

Analysis of customer selection and decision model in wildlife conservation projects

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Abstract. Today, the global illicit hunting of wildlife and illegal trade in wildlife have a detrimental impact on ecosystems, posing a threat to global biodiversity and progressively emerging as the fourth largest illicit trade worldwide. In order to mitigate wildlife trade and safeguard fauna, it is imperative to carefully select appropriate enforcement stakeholders. Based on factors such as visibility, impact, and global reach, this study has identified 20 institutions and organizations out of 50 candidates that align with the client's criteria. Subsequently, employing a comprehensive evaluation model known as CRITIC-TOPSIS along with 12 indicators, an assessment was conducted to score these 20 organizations. Furthermore, an analysis of their coupling degree was performed which revealed positive coupling effects.

Keywords: Animal Protection, Customer Selection, Comprehensive Evaluation.

1. Introduction

Wildlife is an important component of all life on Earth and of natural ecosystems, and its survival is closely related to the sustainable development of humankind. Currently, illegal trade in wildlife has become the fourth largest crime in the world, seriously affecting biodiversity, ecosystem services, global social order and public security, as well as the welfare of wildlife [1]. Moreover, many studies have shown that illegal trade in wildlife is one of the reasons that threaten the survival of wildlife and lead to species extinction [2]. Consumption of wildlife resources is closely related to wildlife conservation, and over-utilization of wildlife directly leads to the endangerment of wildlife [3]. By diverting and resisting the trade in illegally hunted wildlife, wildlife and its living environment can be protected, and the stability of the entire ecosystem and biodiversity can also be benefited [4]. To reduce wildlife trade and protect wildlife, it is necessary to select the right enforcement customers [5]. The frequency of wildlife trade around the world and the names of plants and animals illegally hunted around the world are shown in Figure 1: The critical-entropy weight model was developed to assess over 20 institutions in order to identify the most effective approach for reducing illegal wildlife trade. Ultimately, TRAFFIC was selected as the primary focus of our research.

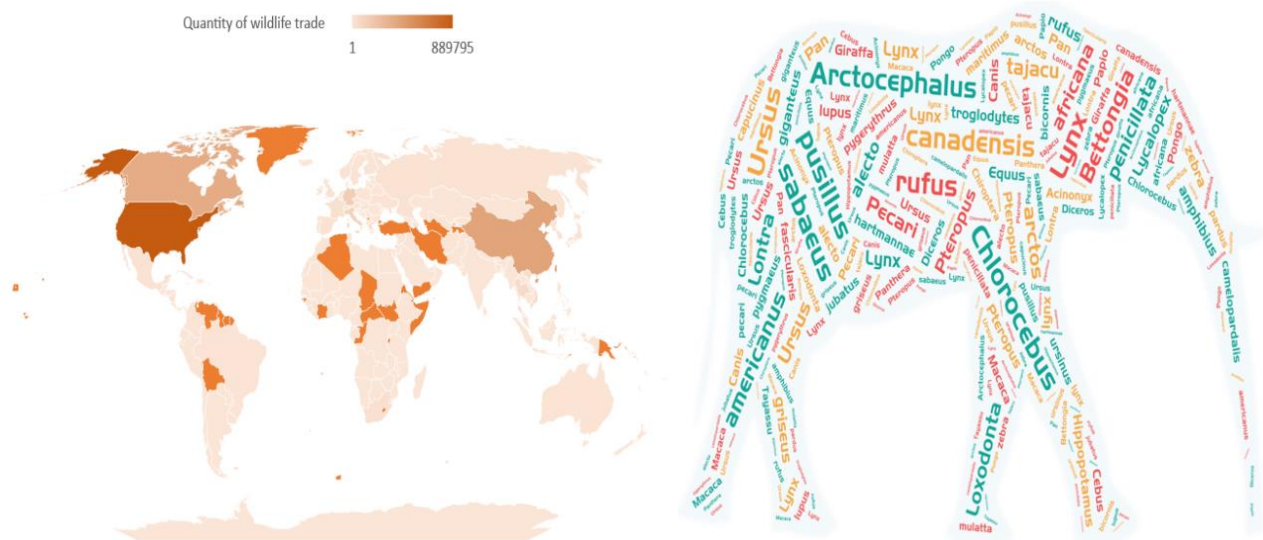


Figure 1. Frequency heat map of world wildlife trade and animals and plants that are illegally hunted around the world.

2. Notations

The primary notations used in this paper are listed in Table 1.

Table 1. Notations.

Symbol	Description
c_t	the unit cost of technical resources
c_h	the unit cost of human resources
z_i	the amount of capital invested in region i
π_{ij}	the utility coefficient of the social cooperation and support that a region i receives from its partner j
U	a composite indicator of the reduction in illegal wildlife trade
r	the natural growth rate
K	the environmental carrying capacity

3. Data source

CITES trade database: <https://cites.org/eng>

UN Comtrade database: <https://comtradeplus.un.org>

Traffic official website: <https://www.traffic.org>

4. First step: Select Client

Determining "Who are our customers?" is a critical aspect of our project's success. Based on visibility, influence and global reach, we need to choose the UN department that protects wildlife and fights illegal hunting and poaching [6]. In addition, we must take into account the government agencies where these behaviors occur, non-profit organizations from various countries or regions, and large companies with large supply chains that may affect wildlife. After careful screening, from a shortlist of 50 agencies, we identified the following 20 agencies and organizations that met the client's criteria: traffic, WPC, IFAW, UNEP, WWF, IUCN, JNCC, UNDP, WAP, Eco-health Alliance, WRI, CWC, WCS, GP, Greenpeace, IIED, NFGA, ICSU, Amazon and Walmart. The world's organization to combat the illegal hunting of wildlife is shown in figure 2.

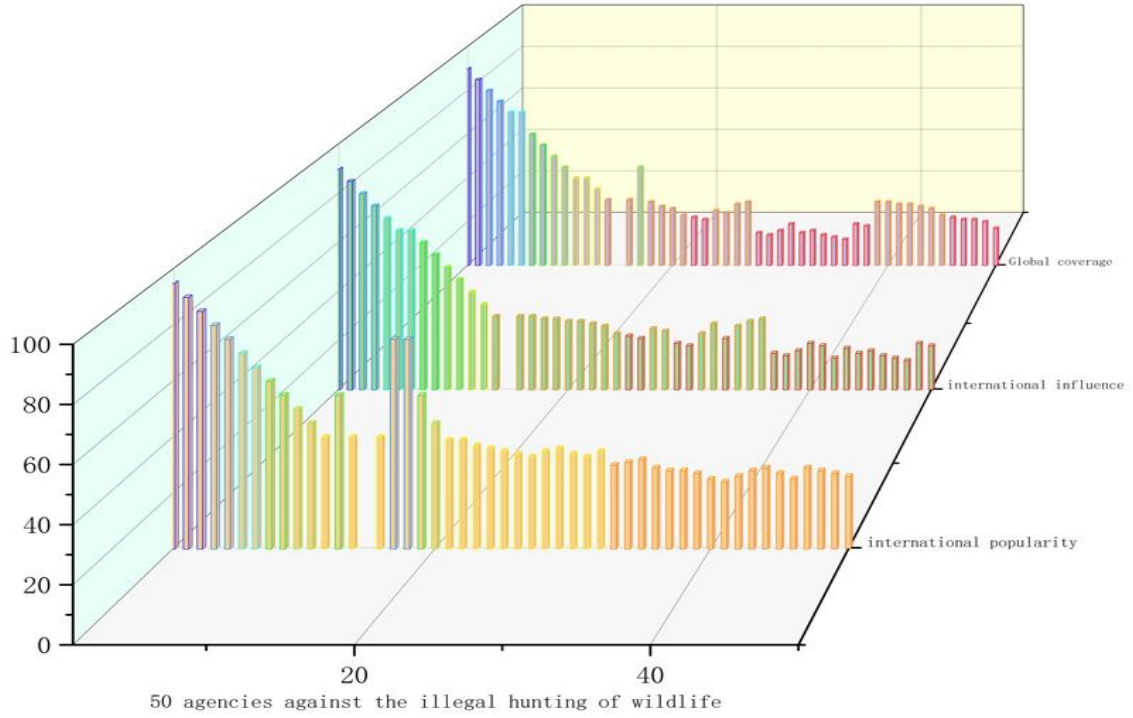


Figure 2. The world's organization to combat the illegal hunting of wildlife.

Selecting our clients amongst eligible agencies and organizations requires consideration of the client's power, resources and interests. Consequently, take the following steps to screen out our clients.

4.1. Second step: Data preprocessing

Due to the dimensional influence between data features, in order to facilitate calculation, accelerate the convergence rate of the model and avoid the impact of outliers on the data, it is necessary to preprocess the data, that is, to normalize and standardize the data.

4.1.1. Normalization

Normalization is a way of converting numeric values into a range (such as [0,1]) to make it easier to compare or manage those values [7].

$$x_{norm} = \frac{x - \min(x)}{\max(x) - \min(x)} \quad (1)$$

x is the original value that you want to normalize. min(x) and max (x) are the minimum and maximum values of the data respectively. Xnorm is the normalized value [8].

4.1.2. Standardization

Standardization is a feature scaling method whose goal is to change the value of the data so that its mean is 0 and its standard deviation is 1. This is mainly used for machine learning algorithms, as some algorithms require or perform better at this scaling [9].

$$X_{norm} = \frac{X - \mu}{\sigma} \quad (2)$$

X_{norm} is the normalized value. X is the original data point. μ is the average of the data set.σ is the standard deviation of the data set.

4.2. Third step: Establish CRITIC-TOPSIS model

The presence of multiple evaluation indicators in the data may lead to dimensional inconsistencies and inherent differences among these indicators, as well as potential uncertainty in some data [10].

The topsis evaluation model based on Critic offers a flexible approach to handle diverse indicators, adapt to dynamic and uncertain environments, enhance the definition of an ideal solution, and provides clear intuitive understanding. Hence, it is suitable for complex decision-making scenarios.

Consequently, in view of the independent data and complex decision environment in this problem, topsis evaluation model based on Critic is adopted to solve this problem.

4.2.1. Critic method (Determine weight)

For each evaluation index i :

(1) Calculate contrast intensity CI_i

$$CI_i = \frac{\sigma_i}{\sum_{j=1}^m \sigma_j} \quad (3)$$

Where σ_i is the standard deviation of indicator i .

(2) Calculating conflict C_i : C_i reflects the correlation between individual indicators and is usually measured by calculating a matrix of correlation coefficients.

(3) Calculate the weight based on contrast strength and conflict W_i :

$$W_i = \frac{CI_i}{\sum_{k=1}^m CI_k} \quad (4)$$

After a series of calculations, the objective weight of each indicator is obtained.

4.2.2. Topsis method (Sorting)

(1) The ideal solution is determined: Determine the positive ideal solution A^+ and the negative ideal solution A^- , that is, the set of the best and worst of all evaluation indicators.

(2) Relative proximity calculation: For each evaluation object, calculate its distance to the positive and negative ideal solutions:

$$\begin{aligned} d_j^+ &= \sum_{i=1}^m (x_{ij}^* - a_i^{++})^2 \\ d_j^- &= \sum_{i=1}^m (x_{ij}^* - a_i^{--})^2 \end{aligned} \quad (5)$$

Where, m is the indicator number and j is the evaluation object number.

(3) Sorting criteria: Calculate the proximity coefficient C_i :

$$C_i = \frac{d_j^-}{d_j^+ + d_j^-} \quad (6)$$

The closer C_i is to 1, the closer the evaluation object is to the positive ideal solution, and the better the evaluation result.

(4) Final sort :All evaluation objects are sorted according to the C_i value. The larger the C_i value, the higher the ranking of the scheme.

The weights obtained by the CRITIC method above are applied to the standardized data in the TOPSIS process, that is, the weighted distance is used in the calculation of proximity to reflect the importance of indicators determined according to the CRITIC method.

4.2.3. Calculation result: Scores and rankings of each institution or organization

By analyzing the power, resources and interests of each organization, the secondary indicators of each indicator are obtained, and the weight of each secondary indicator is obtained by the Critic method. The results are shown below:

Through the above calculation method, the score of 12 three-level indicators of each institution or organization can be obtained, and the comprehensive score of the organization or organization can be obtained according to the score of each index. Put the combined scores of each organization or institution in order. The calculation results and sorting results are shown in the figure 3:

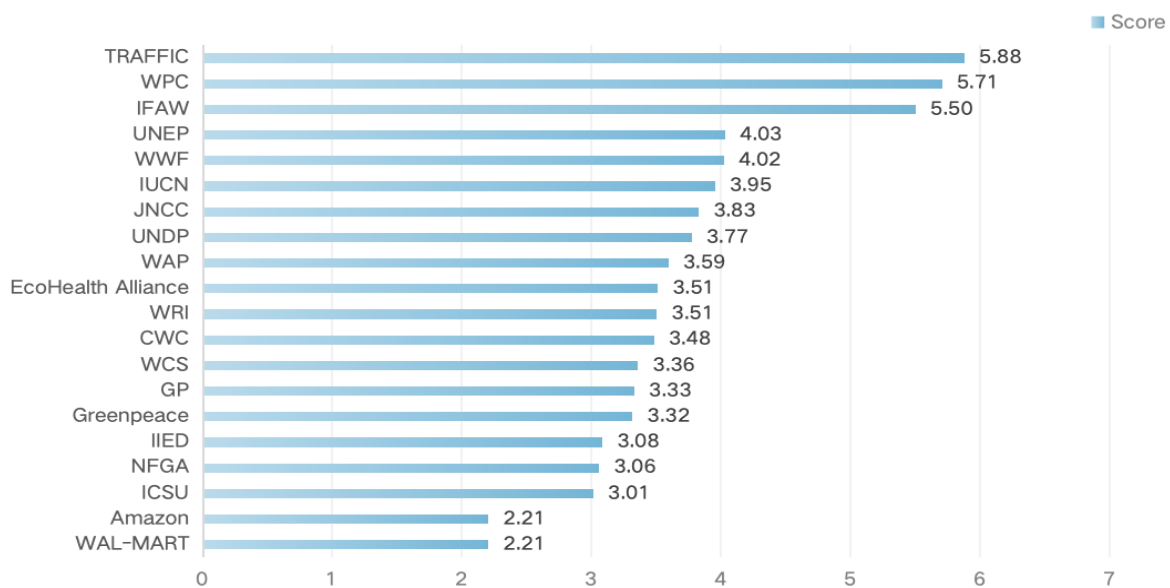


Figure 3. The graph of the overall score results for each institution or organization.

As can be seen from the above table, the organization that ranks first according to the score is TRAFFIC, whose score is 5.88, so we choose it as our client. The specific scores of Traffic indicators are shown in the following table 2:

Table 2. The score of each index and the comprehensive score of Traffic organization.

Organization	TRAFFIC
Political influence	8.5
Decision-making ability	8
International cooperation capacity	8.5
Technical resources	8.5
Human resources	7.5
Infrastructure	7.5
Environmental awareness	8.5
Sense of social responsibility	8.5
Long-term goal	8.5
Willingness to cooperate	9
Law enforcement capacity	4
Financial capacity	6
Score	5.8775

4.3. Final step: Coupling degree analysis

In the coupling coordination degree model between two systems, suppose we have two subsystems 1 and 2, their respective comprehensive indexes are U_1 and U_2 , and they have comprehensive coordination index T , coupling degree C , and weight coefficient $a = b = 0.5$ (can be adjusted according to the actual situation), then:

The calculation formula of coupling degree C :

$$C = \frac{1}{n(n-1)} \sum_{i=1}^n \sum_{j=1, j \neq i}^n A_{ij} \cdot d(X_i, X_j) \quad (7)$$

Here, C represents the coordination degree of the system, A_{ij} represents the coupling relationship between subsystems, and $d(x_i, x_j)$ represents the degree of measurement difference between subsystems i and j . According to this problem, the calculation method to measure the degree of difference of indicators adopts Euclidean distance. The overall coordination index T may be calculated in the following manner:

$$T = a \cdot U_1 + b \cdot U_2 \quad (8)$$

The calculation formula of coupling coordination degree D is based on the relationship between C and T :

$$D = \frac{C}{T} \quad (9)$$

or use some form of correction to ensure that D is within the $[0,1]$ range.

According to the above calculation method of coupling coordination degree, each value of coupling coordination degree of each institution or organization is obtained. The results are shown in the following figure 4:

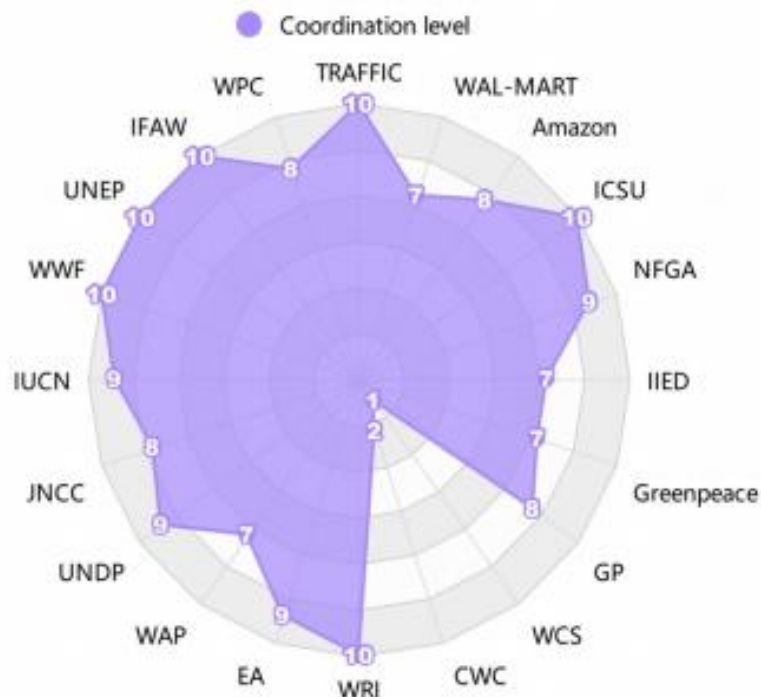


Figure 4. The degree of coupling of each mechanism.

A high level of coupled coordination showcases the effective collaboration and resource allocation among various subsystems. It facilitates inter-departmental and inter-agency information sharing, fostering a collaborative environment that reduces redundancies, optimizes the use of resources, and significantly enhances the efficiency and impact of conservation initiatives.

5. Conclusions

Today, the global illicit hunting and trade of wildlife significantly damage ecosystems and threaten global biodiversity, increasingly becoming the fourth largest illegal trade world wide. To mitigate wildlife trade and protect flora and fauna, it is crucial to carefully select appropriate enforcement stakeholders. From 50 candidate organizations, this study identified 20 that meet the client's standards, based on criteria including visibility, impact, and global reach. These organizations were then evaluated using a comprehensive model known as CRITIC-TOPSIS along with 12 indicators.

Additionally, an analysis of their coupling degree was conducted, which showed positive coupling effects. The results of this evaluation highlighted several organizations with exemplary performance across the 12 indicators. Notable among these were international bodies with extensive reach and influence, as well as local NGOs with deep-rooted connections in high-risk areas. The positive coupling effects suggest that fostering partnerships and collaborative frameworks among these organizations can amplify their impact, creating a united front against wildlife trade.

Moving forward, it is essential to leverage the strengths of these selected organizations to develop integrated enforcement strategies. Enhancing communication channels, sharing best practices, and coordinating efforts can lead to more efficient and effective enforcement actions. Additionally, continuous monitoring and adaptation of strategies in response to evolving wildlife trade dynamics are critical.

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