic exploration of the spatial differentiation mechanism of ecological service value in the Chaohu Lake basin in the past 20 years [J]. Geographic Research, 38 (11): 2790-2803.

[4] Liu Pingyang. (2010).Comparative analysis of ecological compensation mechanisms between developed and developing countries [J]. Resources and Environment in Arid Areas, 9 (24): 2-5.

[5] MATTHEWS R. (2006).The People and Landscape Model(PALM):Towards full integration of human decision- making and biophysical simulation models.Ecological Modelling,94:329-343.

[6] Liu Mocheng, Li Wenhua. (2010).Estimation of ecological footprint balance factors across China based on net primary productivity [J] Journal of Ecology and Rural Environment, 26 (05): 401-406

[7] Wackemagel M.(1999). Why sustainability analyses must include biophysical assessments [J]. Ecological Economics, 29:12-15.

[8] Liu Mocheng, Li Wenhua, Xie Gaodi.(2010). Estimation of China's ecological footprint yield factor based on net primary productivity [J]. Journal of Ecology, 29 (03): 592-597

[9] Zhang Haowei, Fang Bin, Wei Qiaoqiao, Qu Ying, Wang Qingri.(2015). Quantitative model construction of regional cultivated land ecological value compensation -- taking Jiangsu Province as an example [J]. China Land Science, 29 (01): 63-70