Prediction of GGDP Based on SEEA-2012 and Logistic Model

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Abstract: The traditional GDP cannot understand the ecological damage and environmental pollution in the process of development, so it cannot really show the real situation of a country's economy, so in order to measure the true economic health of a country, taking into account environmental factors, the GGDP was proposed. In this paper, SEEA-2012 accounting method is chosen, three indexes which affect GGDP are selected, and the indexes which affect GGDP are queried and calculated by SEEA-2012 accounting method, using the Logistic model to forecast the data of natural capital in 2012-2021, using natural capital consumption data and global temperature data to establish the BP neural network model to forecast the global temperature, compared with the actual global temperature, the change of temperature was slowed down, and the stability of the model is judged to be good by sensitivity analysis after adding GDP factors.

1 INTRODUCTION

There are three forms of expression of GDP, namely, value form, income form and product form (Wu Nan， 2007). the current method of calculating GDP is based on the three forms of expression of GDP, its methods are: production method, income method and expenditure method.

Traditional GDP accounting has its drawbacks: not all production is included in GDP, and “GDP” does not take into account the effect of inflation on the currency. GDP is not a measure of a country's overall standard of living or happiness. “Although changes in per capita gross domestic product are often used to measure whether the average citizen of a country is doing well or badly, they do not include things that might be considered important for general well-being(Callan, T., 2023).

The System of Integrated Environmental-Economic Accounting (SEEA) was created in the 1980s from the concept of sustainable development. It is based on the SNA-1993, a set of accounts built in cooperation with international organizations (Hoff Jens V, 2020) there is a strong correlation between SEEA and SNA.

In this paper, SEEA-2012 accounting natural capital is classified as natural resource depletion value cost, environmental pollution damage value cost and ecological benefit improvement value. In accounting for this natural capital, the consumption and unit price of each indicator are looked for, and each data has a relevant source, and the relevant calculation formula is used for each indicator, the resulting GGDP is closer to the real thing. Because GGDP is a measure that has emerged in recent years, the SEEA-2012 accounting system used in this article was adopted by the United Nations after the 2012 revision of the SEEA accounting system theory, governments and academics use the system to account for GGDP after 2012. To better find these indicators, this paper selects the period from 2012 to 2021. In this paper, a comprehensive and unified accounting method for natural resource depletion, environmental pollution damage and ecological benefit improvement is established, which fully combines the latest research results and is consistent with the theoretical framework, in line with increasingly stringent environmental constraints and policies.

2 RESEARCH HYPOTHESES

Considering that many of the GGDP-related data are available internationally in U.S. dollars, in order to better understand these indicators, the US dollar settlement unit at the direct exchange rate of 1.00USD: 6.8CNY into RMB. Considering also that GGDP is the main indicator of a country's economic health, countries will change their behavior because

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of this way of assessing and comparing economies, thus having a good effect on the natural environment, that is, an increased blocking effect.

So in order to fully analyze the problem and simplify the model, we make the following reasonable assumptions.

Hypothesis 1: It is assumed that when looking for categories of consumption of natural capital, the estimated data are meaningful due to the difficulty of measuring the data.

Hypothesis 2: The conversion of United States dollars into renminbi is assumed to be free of the effects of inflation and exchange rate changes.

Hypothesis 3: Suppose that the human-induced change in the consumption of natural capital from the original exponential curve to a restricted Logistic curve, that is, the consumption of natural capital increases to a certain amount after the growth rate will decline.

3 DATA SOURCES AND MODEL DESIGN

3.1 Data Sources

Based on global temperature, GDP and worldwide consumption of various resources from 2012-2021, we choose a method that can mitigate climate change in the calculation of GGDP, and measure and calculate the global impact of GGDP, estimate how this global impact will mitigate climate change. The global average temperature and global GDP in this paper were obtained from World Bank Open Data | Data, and the worldwide consumption of various resources was obtained from World Health Data Platform (who.int), World Meteorological Organization | (wmo.int) and World Bank Open Data | Data.

3.2 Modeling

1) SEEA-2012 Analysis of Accounting for The Depletion Value of Natural Capital

SEEA-2012 classifies the value of natural capital depletion into the cost of natural resource depletion, the cost of environmental pollution damage and the value of ecological benefit improvement (Yiu Lee Fai, 2017). The formula is as follows:

$$C_{NaturalCapital} = C_{NaturalResources} + C_{Environment} - U_{Ecologicalbenefits} \quad (1)$$

Among them, $C_{NaturalCapital}$ is the consumption of natural capital, $C_{NaturalResources}$ is the cost of reducing the value of natural resources, $C_{Environment}$ is the cost of environmental pollution damage, and $C_{Ecologicalbenefits}$ is the value of improving ecological benefits.

The depletion value cost of natural resources focuses on the quantitative aspects of the utilization of natural assets, including the material flows and sources of utilization of resources in economic processes, and on the quantity of resource depletion and its efficiency in the process of exploitation and utilization, resources include water resources, energy minerals, forest resources and land resources. The formula is as follows:

$$C_{NaturalResources} = C_1 + C_2 + C_3 + C_4 \quad (2)$$

Among them, $C_{NaturalResources}$ is the cost of reducing the value of natural resources, C_1 is the cost of reducing the value of water resources, C_2 is the cost of reducing the value of energy minerals, C_3 is the cost of reducing the value of forest resources and C_4 is the cost of reducing the value of land resources.

Environmental pollution damage accounting includes true object and value cost accounting of pollutants (water and air pollution). The formula is as follows:

$$C_{Environment} = C_5 + C_6 \quad (3)$$

Among them, C_5 is the cost of water resources rectification, C_6 is the cost of air pollution control.

Ecological benefit accounting is mainly accounting for the quality of services and their value costs of various ecosystems, represented by conservation soil values. The formula is as follows:

$$U_{Eco-efficiency} = U_7 = U_{Solidsoil} + U_{Fertilizer} \quad (4)$$

Among them, $U_{Eco-efficiency}$ is the value of ecological benefit improvement, $U_{Solidsoil}$ is the value of soil consolidation, and $U_{Fertilizer}$ is the value of fertilizer conservation.

2) The Principle and Calculation Formula of The Logistic Model

The Logistic model is derived from the exponential growth model, that is, the classification index of the value of natural capital depletion is regarded as the continuous differentiable function x(t) of continuous time t. The value of each category index at the initial time (t =0) is x_0. Suppose that the growth rate per unit time is a constant r, $r \times x(t)$

is the growth $\frac{dx}{dt}$ of x(t) per unit time, the differential equation and initial conditions satisfied by x(t) are thus obtained as follows(Ji Yancui, 2014):

$$\frac{dx}{dt} = rx, x(0) = x_0 \tag{5}$$

Get the logistic model:

$$x(t) = \frac{x_m}{1 + \left(\frac{x_m}{x_0} - 1\right)e^{-rt}} \tag{6}$$

The parameter solution is consistent with the above exponential growth model method, requiring r and x_m .

3) The Basic Principle of 3BP Neural Network

A neural network model consists of a number of neurons linked by adjustable connection weights. Each neuron multiplies the initial input value by a certain weight and adds other inputs into the neuron, finally, a sum is calculated, and the output value is normalized by the excitation function after the deviation adjustment of the neuron (Zhao Jian, 2016).

First, we initialize the link weights W_1 and W_2, usually using the random initialization method. In the general linear regression fitting process, we always add a bias b, the offset items b_1 and b_2 are added to the input layer and the hidden layer respectively, and the following formulas are obtained:

$$Y = (X * W_1 + b_1)W_2 + b_2 \tag{7}$$

Then, add a nonlinear activation function F to the hidden layer and the output layer to get:

$$Y = f[(X * W_1 + b_1)W_2 + b_2] \tag{8}$$

After outputting Y, a forward propagation is completed, followed by a backward propagation, and the backward propagation information is the error, that is the network output value Y and the true value $\widehat{Y}$ of the gap. This difference is usually expressed by the mean square error loss function, and the resulting mean square error loss function is as follows:

$$E = \frac{1}{2}\left(\hat{Y} - Y\right)^2 \tag{9}$$

The smaller the error is, the closer the network is to the real relationship. BP neural network training can greatly solve the training efficiency problem.

4 EMPIRICAL ANALYSIS

4.1 SEEA-2012 Accounts for the Depletion of Natural Capital

1) Depletion of Natural Resources

a) Accounting for The Cost of Water Depletion Value

Access to United Nations databases and the official website of the World Resources Institute and other authoritative websites provides information on the amount of water used worldwide each year. Based on a large amount of information and the trend of water price changes, this topic sorted out the 2012-20212021 price. After obtaining the global water consumption and price, we calculated the 2012-2021 water resource value cost data as follows:

Table 1: Global Water Resources Depletion Value Cost Table 2012-2021.

Year	Water consumption (cubic meters)	Water Price (cubic meters/yuan)	Water depletion value cost (million yuan)
2012	5694700000000	8.4	478354800
2013	6054800000000	8.6	5207128000
2014	6248900000000	9.1	5686499000
2015	6548600000000	9.3	6090198000
2016	6493500000000	9.8	6363630000
2017	6832500000000	10.1	6900825000
2018	7126800000000	10.6	7554408000
2019	7265900000000	10.8	7847172000
2020	7625900000000	11.2	8541008000
2021	8269400000000	11.6	9592504000

b) Accounting for The Cost of Reducing The Value of Energy Minerals

The formula for calculating the cost of energy and mineral depletion is as follows:

$$C_2 = \sum_{i=1}^{n} Q_{Energy} \times \sum_{i=1}^{n} P_{Energy} \tag{10}$$

Among them, Q_{Energy} is energy mineral consumption (10,000 tons), P_{Energy} is energy mineral price (10,000 yuan/10,000 tons), n is the main category of energy minerals. Inquiring about global energy mineral consumption, the International Energy Agency (IEA) was selected, and based on the trend of energy prices, the price of coal was 651,255 yuan per ton, while the price of oil was 539 yuan per barrel, or 39,340 yuan per ton, natural gas costs 3.8 yuan per cubic meter, or 5,510 yuan per ton, gasoline 15,000 yuan per ton, diesel

12,000 yuan per ton, and clean energy 8,000 yuan per ton, combined with formula 10, the global consumption values of energy minerals and the cost of energy mineral depletion are calculated as follows:

Table 2: Table of consumption values of various minerals and cost tables of energy mineral depletion values.

Year	Coal consumption value (million yuan)	Oil consumption value (million yuan)	Consumption value of natural gas (million yuan)	Gasoline consumption value (million yuan)	Diesel consumption value (million yuan)	Clean consumption value (million yuan)	Cost of energy mineral consumption (million yuan)
2012	88661.84	6312857.34	627486.24	524113.04	486376.89	236044.98	8275540.33
2013	89856.16	6397894.65	635938.79	531173.10	492928.63	239224.62	8387015.95
2014	91519.82	6516349.79	647713.01	541007.61	502055.06	243653.80	8542299.08
2015	92416.57	6580200.03	654059.60	546308.66	506974.43	246041.23	8626000.51
2016	93246.99	6639326.98	659936.71	551217.56	511529.89	248252.05	8703510.19
2017	94502.68	6728733.90	668823.59	558640.40	518418.29	251595.08	8820713.93
2018	96229.22	6851665.97	681042.81	568846.61	527889.64	256191.65	8981865.90
2019	98679.74	7026146.78	698385.88	583332.54	541332.59	262715.69	9210593.22
2020	99602.32	7091836.08	704915.27	588786.27	546393.66	265171.89	9296705.49
2021	95341.32	6788446.24	674758.89	563597.90	523018.85	253827.79	8898990.98

c) Accounting for The Cost of Reducing The Value of Forest Resources

The formula for calculating the cost of the declining value of forest resources is as follows:

$$C_3 = Q_{Forest} \times P_{Forest} \tag{11}$$

Among them, Q_{Forest} is the area of the New Forest Loss (hm^2), P_{Forest} is the transfer price of forest resources (10,000 yuan/10,000 hm^2). By consulting the World Resources Institute and the Foresight Database website to obtain the annual area of forest resources and their transfer prices, the reduced value costs for the period 2012-2021 for 2021 are calculated using Formula 11 after obtaining the area of New Forest losses and the transfer price, as follows:

Table 3: The cost of declining value of forest resources.

Year	New Forest Loss (hm^2)	The circulation price of forest (10,000 yuan/10,000 hm^2	The cost of reducing the value of forest resources (10,000 yuan)
2012	59.8	16.08	961.584
2013	55.7	16.38	912.366
2014	50.6	17.21	870.826
2015	44.9	17.85	801.465
2016	29.8	18.06	538.188
2017	16.4	17.68	289.952
2018	10.3	18.11	186.533
2019	8.5	18.35	155.975
2020	4	18.68	74.72
2021	2	19.64	39.28

e) Accounting for The Cost of Declining Value of Land Resources

The formula for calculating the cost of declining land value is as follows:

$$C_4 = C_{Cropland} = S_{Cropland} \times P_{Cropland} \tag{12}$$

Among them, $C_{Cropland}$ is the cost of reducing the value of cultivated land resources (10,000 yuan), $S_{Cropland}$ is the global area of cultivated land (hm^2), the value of each hm^2 land (hm^2/10,000 yuan). Access the World Bank website, the World Resources Institute, and other authoritative sites to obtain land and arable land area and the value of each hm^2 of land. Using formula 12, the cost of declining value for 2012-2021 can be calculated as follows:

Table 4: Cost of declining value of land resources.

Year	Global arable land area (hm^2)	Yield of arable land (10,000 yuan/ hm^2)	Cost of declining value of land resources (10,000 yuan)
2012	158834000	1.21	192189140
2013	159132000	1.31	208462920
2014	159281000	1.35	215029350
2015	159371000	1.42	226306820
2016	159434000	1.53	243934020
2017	160026000	1.56	249640560
2018	159817000	1.65	263698050
2019	159579000	1.68	268092720
2020	159348000	1.86	296387280
2021	159237000	1.76	280257120

2) Cost of Environmental Damage

a) Accounting for The Cost of Water Pollution Rectification

This paper calculates the cost of treatment required to treat wastewater. The formula for accounting for the cost of water pollution rectification is as follows:

$$C_5 = V_{Wastewater} = Q_{Wastewater} \times P_{Wastewater} \tag{13}$$

Among them, $V_{Wastewater}$ is the treatment cost (10,000 yuan) for wastewater treatment, $Q_{Wastewater}$ is the amount of wastewater discharge (10,000 tons), $P_{Wastewater}$ is the cost of wastewater treatment (10,000 yuan/10,000 tons). According to the official website of the World Meteorological Organization, global wastewater discharge has reached 4,260 m^3 in the past two years. The annual global wastewater discharge is about 4,000 m^3. By default, 1 m^3 is 1 ton, combined with the trend of global wastewater discharge, the data required for the study were collated, and the global wastewater discharge and wastewater treatment cost prices were obtained. With formula 13, the 2012-2021 clean-up costs were calculated as follows:

Table 5: Cost of water pollution rectification.

Year	Discharge of waste water (10,000 tons)	Price (10,000 yuan/10,000 tons)	Clean-up of water pollution (10,000 yuan)
2012	39246961	1.539	60401073
2013	38846594	2.114	82121700
2014	39517356	2.963	117089926
2015	40686172	3.247	132108000
2016	39557163	3.765	148932719
2017	40715869	4.025	163881373
2018	41695718	4.836	201640492
2019	41865567	5.231	218998781
2020	42175143	6.012	253556960
2021	42605240	6.978	297299365

4.2 Accounting for Air Pollution Control Costs

The formula for calculating the cost of air pollution control is as follows:

$$C_6 = V_{exhaustgas} = \sum_{i=1}^{n} Q_{pollutants} \times \sum_{i=1}^{n} P_{pollutants} \quad (14)$$

Among them, $V_{exhaustgas}$ is the cost of controlling pollutants in air pollution (10,000 yuan), $Q_{pollutants}$ is the amount of major pollutants in the air (100 million tons) , and $P_{pollutants}$ is the average unit treatment price of pollutants (yuan/ton) , n is the major category of air pollutants. Global average annual emissions of air pollution between 2010 and 2019 were the highest in human history, reaching 59 billion tones in 2019, a 12% jump from 52.5 billion tones in 2010, according to the UN report, the average annual growth rate in the past 10 years was 1.3%. The study data were obtained in conjunction with global trends in exhaust emissions, the total cost of air pollution control in the past 10 years was calculated.

Table 6: The cost of air pollution control and the global cost of air pollution control.

Year	SO_2 governance value cost (billion yuan)	Nitrogen oxide treatment value cost (billion yuan)	Cost of flue gas treatment value (billion yuan)	Total cost of air pollution control (10,000 yuan)
2012	280178.5144	502324.508	88144.69104	8706477134
2013	308611.17	553300.65	97089.65831	9590014783
2014	364550.4187	653592.6215	114688.2519	11328312920
2015	438033.0852	785337.714	137806.0378	13611768370
2016	496699.515	890519.175	156262.6077	15434812980
2017	516686.5704	926353.428	162550.5732	16055905720
2018	587062.112	1052527.84	184690.8518	18242808040
2019	798703.65	1431974.25	251273.6803	24819515800
2020	1035802.68	187062.711	325865.4839	32187308750
2021	1548367.52	2696711.36	473488.62	47185675000

3) Ecological Efficiency Improvement Value

a) Soil Conservation Value

The formula is as follows:

$$U_{Eco-efficiency} = U_7 = U_{Solidsoil} + U_{Fertilizer} \quad (15)$$

Among them, $U_{Eco-efficiency}$ is the value of ecological benefit improvement, $U_{Solidsoil}$ is the value of soil consolidation, and $U_{Fertilizer}$ is the value of fertilizer conservation. The sequestration value generated by the forest ecosystem can be calculated by the cost required for water storage, which is calculated by a specific formula. The formula is as follows:

$$U_{Solidsoil} = C_{Waterstoragecosts} = A \times P_{impoundment} \times \frac{X}{\rho} \quad (16)$$

Among them, $U_{Solidsoil}$ the value of soil consolidation (10,000 yuan) , $C_{Waterstoragecosts}$ is the cost of water storage (10,000 yuan) ,A is a new area of forest (hm^2) , and $P_{impoundment}$ is the cost of average storage capacity (yuan/m^3) ,X is the annual average reduction of land loss from forested land to unforested land (t/hm^2) , ρ is Represents the soil capacity contained in the forest (g/cm^3). The annual area of forest resources (hm^2) was obtained by consulting the official website of the World Resources Institute and the forward-looking database and other official websites, and the area added to the forest (hm^2) was obtained by subtract the first from the last, the cost of the average storage capacity can reach 6.11 yuan per cubic meter, or 6.11 thousand yuan per hectare, and the annual average reduction of land loss from forested land to non-forested land is 334.57 tons/hectare, or 33.457 kg/hectare, soil bulk density is 1.24 g/cm^3, or 1240 kg/m^3. The value of soil consolidation in the last 10 years can be calculated by using the data in Formula 16 as shown in table 7.

The method of calculating the value of fertilizer preservation is to calculate the three main nutrients in soil, namely nitrogen, phosphorus and potassium. The detailed formula is as follows:

$$U_{Fertilizer} = A \times X \times \left(\frac{NC_1}{R_1} + \frac{PC_1}{R_2} + \frac{KC_2}{R_3} \right) \quad (17)$$

Among them ,A is the newly increased area of forest (hm^2) ,X is the annual average reduction of land loss in forested land compared with non-forested land (t/hm^2) , and N is the average nitrogen content (%) in forest soil, C_1 is the price of diamine phosphate fertilizer (yuan/ton) , R_1 is the content of nitrogen in diamine phosphate fertilizer (%) , P is the average content of phosphorus in forest soil (%) , R_2 is the content of phosphorus in diamine phosphate fertilizer (%); K is the average potassium content (%) in forest soil, C_2 is the price (yuan per ton) of potassium chloride fertilizer, R_3 is the potassium content (%) of potassium chloride. According to the searching data, the average nitrogen content, phosphorus content and potassium content in forest soil were 0.11% , 2.23% and 0.37%, respectively, and the nitrogen content and phosphorus content in diamine phosphate fertilizer were 14.0% and 15.0% , respectively, the potassium content in potassium chloride is 50.0% , the price of diamine phosphate fertilizer is 2,400 yuan per ton, or 0.24 million yuan per ton, and the price of potassium chloride fertilizer is 2,200 yuan per ton, or 0.22 million yuan per ton, using the data from Formula 17, the fertilizer retention values for the past 10 years are shown in table 7. Combined with formula 15 for soil conservation values, the final conservation values are shown in table 7:

Table 7: Soil conservation values.

Year	Soil consolidation value (10,000 yuan)	Fertilizer Value (10,000 yuan)	Soil conservation value (10,000 yuan)
2012	-9.86102	- 784.163	-794.024
2013	- 9.18493	-730.4	- 739.585
2014	-8.34394	- 663.523	-671.867
2015	- 7.40401	-588.778	-596.182
2016	-4.91402	-390.77	-395.684
2017	- 2.70436	-215.055	-217.759
2018	-1.69847	- 135.065	-136.763
2019	-1.40165	-111.461	-112.863
2020	-0.6596	- 52.4524	-53.112
2021	- 0.3298	-26.2262	- 26.556

To sum up, water resources, energy and mineral depletion value, forest resources and land resources, the cost of reducing value, the cost of cleaning up water pollution, the cost of cleaning up air pollution, and the value of soil conservation are added together to get the cost of natural capital, and then the cost of GDP minus the cost of natural capital is used to get the GGDP. See Table 8:

Table 8: Natural capital consumption and GGDP.

Year	Global natural capital (10,000 yuan)	Global CDP (10,000 yuan)	Global GGDP (10,000 yuan)
2012	13750892643	51340000000	37589107357
2013	15096116071	52774800000	37678683929
2014	17355475038	54216400000	36860924962
2015	20069008589	51129200000	31060191411
2016	22200014163	51992800000	29792785837
2017	23379073874	55352000000	31972926126
2018	26271536771	58792800000	32521263229
2019	33162990163	59602000000	26439009837
2020	41287557823	57874800000	16587242177
2021	57364634542	65694800000	8330165458

4.3 Logistic Model Predicts the Consumption of Natural Capital Under Constraints

Because the classification of the depletion value of natural capital refers to the tendency to change over time similar to the exponential model, and if GGDP is used as the main indicator to measure the health of a country's economy, this paper argues that this kind of artificial change will make the consumption of natural capital change from the original exponential curve to the Logistic curve. Under the condition of natural capital consumption calculated by SEEA-2012, the Logistic model can be used to predict the natural capital consumption after GGDP is taken as the main index to measure the national economic health. Taking the cost of water resources depletion value as an example, the following formulas were fitted using the fitting toolbox:

$$x(t) = \frac{x_m}{1 + \left(\frac{x_m}{4783548000} - 1 \right) e^{r\,(t-2012)}} \quad (18)$$

Because the cost of water resources depletion value is on the rise, the constraint condition is set as the maximum value “9592504000”. Using the same method, the predicted values of the remaining 6 indicators are as follows:

Table 9: Summary of forecasts for seven indicators of natural capital.

Year	Water resources depletion value (10,000 yuan)	The cost of reducing the value of forest resources (10,000 yuan)	Cost of declining value of land resources (10,000 yuan)	Clean-up of water pollution (10,000 yuan)	Cost of air pollution control (10,000 yuan)	Soil conservation value (10,000 yuan)
2012	4783548000	961.584	192189140	60401073	8706477134	-794.024
2013	5330761000	794.1264	205030500	76760950	10749160000	- 643.859
2014	5864245000	655.8356	217579700	96328900	13107850000	-522.095
2015	6371311000	541.6302	229716600	11909910	15760260000	-423.362
2016	6841772000	447.3142	241337100	14476290	18655610000	-343.301
2017	7268596000	369.4233	252356700	17266760	21715370000	-278.382
2018	7648027000	305.0964	262711300	20184850	24840100000	-225.739
2019	7979271000	251.9714	272357900	23114580	27921630000	- 183.052
2020	8263905000	208.0972	281273300	25938120	30857650000	-148.437
2021	8505180000	171.8628	289452100	28554070	33564610000	-120.368

4.4 BP Neural Network Model to Predict Global Temperature

A BP neural network model can be built to predict the global temperature by combining the data of each indicator of natural capital consumption predicted by the logistic model for 10 years from 2012 to 2021 and the global temperature data. The predicted global temperature is compared with the actual global temperature to see if the temperature change is slowed down. In the process of model self-training, the minimum error is 0.001, a total of 1000 times of training, so the ultimate learning efficiency is 0.1, in order to make the predicted data reliable and accessible, of the original data corresponding to the 7 related indicators, 70% was selected as training data, 20% as validation data, and 10% as test data. Using Bayesian regularization method, the relevant training parameters were obtained as follows:

Table 10: Results of global temperature prediction parameters.

Parameters (in units)	Initial value	Stop the value	The target value
Iterations	0	5	1000
Duration (seconds)	0.00	0.01	-
Performance	0.0394	1.08e-20	0.00
Gradient	0.114	6.98 e-12	1.00e-07
Mu	0.001	1.00e-08	1.00e + 10

As can be seen from the table above, after 15 iterations, the final error can be limited to about 0.01, so the final test results show that the model training is successful.

The analysis of fitting effect and prediction precision is made below, in which the closer R is to 1, the closer MSE is to 0, the higher the model precision is. In the first round of training, the best training group has a mean square error of 0.00084909, which is close to 0, and reaches the requirement of mean square error of 1%. R average is about 0.95, the fitting degree is good, the mean square error can be controlled at 0.00084909, and it is close to 0, reaching the requirement value of about 1%, the error is relatively small, the trained neural network can be used for data prediction. A visual representation of the difference between the predicted temperature (affected by GGDP) and the actual temperature is shown in Figure 1.

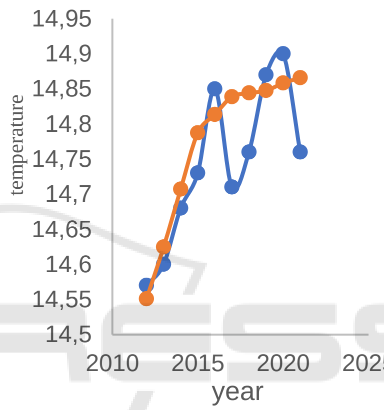

Figure 1: Plot of predicted temperature (affected by GGDP) versus actual temperature.

The blue line is the actual temperature folding graph, and the orange line is the predicted temperature (influenced by GGDP), as can be seen from Figure 1, the overall trend of global raw temperature shows a fluctuating upward trend, concentrating on an obvious upward trend before 2016, with a large fluctuation from 2016 to 2021, and the highest value of temperature in 2020; And the projected global temperature influenced by GGDP is generally on a gentle upward trend from 2015, and eventually gradually converge to the same. It indicates that the constraint GGDP is introduced to make the change of global temperature level off.

4.5 Sensitivity Analysis

By subtracting the value of water consumption from GDP, we get the value of GDP plus the value of excess water consumption, that is, we add the effect of GDP into the index, and then use the BP neural network model to predict the global temperature. After the data processing, the data needed for the training and prediction of the BP model can be obtained. The average R of the model is about 0.9, the fitting degree is good, the mean square error can be controlled at 0.010829, reaching about 1% of the required value, the error is relatively small, the trained neural network can be used for data prediction. To visualize the difference between the predicted global temperature (GDP-GGDP) and the original predicted temperature (affected by GGDP), Excel was used to present the data of both on the same folding line chart, as shown in Figure 2:

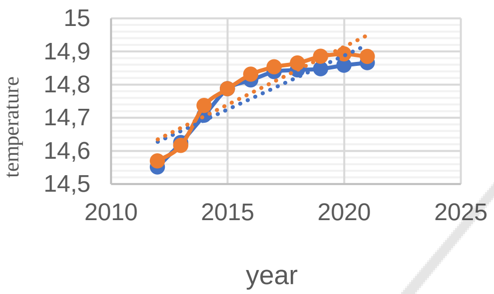

Figure 2: Plot of forecast temperature (GDP-GGDP) and original forecast temperature (GGDP).

The blue line is the original predicted temperature (GGDP), and the Orange Line is the predicted temperature (GDP-GGDP). As can be seen from Figure 2, the trend of the two data line charts is roughly the same, through its linear trend line, it can be intuitively explained that the sensitivity of the model used is small and the stability of the model is high.

5 RESEARCH CONCLUSIONS

This paper is based on global temperature, GDP and worldwide consumption of various resources from 2012-2021, we choose a method that can mitigate climate change in the calculation of GGDP, and measure and calculate the global impact of GGDP, estimate how this global impact will mitigate climate change. Based on these studies, the following conclusions can be drawn:

1. The influence of GGDP as the main indicator of national economic health on the consumption value cost of natural capital in the world is shown in table 9.

2. The overall trend of global raw temperature shows a fluctuating upward trend, concentrating on an obvious upward trend before 2016, with a large fluctuation from 2016 to 2021, and the highest value of temperature in 2020; And the projected global temperature influenced by GGDP is generally on a gentle upward trend from 2015, and eventually gradually converge to the same. It indicates that the constraint GGDP is introduced to make the change of global temperature level off.

3. The difference between the predicted global temperature (GDP-GGDP) and the original predicted temperature (affected by GGDP) is not big, which shows that the sensitivity of the model is small and the stability of the model is high.

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