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Optimizing Tourism Offers with COPRAS-SVNS for Stress Reduction and Sustainability Promotion

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Abstract. This study focused on the evaluation of tourist packages in the Pichincha region, Ecuador, designed to combine sustainability and stress reduction. Its main objective was to identify the most effective alternatives using multicriteria decision methods, incorporating neutrosophic logic as a key approach. Eight tourist packages were analyzed, integrating activities such as reforestation, meditation, and rural tourism with organic gardens, all aimed at environmental sustainability and the emotional well-being of participants. Using the neutrosophic correlation method, the most relevant criteria for subsequent analysis were selected. The application of the COPRAS-SVNS method determined that the "Eco-destinations with electric bicycle" package represented the best option, as it optimally balanced the objectives of sustainability and stress reduction. The study emphasized the relevance of neutrosophic logic in addressing the uncertainty and ambiguity inherent in evaluating complex tourist alternatives.

Keywords: Sustainable tourism, stress reduction, multicriteria decision-making, neutrosophic logic, COPRAS-SVNS.

1 Introduction

Tourism has undergone significant evolution since its beginnings when it was primarily limited to travel for recreational purposes. Today, this concept has acquired new dimensions, including the pursuit of physical and emotional well-being, connection with nature, and the promotion of sustainable practices [1], [2]. As people seek experiences that allow them to disconnect from the fast-paced rhythm of modern life, tourism emerges as a means to achieve tranquility, relaxation, and, at the same time, contribute to environmental conservation [3].

Stress, understood as the body's response to situations perceived as threatening or challenging, has been the subject of numerous studies due to its adverse effects on health. It has been demonstrated that prolonged stress negatively impacts various areas of human well-being, including mental, physical, and social health [4]. Its relationship with disorders such as anxiety, depression, hypertension, and even autoimmune diseases has been extensively documented [5]–[7]. To mitigate these effects, various approaches such as meditation, physical exercise, and connection with nature have proven to be effective tools for stress reduction. Thus, tourism not only serves as a means for recreation but also as a strategy for stress management, promoting physical and emotional recovery for individuals.

In this context, previous studies in the Ecuadorian region of Pichincha have identified the close relationship between the type of tourism consumed in the area and the levels of stress that tourists experience when enjoying these services. This raises the need to optimize tourism offerings so that not only the momentary pleasure or enjoyment is considered, but also its capacity to contribute to sustainability and stress reduction.

This challenge requires the use of effective decision-making tools that allow for the selection of tourism packages that best combine these two elements. Multicriteria decision-making (MCDM) methods are tools that enable the evaluation of alternatives based on multiple criteria [8], making them a powerful resource for addressing the complexity of problems involving multiple competing factors, such as the design of tourism packages that balance sustainability and well-being.

However, traditional decision-making methods are not always suitable for dealing with the uncertainty inherent in real-world problems [9]–[11]. The available information is often incomplete, ambiguous, or imprecise, making it difficult to formulate decisions that faithfully reflect reality. In this regard, fuzzy set theory, introduced by Zadeh in the 1960s, has stood out as a tool for modeling imprecision in information. However, this theory has limitations when addressing indeterminacy and ambiguity in complex situations. Due to these limitations, a new approach known as Neutrosophy emerged, developed by Florentin Smarandache in 1995. Neutrosophy is a branch of mathematical philosophy that allows modeling not only uncertainty but also indeterminacy and falsehood in a unified space, making it a more robust tool for decision-making in complex environments [12].

Neutrosophy has proven especially useful in solving multicriteria problems, as it allows for the incorporation of vagueness and indeterminacy into the evaluation of alternatives, which is essential for tackling the uncertainties arising in the field of sustainable tourism. By combining Neutrosophy with multicriteria decision-making methods, decision-makers can introduce greater flexibility into the process, allowing for a more comprehensive and realistic analysis of the available alternatives. In practice, this involves creating more accurate evaluation models that consider both the quantitative and qualitative aspects of tourism alternatives [13].

The use of multicriteria decision-making methods and Neutrosophy enables a more comprehensive and detailed evaluation of tourism offerings, considering diverse criteria. In this regard, the purpose of this work is to identify and evaluate tourism packages in the Pichincha region that combine sustainability and stress reduction. Through this, it is expected to select the optimal alternative that enhances the user experience and promotes responsible tourism practices. By conducting detailed analysis using multicriteria decision-making methods supported by Neutrosophy, the goal is to provide a tool to improve the tourism offering, optimizing customer experience, and promoting more responsible and sustainable practices in the industry.

2 Methods

2.1 Preliminaries

Definition 1. Let X represent a space of points (or objects), with a generic element denoted as x. A neutrosophic set A in X is characterized by a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$. The functions $T_A(x)$, $I_A(x)$ and $F_A(x)$ are real standard or nonstandard subsets of $]0^-, 1^+[$, i.e., $T_A(x): X \to]0^-, 1^+[$, $I_A(x): X \to]0^-, 1^+[$ and $F_A(x): X \to]0^-, 1^+[$. There is no restriction on the sum of $T_A(x)$, $I_A(x)$ and $F_A(x)$, so $0^- \leq supT_A(x) + supI_A(x) + supF_A(x) \leq 3^+$. Due to the complexity of applying neutrosophic sets in practice, the single-valued neutrosophic set (SVNS) was introduced as a simplified form for real-world scientific and engineering applications. The following definitions provide the formalization of SVNSs.

Definition 2. Given a set X of objects with elements denoted by x, an SVNS A in X is characterized by a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$ for each point x in X, where $T_A(x), I_A(x), F_A(x) \in [0,1]$. An SVNS A can be expressed as $A = \{x, T_A(x), I_A(x), F_A(x) \,|x \in X\}$, and the sum of $T_A(x)$, $I_A(x)$ and $F_A(x)$, satisfies $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

Definition 3. The complement of an SVNS A is denoted by Ac and is given by$Ac = \{x, F_A(x), 1 - I_A(x), T_A(x) \,|x \in X\}$

Definition 4. An SVNS A i is considered a subset of another SVNS $B, A \subseteq B$ if and only if $T_A(x) \leq$

$T_B(x), I_A(x) \geq I_B(x)$, and $F_A(x) \geq F_B(x)$ for every x in X.

Definition 5. Two SVNSs A and B are equal, written as A = B, if and only if $A \subseteq B$ and $B \subseteq A$

Definition 6. For any two SVNSs A and B in the universe $X = \{x_1, x_2, \ldots, x_n\}$, their correlation coefficient is defined as:[14]

$$M(A,B) = \frac{1}{3n}\sum_{i=1}^{n}[\phi_i(1-\Delta T_i) + \varphi_i(1-\Delta I_i) + \psi_i(1-\Delta F_i)] \quad (1)$$

Where the parameters are defined as:

$$\phi_i = \frac{3-\Delta T_i - \Delta T_{max}}{3-\Delta T_{min} - \Delta T_{max}}, \qquad \varphi_i = \frac{3-\Delta I_i - \Delta I_{max}}{3-\Delta I_{min} - \Delta I_{max}}, \qquad \psi_i = \frac{3-\Delta F_i - \Delta F_{max}}{3-\Delta F_{min} - \Delta F_{max}}$$

The differences are calculated as:

$$\Delta T_i = |T_A(x_i) - T_B(x_i)|, \qquad \Delta I_i = |I_A(x_i) - I_B(x_i)|, \qquad \Delta T_i = |T_A(x_i) - T_B(x_i)|,$$

and

$$\Delta T_{min} = min_i|T_A(x_i) - T_B(x_i)|, \qquad \Delta F_{min} = min_i|F_A(x_i) - F_B(x_i)|, \qquad \Delta I_{max} = max_i|I_A(x_i) - I_B(x_i)|,$$

$$\Delta I_{min} = min_i|I_A(x_i) - I_B(x_i)|, \qquad \Delta T_{max} = max_i|T_A(x_i) - T_B(x_i)|, \qquad \Delta F_{max} = max_i|F_A(x_i) - F_B(x_i)|,$$

for any $x_i \in X$ and i = 1, 2, . . ., n

However, the differences of importance are considered in the elements in the universe. Therefore, it is necessary to take the weight of the element. $x_i (i = 1, 2, \ldots, n)$ into account. In the following, a weighted correlation coefficient between SVNSs is introduced.

Definition 7. Let w_i be the weight for each element x_i $(i = 1, 2, \ldots, n), w_i \in [0, 1]$, and $\sum_{i=1}^{n} w_i = 1$, then the following weighted correlation coefficient between the SVNSs A and B can be defined:

$$M_w(A,B) = \frac{1}{3}\sum_{i=1}^{n} w_i[\phi_i(1-\Delta T_i) + \varphi_i(1-\Delta I_i) + \psi_i(1-\Delta F_i)] \quad (2)$$

Definition 8. For two SVNS numbers $A = (T_A, I_A, F_A)$ and $B = (T_B, I_B, F_B)$ Their sum is defined as:

$$A + B = (T_A + T_B - T_A t_B, I_A I_B, F_A F_B) \quad (3)$$

Definition 9. The product of $A = (T_A, I_A, F_A)$ and $B = (T_B, I_B, F_B)$ is given by:

$$A * B = (T_A T_B, I_A + I_B - I_A I_B, F_A + F_B - F_A F_B) \quad (4)$$

Definition 10. Let $A = (T_A, I_A, F_A)$ be a SVN number and $\lambda \in \mathbb{R}$ an arbitrary positive real number, then:

$$\lambda A = \left(1-(1-T_A)^{\lambda}, I_A{}^{\lambda}, F_A{}^{\lambda}\right), \lambda > 0 \quad (5)$$

Definition 11. For two SVNSs A= $\{A_1, A_2, \ldots, A_n\}$, and B= $\{B_1, B_2, \ldots, B_n\}$ (i= 1,2,…,m) the separation measure based on normalized Euclidean distance is:

$$q_n(A,B) = \sqrt{\frac{1}{3n}\sum_{j=1}^{n}\left(\left(T_A(x_i) - T_B(x_i)\right)\right)^2 + \left(\left(I_A(x_i) - I_B(x_i)\right)\right)^2 + \left(\left(F_A(x_i) - F_B(x_i)\right)\right)^2}$$

$$(i = 1, 2, \ldots, n) \quad (6)$$

Definition 12. Let $A = (T_A, I_A, F_A)$ be a single-valued neutrosophic number, a score function is mapped $\tilde{N}_A$ into the single crisp output $S(\tilde{N}_A)$ as follows:

$$S(\tilde{N}_A) = \frac{3 + T_A - 2I_A - F_A}{4} \quad (7)$$

where $S(\tilde{N}_A) \in [0,1]$. This score function ensures consistency within the interval for SVNS evaluations.

2.2 Decision-making method using the correlation coefficient of SVNSs [14]

In problems of decision-making involving multiple attributes and single-valued neutrosophic information, the performance of an alternative A_i $(i = 1, 2, \ldots, m)$ for a given attribute C_j $(j = 1, 2, \ldots, n)$ is characterized as $A_i = \{C_j, T_{Ai}(C_j), I_{Ai}(C_j), F_{Ai}(C_j) | Cj \in C, j = 1, 2, \ldots, n\}$. Where $T_{Ai}(C_j)$, $I_{Ai}(C_j)$, $F_{Ai}(C_j)) \in [0, 1]$ and $0 \leq T_{Ai}(C_j), I_{Ai}(C_j), F_{Ai}(C_j) \leq 3$ for $Cj \in C, j = 1, 2, \ldots, n, and\ i = 1, 2, \ldots, m$.

For simplicity, the set of values $T_{Ai}(C_j)$, $I_{Ai}(C_j)$, $F_{Ai}(C_j)$ is expressed as a single-valued neutrosophic value (SVNV)$d_{ij} = < t_{ij}, i_{ij}, f_{ij} >$ $(i = 1, 2, \ldots, m;\ j = 1, 2, \ldots, n)$. This value typically originates from expert evaluations of the alternative $A_i$with respect to a criterion C_j. Consequently, a single-valued neutrosophic decision matrix can be constructed as $D = (d_{ij})_{mxn}$.

In multiple-attribute decision-making, the concept of an ideal point serves as a theoretical benchmark to evaluate alternatives, even though such an ideal alternative A^* can be defined as:

$d_j^* =< t_j^*, i_j^*, f_j^* >=< 1, 0, 0 >$ $(j = 1, 2, \ldots, n)$

The weighted correlation coefficient between an alternative A_i $(i = 1, 2, \ldots, m)$ and the ideal alternative A^* is given by:

$$M_w(A_i, A^*) = \frac{1}{3}\sum_{j=1}^{n} w_j\left[\phi_{ij}\left(1 - \Delta t_{ij}\right) + \varphi_{ij}\left(1 - \Delta i_{ij}\right) + \psi_{ij}\left(1 - \Delta f_{ij}\right)\right] \tag{8}$$

where the parameters are defined as follows:

$$\phi_{ij} = \frac{3 - \Delta t_{ij} - \Delta t_{i\,max}}{3 - \Delta t_{i\,min} - \Delta t_{i\,max}},$$

$$\varphi_i = \frac{3 - \Delta i_{ij} - \Delta i_{i\,max}}{3 - \Delta i_{i\,min} - \Delta i_{i\,max}},$$

$$\psi_i = \frac{3 - \Delta f_{ij} - \Delta f_{i\,max}}{3 - \Delta f_{i\,min} - \Delta f_{i\,max}},$$

$$\Delta t_{ij} = \left|t_{ij} - t_j^*)\right|,$$

$$\Delta i_{ij} = \left|i_{ij} - i_j^*)\right| ,$$

$$\Delta f_{ij} = \left|f_{ij} - f_j^*)\right|,$$

$$\Delta t_{i\,min} = min_j\left|t_{ij} - t_j^*\right|,$$

$$\Delta i_{i\,min} = min_j\left|i_{ij} - i_j^*\right|,$$

$$\Delta f_{i\,min} = min_j\left|f_{ij} - f_j^*\right|,$$

$$\Delta t_{i\,max} = max_j\left|t_{ij} - t_j^*\right|,$$

$$\Delta i_{i\,max} = max_j\left|i_{ij} - i_j^*\right|,$$

$$\Delta f_{i\,max} = max_j\left|f_{ij} - f_j^*\right|,$$

for $i = 1, 2, \ldots, m$ and $j = 1, 2, \ldots, n$.

Using the correlation coefficients $M_w(A_i, A^*)$ $(i = 1, 2, \ldots, m)$, alternatives can be ranked, and the best alternative(s) can be identified.

2.3 COPRAS-SVNS

The concept of a linguistic variable proves to be highly beneficial in addressing decision-making problems characterized by intricate and multifaceted content. The value of such a variable is defined as an element within its term set, and these linguistic values can be represented as single-valued neutrosophic numbers (SVNNs).

Within the COPRAS-SVNS method, the decision-making framework involves k decision-makers, m alternatives, and n criteria. The k decision-makers assess the importance of the m alternatives based on the n criteria and evaluate the performance of these criteria using linguistic terms, which are subsequently transformed into SVNNs. Table 1 illustrates the importance weights assigned to linguistic terms, expressed through SVNNs.

Table 1: Linguistic variable and SVNSs. Source:[15]

Linguistic terms	**SVNNs**
Extremely good (EG)/ 10 points	(1.00, 0.00, 0.00)
Very very good (VVG)/ 9 points	(0.90, 0.10, 0.10)
Very good (VG)/ 8 points	(0.80, 0.15, 0.20)

Linguistic terms	SVNNs
Good (G) / 7 points	(0.70, 0.25, 0.30)
Medium good (MG) / 6 points	(0.60, 0.35, 0.40)
Medium (M) / 5 points	(0.50, 0.50, 0.50)
Medium bad (MB) / 4 points	(0.40, 0.65, 0.60)
Bad (B) / 3 points	(0.30, 0.75, 0.70)
Very bad (VB) / 2 points	(0.20, 0.85, 0.80)
Very very bad (VVB) / 1 point	(0.10, 0.90, 0.90)
Extremely bad (EB) / 0 points	(0.00, 1.00, 1.00)

The COPRAS-SVNS method for group decision-making is executed through the following sequential steps[16,17]:

- **Determine Expert Importance**: When decisions are made by a panel of experts, the contribution of each expert to the final decision is quantified. Let $\lambda = (\lambda_1, \lambda_2, \ldots, \lambda_k)$ represent the importance vector of the k experts, where $\lambda_k \geq 0$ and $\sum_{k=1}^{K} \lambda_k = 1$.
- **Evaluate Alternatives**: Each expert evaluates the m alternatives with respect to the n criteria using linguistic terms (refer to Table 1). The resulting decision matrix for an expert k is denoted as:

$$X^k = \begin{bmatrix} {x^k}_{11} & {x^k}_{12} \cdots & {x^k}_{1n} \\ {x^k}_{22} & {x^k}_{22} \cdots & {x^k}_{2n} \\ \vdots & \vdots & \vdots \\ {x^k}_{m1} & {x^k}_{m2} \cdots & {x^k}_{mn} \end{bmatrix} \tag{9}$$

- **Calculate Criterion Weights**: The aggregated weights of the criteria are derived as:

$$\mathrm{w}_j = \lambda_1 \mathrm{w}_j^{(1)} \cup \lambda_2 \mathrm{w}_j^{(2)} \cup \ldots \cup \lambda_k \mathrm{w}_j^{(k)} = \left(1 - \prod_{k=1}^{K}\left(1 - {T_j}^{(w_k)}\right)^{\lambda_k}, \prod_{k=1}^{K}\left({I_j}^{(w_k)}\right)^{\lambda_k}, \prod_{k=1}^{K}\left({F_j}^{(w_k)}\right)^{\lambda_k}\right) \tag{10}$$

- **Construct Aggregated Decision Matrix**: The aggregated weighted decision matrix. $\tilde{X}$ is given by:

$$\tilde{X} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} \cdots & \tilde{x}_{1n} \\ \tilde{x}_{22} & \tilde{x}_{22} \cdots & \tilde{x}_{2n} \\ \vdots & \vdots & \vdots \\ \tilde{x}_{m1} & \tilde{x}_{m2} \cdots & \tilde{x}_{mn} \end{bmatrix} \tag{11}$$

where each element is determined as:

$$\tilde{x}_{ij} = \lambda_1 \mathrm{x}_{ij}^{(1)} \cup \lambda_2 \mathrm{x}_{ij}^{(2)} \cup \ldots \cup \lambda_k \mathrm{x}_{ij}^{(k)} = \left(1 - \prod_{k=1}^{K}\left(1 - {T_j}^{(x_k)}\right)^{\lambda_k}, \prod_{k=1}^{K}\left({I_j}^{(x_k)}\right)^{\lambda_k}, \prod_{k=1}^{K}\left({F_j}^{(x_k)}\right)^{\lambda_k}\right) \tag{12}$$

- **Determine Weighted Decision Matrix**: The weighted decision matrix can be expressed as $D = \lfloor d_{ij} \rfloor, d = 1,2, \ldots, m; j = 1,2, \ldots, n$, where $d_{ij} = \tilde{x}_{ij} * w_j$. A single element of the weighted decision matrix can be calculated as

$$d_{ij} = T_{ij}^{\tilde{x}} T_j^{w}, I_{ij}^{\tilde{x}} + I_j^{w} - I_{ij}^{\tilde{x}} I_j^{w}, F_{ij}^{\tilde{x}} + F_j^{w} - F_{ij}^{\tilde{x}} F_j^{w} \tag{13}$$

- **Summation for Benefit Criteria**: For criteria to be maximized $L_+ = \{1,2, \ldots, L_{max}\}$ calculate the benefit index:

$$P_{+i} = \sum_{j=1}^{L_{max}} d_{+ij} \tag{14}$$

- **Summation for Cost Criteria**: For criteria to be minimized $L_- = \{1,2, \ldots, L_{min}\}$ calculate the cost index:

$$P_{-i} = \sum_{j=1}^{L_{min}} d_{-ij} \tag{15}$$

- **Determine Minimum Cost Value**: Identify the smallest P_{-i} among all alternatives.

- **Calculate Score Values**: The aggregated benefit and cost indices are used to derive the score values. Q_i for each alternative. At the beginning, the score values are calculated from the aggregated values for benefit and the cost $S(P_{+i})$ and $S(P_{-i})$ by using equation (7). The score values of the alternatives can be expressed as

$$Q_i = S(P_{+i}) + \frac{S(P_{-min}) \sum_{i=1}^{L_{min}} S(P_{-i})}{S(P_{-min}) \sum_{i=1}^{L_{min}} \frac{S(P_{-min})}{S(P_{-i})}} \tag{16}$$

- **Optimality Criterion**: Identify the optimal alternative based on the maximum Q_i:

$$K = max_i Q_i ; i = 1,2, \dots , m \tag{17}$$

- **Rank Alternatives**: Higher Q_i values correspond to higher-ranking alternatives, indicating their priority.

3 Results

The study analyzed eight sustainable tourism packages, selected for their ability to integrate environmental sustainability with benefits in stress reduction. These packages included activities designed to promote ecological awareness and personal well-being. Among them, the Reforestation and Meditation package combines reforestation days with outdoor meditation sessions, promoting ecosystem restoration and mental relaxation. The Rural Tourism with Organic Gardens package highlights local agricultural practices and healthy eating, while the Digital Detox in Nature Reserves focuses on digital rest. Other options included Eco-destinations with Electric Bicycles, Wellness Retreats in Eco-Lodges, Exploration of Local Fauna and Flora, Cultural Routes with Sustainable Traditions, and Environmental Clean-Up Camps. Each package makes unique contributions to sustainability and emotional well-being.

To evaluate the alternatives, the experts involved in the study identified various relevant elements for analysis. Through a brainstorming process, six potential criteria were initially generated. However, it was deemed necessary to prioritize those elements that could have a more significant impact on the quality of the experience offered to potential customers of the tourism packages. For this purpose, the neutrosophic correlation method was implemented, which allowed for refining and selecting the most relevant criteria, thus ensuring an approach focused on maximizing the effectiveness and relevance of the alternatives studied.

In this sense, the initial evaluations from the experts provided the data for the development of the method. Table 1 presents the main results obtained.

Table 1: Method output. Source: Own elaboration

Criteria evaluated	φij			μij			ψij			Mw
	C1	C2	C3	C1	C2	C3	C1	C2	C3	
Package cost	1.20	1.20	1.20	1.08	1.08	1.08	1.04	1.04	1.08	0.67
Environmental sustainability	1.14	1.14	1.14	1.08	1.08	1.08	1.04	1.04	1.08	0.72
Diversity of activities	1.20	1.20	1.20	1.08	1.08	1.08	1.04	1.04	1.08	0.66
Community participation	1.40	1.40	1.40	1.09	1.09	1.09	1.08	1.08	1.09	0.56
Logistics and accessibility	1.47	1.47	1.47	1.14	1.14	1.14	1.08	1.08	1.09	0.55
Impact on stress reduction	1.20	1.20	1.20	1.08	1.08	1.08	1.04	1.04	1.09	0.69

Subsequently, based on the criteria obtained as the most relevant in the previous analysis, the evaluation of the initially considered tourism package options was conducted. Using the experts' evaluations and following the logic of the COPRAS-SVNS method, the necessary transformations were made to obtain the decision matrix. The equation (12) was then applied, which allowed for generating the weighted decision matrix, and the results are summarized in Table 2.

Table 2: Weighted decision matrix. Source: Own elaboration

Tour packages	Package cost	Environmental sustainability	Impact on stress reduction
Reforestation and meditation	(0.53;0.47;0.43)	(0.5;0.5;0.47)	(0.28;0.8;0.83)
Rural tourism with organic gardens	(0.53;0.47;0.43)	(0.4;0.6;0.59)	(0.3;0.76;0.78)
Digital disconnection in nature reserves	(0.75;0.25;0.23)	(0.62;0.38;0.36)	(0.53;0.47;0.41)
Eco-destinations with electric bicycles	(0.57;0.43;0.38)	(0.58;0.42;0.39)	(0.54;0.46;0.42)
Wellness retreats in eco-lodges	(0.59;0.41;0.39)	(0.49;0.51;0.51)	(0.54;0.46;0.42)
Exploring local flora and fauna	(0.53;0.47;0.43)	(0.48;0.53;0.49)	(0.43;0.58;0.55)
Cultural routes with sustainable traditions	(0.61;0.39;0.34)	(0.54;0.46;0.42)	(0.48;0.53;0.49)
Environmental clean-up camps	(0.57;0.43;0.38)	(0.5;0.5;0.47)	(0.43;0.58;0.55)

Once the relevant information was obtained, the coefficients established by the method for selecting the tourist packages were calculated. During this analysis, it was identified that criteria 2 and 3 correspond to benefit criteria, so their objective was to be maximized. On the other hand, criterion 1 was classified as a cost criterion, so it was considered more beneficial to minimize it. The results derived from this analysis and calculation of the data are presented in Table 3.

Table 3: Weighted decision matrix. Source: Own elaboration

Tour packages	Pi+	Pi-	S(P+)	S(P-)	Q
Reforestation and meditation	(0.62, 0.40, 0.39)	(0.53, 0.47, 0.43)	0.59	0.54	1.24
Rural tourism with organic gardens	(0.69, 0.46, 0.46)	(0.53, 0.47, 0.43)	0.65	0.54	1.30
Digital disconnection in nature reserves	(0.82, 0.18, 0.15)	(0.75, 0.25, 0.23)	0.83	0.76	1.29
Eco-destinations with electric bicycles	(0.81, 0.19, 0.16)	(0.57, 0.43, 0.38)	0.82	0.58	1.41
Wellness retreats in eco-lodges	(0.77, 0.24, 0.22)	(0.59, 0.41, 0.39)	0.77	0.59	1.36
Exploring local flora and fauna	(0.70, 0.31, 0.27)	(0.53, 0.47, 0.43)	0.70	0.54	1.35
Cultural routes with sustainable traditions	(0.76, 0.25, 0.20)	(0.61, 0.39, 0.34)	0.76	0.62	1.33
Environmental clean-up camps	(0.71, 0.29, 0.26)	(0.57, 0.43, 0.38)	0.72	0.58	1.32

After applying the method, the results indicated that the tourism package with the highest Q value was "Eco-destinations with electric bicycles," suggesting that this option might be the most suitable for combining sustainability and stress reduction in the Pichincha region, according to the experts. The values close between the packages, such as "Wellness retreats in eco-lodges" and "Exploration of local fauna and flora," show that several alternatives offer similar benefits in terms of enhancing the user experience and promoting responsible practices. However, the difference in Q values reflects a slight preference for packages that integrate more direct physical and ecological well-being practices.

4. Conclusion

This study allowed for a detailed analysis of several tourism packages in the Pichincha region, aiming to identify those that best combine environmental sustainability with stress reduction. Using multicriteria decision-making methods supported by neutrosophic logic, various alternatives integrating ecological and well-being practices were evaluated. This approach addressed the uncertainty inherent in the available information, providing a robust framework for selecting the most suitable option based on multiple criteria. The results showed that the "Eco-destinations with electric bicycles" package stood out as the optimal option, highlighting the effectiveness of this method in discerning between alternatives offering similar benefits in terms of sustainability and well-being.

The study made a significant contribution to improving the tourism offerings in Pichincha, providing an efficient tool to optimize the user experience and promote responsible practices. The combination of Neutrosophy with multicriteria decision-making methods proved essential for handling the ambiguity and indeterminacy present in tourism decision-making. This methodology not only enabled more precise evaluation but also expanded the possibilities for analysis in future studies on sustainable tourism, offering a path toward creating more balanced offerings adapted to the contemporary needs of tourists.

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