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Assessing Client Capability: An Analysis of National Project Execution Capacity Based on Illegal Wildlife Trade

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Abstract: This study aims to assess the implementation capacity of countries interested in participating in projects, using illegal wildlife trade as a case study. It comprehensively analyzes the potential and feasibility of countries in executing projects, from the selection of client countries to the establishment and evaluation of project implementation models. By employing methods such as Analytic Hierarchy Process, Entropy Weight Method, weight assignment based on standard deviation and maximization of average difference, a multidimensional indicator system is established. The weights for each indicator are calculated and combined to obtain the execution capacity scores for each country. The United States is selected as the client for this project. Furthermore, by utilizing grey forecasting models, ARIMA forecasting models, and combination forecasting models, changes before and after project implementation in the United States are analyzed to demonstrate its positive impact on economic development and ecological stability.

1. Introduction

The illegal wildlife trade is one of the fourth largest in the world. It poses a threat to the sustainable development of the world. A comprehensive ban on the illegal trade of wild animals and plants is a major measure to safeguard national ecological security and biodiversity, prevent public health security risks, and is an important part of the construction of ecological civilization[1].To curb the illegal wildlife trade, this paper establishes a 5-year project to develop a series of methods to determine the specific content and impact of the project. Based on the analysis of wildlife related data, the specific measures of the project are determined from five aspects: ecology, science and technology, law, publicity and cooperation, and strive to achieve the improvement of the Living Earth index (NLPI), Public Safety Index (PSI) and International Strength Index (NPI) within five years[2]. In order to evaluate the execution capacity of illegal wildlife protection countries and achieve the most appropriate development of the project, the improved analytic hierarchy process (AHP) and objective methods were combined to solve the single objective optimization model based on the weight assignment method to maximize the standard deviation and average difference to determine the weight of indicators, and the United States with the highest score was selected as the customer for the implementation of the project. Then, the combination of metabolism GM(1,1) model with small error and ARIMA model is used to determine the prediction function by establishing an optimal model with minimum prediction error. Finally, a further prediction study was conducted on the government income and species diversity index of American households before and after the implementation of the project to prove the positive impact of the project on the United States.

2. Evaluate customer capability

2.1 Customer country selection

This paper selects countries where illegal wildlife trade practices are prevalent, and analyzes the specific circumstances of each country to determine whether they are interested in participating in our project.

On the one hand, it selected areas where illegal wildlife trade is prevalent and impedes local sustainable development, such as India, Indonesia, and Australia. In India, for example, wildlife trade is the biggest threat to wildlife conservation in India [3-4]. Although the Indian government has enacted policies to actively curb the illegal wildlife trade, there are still many challenges to combating the illegal wildlife trade. There is reason to think that a project that would counter the illegal wildlife trade would be attractive to them.

On the other hand, China and the United States are powerful, but because they are the world's largest illegal wildlife trade market, they are often criticized in the international community and are in a passive position in relevant international organizations, and their relevant political, economic and cultural interests in this field will also be subject to others [5]. Therefore, it is obvious that China and the United States are willing to participate in projects in this field [6].

2.2 Project execution capability model

2.2.1 Establishment of index system

Different project measures have different capability requirements, this paper analyzes the needs of project measures, the process of establishing the system is shown in Figure 1, and finally determines four first-level and twelve second-level indicators.

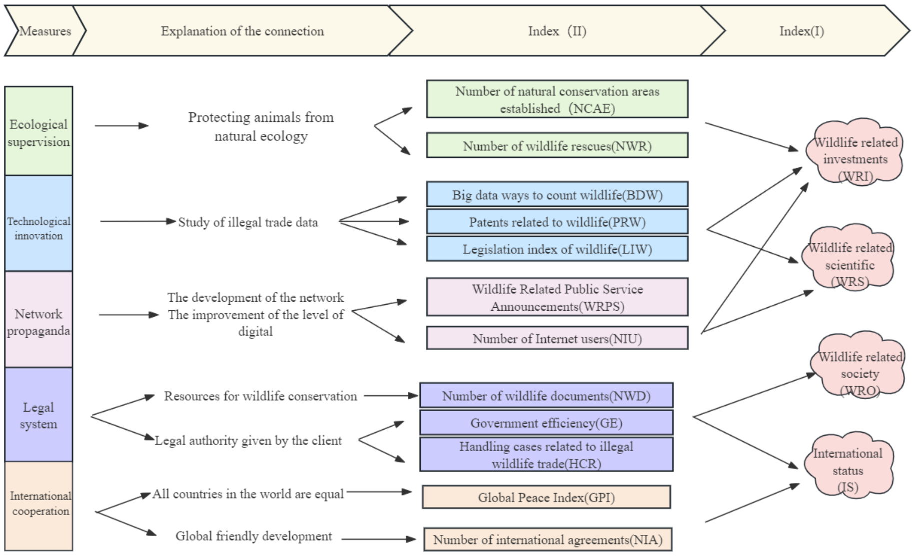

Figure 1: Index selection system

2.2.2 Index weight calculation

(1) Analytic hierarchy process

Firstly, the traditional weight calculation method is innovated: the final weight of the analytic hierarchy process combines the results of three calculation methods; The optimization model is established when the weights are combined, and the characteristics of each index are considered.

Step 1: Establish hierarchical structure model: target layer, scheme layer. The hierarchical structure model is shown in Figure 2:

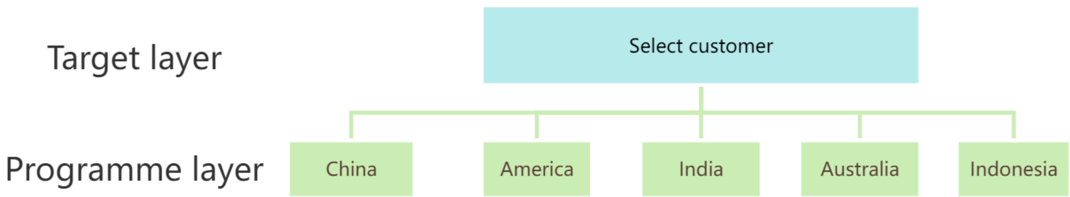

Figure 2: Analytic hierarchy structure

Step 2: Construct the judgment matrix and conduct consistency test: when CR=$\frac{CI}{RI}$≤0.10, it is considered that the consistency of the judgment matrix is acceptable.

Step 3: Combine the results to calculate the average indicator weights W_1.

$$w_1 = \frac{w_i + w_j + w_k}{3} \tag{1}$$

Among them, W_i, W_j, W_k the weights obtained by arithmetic average method, geometric average method and eigenvalue method are respectively.

(2) Entropy weight method

The entropy weight method determines the weight coefficient of each index according to the information entropy value:

$$W_{1j}=\frac{1-h_j}{m-\sum_{j=1}^{m}h_j} \tag{2}$$

Where j=1,2,... ,m, represents m evaluation indicators, and h_j is the information entropy value of the JTH indicator

(3) Weight assignment method based on maximum standard deviation and mean difference

Index j is weighted based on the maximization of standard deviation and mean difference:

$$W_{2j}=\frac{z_1\sigma_j+z_1\mu_j}{\sum_{j}^{m}(z_1\sigma_j+z_1\mu_j)} \tag{3}$$

Where, σ_j, u_j respectively are the mean difference and standard deviation of evaluation index j for each event, z_1, z_2 respectively are the importance coefficient of standard deviation and average difference, $z_1+z_2=1$, and 0.5 is taken here.

(4) Combination weight

The integrated weight vector of the evaluation index is$[w_1,w_2,\ldots,w_m]$.For subjective weights, if the number of decision-makers tends to be large, it can be seen from the large number theorem of statistics that the weight vector integration result of its judgment will be close to the integrated weight vector$[w_1 ,w_2,\ldots,w_m]$;For objective weights, the results obtained by different algorithms have repeatability. Therefore, it can be thought of as taking a sample from the population to estimate the combined weight vector$[w_1 ,w_2,\ldots,w_m]$.

For different evaluation indicators, the relative importance degree of subjective weight and objective weight are different. If the relative importance degree coefficients of subjective weight and objective weight are recorded as α and β respectively, it can be obtained.

$$\begin{cases}\alpha_j=\dfrac{E(W_{sj})}{E(W_{sj})+E(W_{bj})}\\ \beta_j=\dfrac{E(W_{bj})}{E(W_{sj})+E(W_{bj})}\end{cases} \tag{4}$$

Using the linear weighting method with equal weights, the optimal single-objective model can be obtained as follows:

$$\begin{cases}\min\ H=\sum_{j=1}^{m}\alpha\sum_{s=1}^{l}(W_j-W_{sj})^2+\sum_{j=1}^{m}\beta\sum_{b=l+1}^{l}(W_j-W_{bj})^2\\ s.t.\sum_{j=1}^{m}W_j=1\\ 0\le W_j\le 1,1\le j\le m\end{cases} \tag{5}$$

By solving equation (5), the optimal combined weight vector based on multiple subjective and objective evaluations can be obtained [7]. Finally, the weights of indicators are obtained, and the results are shown in Table 1.

Table 1: Weight of each indicator

Indicators(I)	Weights	Indicators	Weights
WRI	0.3596	NCAE	0.1370
		PRW	0.2226
WRS	0.1442	BDW	0.0011
		PRW	0.0655
		LIW	0.0215
		WRPS	0.0072
		DL	0.0234
		NWD	0.0256
WRO	0.2313	GB	0.1834
		HCR	0.0479
IS	0.2648	GPI	0.1285
		NIA	0.1363

2.2.3 Execution ability score calculation

Customer executive ability score CLM is calculated as follows:

$$CLM=w_a*WRI+w_b*WRS+w_c*WRO+w_d*IS \quad (6)$$

2.3 Perform the customer's selection

After obtaining the scores of the selected countries, the results are shown in Table 2:

Table 2: Scores by country

Country	China	America	Australia	India	Indonesia
Score	54.36	75.49	43.78	33.44	32.94

From this, it can be concluded that the United States has the highest customer capability index, so it is selected as the customer.

3. Project and customer fit

3.1 Project analysis

This paper takes improving the legal system and strengthening international cooperation as an example to illustrate the rationality of the project. A unified law enforcement platform can more efficiently integrate law enforcement forces, form a full-chain situation to combat illegal acts, and strengthen the fighting force [8]. At the same time, the illegal trade in wildlife is not limited to a single country or region [9], so international information exchange and cooperation in law enforcement are necessary. This paper analyzes the results before and after the implementation of the project in the United States.

3.1.1 Improved grey prediction model

Step 1: The traditional grey prediction model is improved [10] and two new models are obtained.

(1) Set to the latest information, place $X^{(0)}$ (n+1) in $X^{(0)}$, and call $X^{(0)}$ = $(X^{(0)}(1),X^{(0)}(2),\dots,X^{(0)}(n),\dots,X^{(0)}(n+1)$the model established is the new information GM(1,1);

(2) Put in the latest information$X^{(0)}(n+1)$, remove the oldest information $X^{(0)}(1)$, call $X^{(0)}$= $(X^{(0)}(2),\dots,X^{(0)}(n),X^{(0)}(n+1))$ the model established is metabolism GM(1,1).

Step 2:80% of the data set is divided into the training group, and the last 20% of the data is used as the test group. At the same time, the error in the prediction of the three models is calculated and compared, and the error results are shown in Table 3:

Table 3: Model error

Type of model	Sum of squares of error
Traditional GM(1,1) model	1.2412
GM(1,1) model of new information	1.2412
The GM(1,1) model of supersedes	0.76765

3.1.2 ARIMA prediction model

In this paper, the time series prediction model is selected, and the autoregressive process AR and the moving average process MA are combined to simulate the stochastic process model of the existing time series sample data.

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \varepsilon_t + \sum_{i=1}^{p} \beta_i \varepsilon_{t-i} \tag{7}$$

3.1.3 Combined Prediction Model (CPM)

In order to combine the advantages of grey prediction and ARIMA in prediction, CPM is used to predict the future index value. Let l_i represent the weight factor of prediction model i.The value of l_i can be estimated by solving the optimization model below.

$$\begin{cases} \min\ J = \sum_{t=1}^{N} \sum_{i=1}^{m} \sum_{j=1}^{m} l_i l_j e_{it} e_{jt} \\ s.t. \sum_{i=1}^{m} l_i = 1 \end{cases} \tag{8}$$

j represents the sum of squares of the combined prediction errors, and e_{ij} represents the prediction errors of the i th prediction model.

3.1.4 Analysis of prediction results

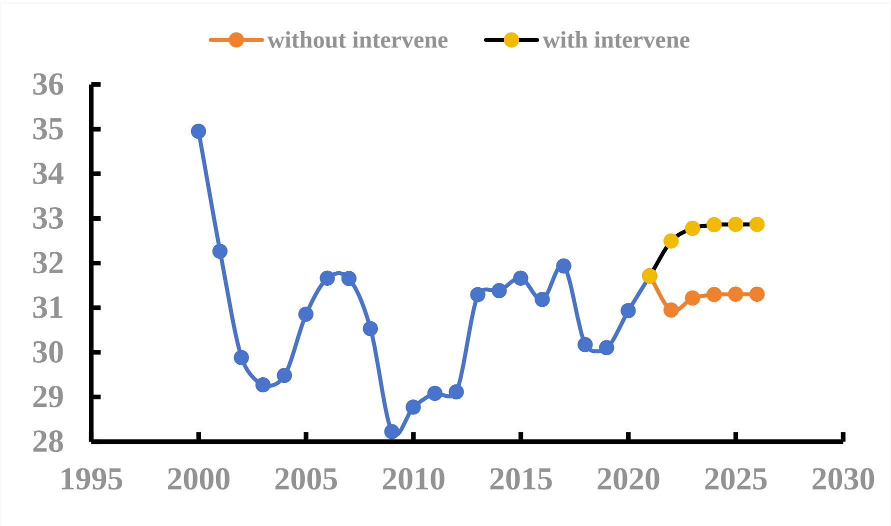

Figure 3: Changes in U.S. government revenue before and after the implementation of the project

Applying the portfolio forecasting model, the change of government revenue in the United States after the implementation of the project for 5 years is shown in Figure 3:

Applying the combined prediction model, the change of the species diversity index in the United States after the implementation of the project for 5 years is shown in Figure 4:

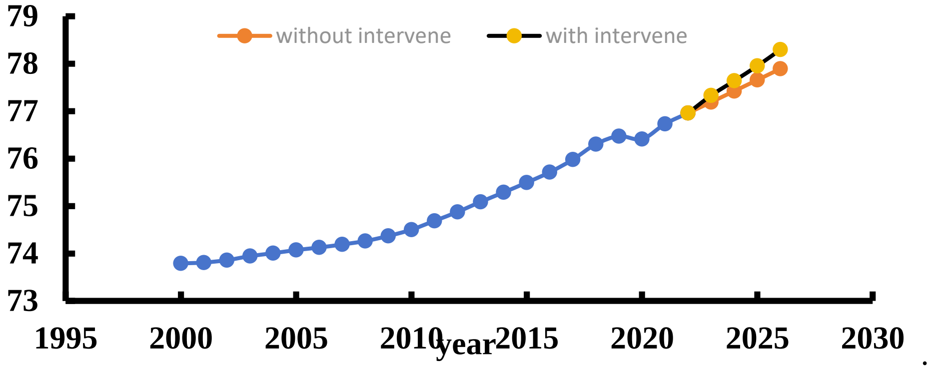

Figure 4: Changes in species diversity in the United States before and after the implementation of the project

The results show that: after the implementation of the project, the proportion of government revenue is more, and the trend of steady growth is in a small range, and the regional ecological stability is rising faster. Therefore, the project is conducive to the economic development of the United States, and at the same time, it is also in line with the trend of ecological intervention in the United States in recent years, and it is complementary to the development plan of the United States.

4. Conclusions

The illegal wildlife trade is raging around the world and continues to expand its reach, which has a negative impact on global sustainable development. In order to curb the illegal wildlife trade, this paper identifies the project from the aspects of ecology, science and technology, law, publicity and cooperation. In order to maximize the potential of the project, it is necessary to select the most suitable country for the implementation of the project. In this paper, the improved analytic hierarchy process (AHP) and objective method are combined to solve the single objective optimization model to determine the weight of the index, and finally the weighted sum is calculated to calculate the scores of the candidate countries, and the United States (75.49) with the highest score is selected as the project customer.After comparing the GM(1,1) model before and after the improvement, the combination of the metabolism GM(1,1) model with the ARIMA model was selected, and the prediction function was determined by establishing the optimal model with the minimum prediction error. Finally, it was found that the government revenue and species diversity index of the United States increased after the implementation of the project.

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