



Neutrosophic Approach to Increasing Production in Small Guinea Pig Breeding Systems: Exploring Tree Soft Set

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Abstract

The article examines the neutrosophic approach as an innovative tool to optimize production in small guinea pig farming systems. Through the exploration of bipolar sets and interval values, the application of this methodology in improving breeding processes is investigated, thus identifying areas of improvement and opportunities for economic and sustainable growth in the sector. The research highlights the importance of considering the uncertainty and imprecision inherent in these systems, proposing a flexible and adaptive framework that allows informed and strategic decision making to increase productivity and profitability. Likewise, the study highlights the need for a holistic and multidisciplinary understanding of the challenges and opportunities in guinea pig farming, recognizing the complexity of the social, economic, and environmental factors involved. Through an interdisciplinary approach, we seek to integrate traditional knowledge and practices with innovative approaches, thus promoting sustainability and the well-being of both producers and animals. Ultimately, this article offers a comprehensive and dynamic perspective on how the neutrosophic approach can significantly contribute to the development and optimization of guinea pig farming systems, thereby driving progress and prosperity in the agricultural sector.

Keywords: Neutrosophic; Guinea Pig Breeding; Decision Making; Neutrosophic Tree Soft Set

1. Introduction

Guinea pig farming, an economic activity rooted in many rural communities, has emerged as a vital component in the food security and economic livelihood of many families in various regions of the world. However, despite their importance, small guinea pig production systems face a series of challenges that limit their potential for growth and development. From managing limited resources to mitigating health risks and optimizing production processes, producers face a series of obstacles that require innovative and adaptive approaches to overcome. In this context, the neutrosophic approach emerges as a promising methodology to address the complexity and uncertainty inherent in guinea pig breeding, offering a flexible and dynamic framework for making informed and strategic decisions [1].

The neutrosophic approach, based on neutrosophic set theory, focuses on the management of uncertainty and ambiguity in data and information. By allowing the representation of imprecise and contradictory information through bipolar sets and interval values, this approach provides a robust platform for the modeling and analysis of complex systems, such as guinea pig farming systems. Exploring bipolar sets and interval values [2] in the context of guinea pig farming allows researchers and producers to examine and evaluate the factors that affect the production and performance of these systems more accurately and holistically. The objective of this study is to investigate and analyze the potential of the neutrosophic approach in increasing production in small guinea pig breeding systems, specifically through the exploration of bipolar sets and interval values. By critically examining the application of this approach in the context of

guinea pig farming, we seek to identify areas of improvement and opportunities for optimization of production processes and practices. Furthermore, the aim is to generate scientific and practical knowledge that contributes to the sustainability and development of the guinea pig breeding sector, thus promoting the economic and social well-being of rural communities that depend on this activity.

This study is based on an exhaustive review of the existing literature on guinea pig breeding [3] and the neutrosophic approach [4], as well as the collection and analysis of primary data obtained through interviews, surveys, and field observations. A rigorous and multidisciplinary methodological approach will be used to guarantee the validity and reliability of the results obtained. Furthermore, it is expected that the findings of this study will contribute to theoretical and practical advances in the field of guinea pig breeding and the application of the neutrosophic approach in the management of agricultural systems. Ultimately, this study is expected to provide valuable information and guidance for producers, researchers, policymakers, and other stakeholders interested in improving the productivity and sustainability of guinea pig farming systems at local, national and international levels.

2. Related Work.

2.1. Bipolar Neutrosophic Sets

This section presents some definitions of interval neutrosophic set (IVNS) [5] and bipolar neutrosophic sets [6].

Definition 1[7]

Let Y be a universe of discourse with a generic element in Y denoted by y . We can define the neutrosophic variable y as $y = (T, I, F)$ where T , I and F refer to the degrees of truth, indeterminacy, and falsity.

$$0 \leq \sup (T(y)) + \sup (I(y)) + \sup (F(y)) \leq 3 \quad (1)$$

We can define the IVNS as:

$$y = [T^L, T^U], [I^L, I^U], [F^L, F^U] \quad (2)$$

Definition 2

Let $y_1 = ([T_{yL1}, T_{yU1}], [I_{yL1}, I_{yU1}], [F_{yL1}, F_{yU1}])$ and $y_2 = ([T_{yL2}, T_{yU2}], [I_{yL2}, I_{yU2}], [F_{yL2}, F_{yU2}])$ two neutrosophic numbers with interval values, The complementation of a neutrosophic number with interval values is defined as follows:

$$y_1^c = ([F_{yL1}, F_{yU1}], [1 - I_{yU1}, 1 - I_{yL1}], [T_{yL1}, T_{yU1}]) \quad (3)$$

Definition 3

We can define bipolar neutrosophic sets (BNS) as [7, 8]:

$$A = \{(x, T^+(x), I^+(x), F^+(x), T^-(x), I^-(x), F^-(x)) : x \in X\} \quad (4)$$

Where $T^+(x), I^+(x), F^+(x), E \rightarrow [0,1], T^-, I^-, F^-, X \rightarrow [-1,0]$

The positive membership degrees $T^+(x), I^+(x), F^+(x)$ represent the levels of truth membership, indeterminate membership, and false membership of an element $x \in X$ in relation to a bipolar neutrosophic set A . Conversely, the negative membership degrees $T^-(x), I^-(x), F^-(x)$ indicate the levels of truth membership, indeterminate membership, and false membership of an element $x \in X$ with respect to an implicit counter-property associated with a bipolar neutrosophic set A .

TreeSoft [9]

Let TSR a set of attributes of the problem (criteria),

$$TSR = \{TSR_1, TSR_2, \dots, TSR_n\}, n \geq 1 \quad (5)$$

Where $TSR_1, TSR_2, \dots, TSR_n$ are criteria from the first level of the tree.

Each attribute $TSR_i, 1 \leq i \leq n$, is formed by sub-attributes:

$$TSR_1 = \{TSR_{1.1}, TSR_{1.2}, \dots\} \quad TSR_2 = \{TSR_{2.1}, TSR_{2.2}, \dots\}$$

$$TSR_n = \{TSR_{n.1}, TSR_{n.2}, \dots\}$$

Where $TSR_{i,j}$ are sub-attributes.

Tree Set Soft can be composed of:

$$F: P(Tree(TSR)) \rightarrow P(H) \quad (11)$$

$$Tree(TSR) = \{TSR_i | i_1 = 1,2,3,\} \cup \{TSR_i | i_1, i_2 = 1,2,3,\} \cup \{TSR_i | i_1, i_2, i_3 = 1,2,3,\} \cup \dots \cup \{TSR_i | i_1, i_2, \dots, i_m = 1,2,3,\dots\} \quad (6)$$

3. Material and Methods

The next steps of the neutrosophic TreeSoft Set [10] with the VIKOR method [11].

Step 1. Build a tree and define nodes.

The tree has more than one level, in the first level the main criteria are entered such as

$$SWM_1, SWM_2, \dots, SWM_n$$

At the second level, the sub-criteria are introduced as $SWM_{1.1}, SWM_{1.2}$, and $SWM_{2.1}, SWM_{2.2}$.

Step 2. Build the decision matrix [12, 13]

The decision matrix is constructed using information from decision makers and experts between criteria and alternatives.

Step 3. Calculate the weights of the criteria [15, 16].

Criteria weights are calculated using the average method.

Step 4. Calculate the alternative closeness to the optimal solution.

$$U_i = \{\sum_{j=1}^m [r_j^* - r_j^-]\} = 1, 2, \dots, m; j = 1, 2, \dots, n; 1 \leq P \leq \infty \quad (7)$$

Where r_j^* is the best and r_j^- it's the worst

$$r_j^* = \text{maximum } x_{ij}$$

$$\{r_j^- = \text{minimum } x_{ij} \text{ (positive criteria)}\} i = 1, 2, \dots, m; j = 1, 2, \dots, n \quad (8)$$

Step 5. Calculate the values of S_i

$$S_i = \sum_{j=1}^m w_j \frac{(r_j^* - r_{ij}^-)}{(r_j^* - r_j^-)} \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n \quad (9)$$

Step 6. Calculate the values of R_i

$$R_i = \max_j \left[w_j \frac{(r_j^* - r_{ij}^-)}{(r_j^* - r_j^-)} \right] \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n \quad (10)$$

Step 7. Calculate the VIKOR index.

$$Q_i = t * \left[\frac{(S_i - S^*)}{(S^- - S^*)} \right] + (1 - t) * \left[\frac{(R_i - R^*)}{(R^- - R^*)} \right] \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n \text{ (twenty)}$$

$S^* = \text{minimum } S_i, S^- = \text{maximum } S_i, R^* = \text{minimum } R_i, R^- = \text{maximum } R_i$ (twenty-one)

Where $t = 0.5$

Step 8. Classification [17]

The components are sorted in descending order according to their Q values.

4. Case study

Increasing production in small guinea pig farming systems can be achieved through a series of specific strategies and practices. Here are seven effective ways to achieve this goal:

- 1. Improving nutrition:** Providing a balanced and nutritious diet is essential for the optimal growth and development of guinea pigs. Increasing the quality and diversity of feeds, including fresh forages, vegetables, and nutritional supplements, can improve animal health and performance.
- 2. Genetic improvement:** Selecting and breeding guinea pigs with high genetic quality can improve feed conversion efficiency and growth rate of offspring. Selecting brood stock with desirable characteristics, such as larger body size, reproductive rate, and disease resistance, can increase the productivity of the breeding system.
- 3. Proper space management:** Providing adequate and comfortable space for guinea pigs is essential for their well-being and productivity. Proper design and management of facilities, including clean, well-ventilated cages, rest, and exercise areas, can reduce stress and improve animal health, resulting in increased production.
- 4. Disease and pest control:** Implementing biosecurity practices, such as regular cleaning of facilities and periodic vaccination, can reduce the risk of diseases and pests that affect guinea pig production. Constant vigilance and rapid response to any signs of disease are crucial to maintaining herd health and minimizing losses.
- 5. Efficient reproductive management:** Optimizing the reproductive management of guinea pigs can increase the reproduction rate and the number of offspring born alive. Carefully controlling the reproductive cycle, providing adequate environmental conditions, and ensuring optimal nutrition are key aspects to maximize reproductive productivity in breeding systems.
- 6. Training and technical assistance:** Providing training and technical assistance to producers can improve their skills and knowledge in guinea pig management. Providing information on up-to-date breeding practices, management techniques and marketing strategies can empower producers to optimize the production and profitability of their breeding systems.
- 7. Product and market diversification:** Exploring new product and market opportunities can increase the income and economic stability of guinea pig producers. Diversification of products, such as fresh, processed or canned meat, as well as marketing in local, regional or international markets, can open new sources of income and increase demand for rabbit products.

Evaluation criteria:

Seven evaluative dimensions to increase production in small guinea pig breeding systems:

- **Food efficiency:** Evaluate the efficiency with which the food resources available to the guinea pigs are used. This includes the quality and quantity of food provided, as well as the minimization of waste.
- **Animal health and well-being:** Evaluate the health status and general well-being of the guinea pigs in the breeding system. This involves controlling disease incidence, providing suitable environmental conditions, and ensuring management practices that minimize stress.
- **Reproduction and growth rate:** Evaluate the effectiveness of reproduction programs and growth of guinea pigs. This involves monitoring the reproduction rate, offspring survival, and proper growth of young guinea pigs until their marketing age.
- **Environmental and facility management:** Evaluate the suitability of facilities and environmental management to promote an optimal environment for guinea pig farming. This includes proper ventilation, temperature, and humidity control, as well as preventing problems such as feces buildup.

- **Economic profitability:** Evaluate the economic profitability of the guinea pig breeding system. This involves analyzing production costs, guinea pig sales prices and other relevant economic factors to determine the financial viability of the guinea pig farming business.
- **Genetic management:** Evaluate the selection and management of guinea pig genetics in the breeding system. This involves selecting breeders of high genetic quality to improve desirable traits such as growth rate, feed efficiency and disease resistance.
- **Environmental sustainability:** Evaluate the environmental impact of the guinea pig farming system and its ability to maintain long-term sustainable practices. This includes considerations such as efficient use of natural resources, minimization of pollution and conservation of biodiversity in the surrounding environment.

In this section, we present the results of TreeSoft using the BNS and VIKOR methods. This study used seven criteria and seven factors as described. Three experts evaluated the criteria and alternatives using bipolar neutron counting (BNN).

Step 1: Build the tree and define the nodes.

There are two or more levels in the tree, at the first level the main criteria are presented as follows:

$$SWM_1, SWM_2, \dots, SWM_n$$

At the second level, the sub-criteria are indicated by $SWM_{1,1}$, $SWM_{1,2}$, and $SWM_{2,1}$, $SWM_{2,2}$.

Step 2: Create a decision matrix of equations. (13). Table 1 shows the decision matrix.

To perform calculations with the provided neutrosophic matrices, we need to understand the operations involved. Neutrosophic matrices contain three types of elements: positive, neutral and negative. Each element is represented as a triplet (a, b, c), where 'a' represents the positive component, 'b' represents the neutral component and 'c' represents the negative component.

This is how we can perform some basic operations on neutrosophic matrices:

1. Addition: To add two neutrosophic matrices, we add the corresponding elements of the matrices.
2. Subtraction: To subtract one neutrosophic matrix from another, we subtract the corresponding elements of the matrices.
3. Scalar multiplication: To multiply a neutrosophic matrix by a scalar, we multiply each element of the matrix by the scalar.
4. Multiplication: The multiplication of neutrosophic matrices is more complex and involves certain rules.

Since you have not specified what calculations, you want to perform, I can demonstrate an example calculation. Let us add MATRIX 1 and MATRIX 2 by elements:

$$\text{MATRIX 1} + \text{MATRIX 2} = [\text{Elementwise sum of the corresponding elements of MATRIX 1 and MATRIX 2}]$$

For example, to calculate the sum of the element of the first row and the first column:

$$\begin{aligned} \text{MED1, CT1} &= [0.90, 0.30, 0.30, -0.30, -0.70, -0.90] + [0.30, 0.30, 0.50, -0.50, -0.30, -0.30] \\ &= [0.90 + 0.30, 0.30 + 0.30, 0.30 + 0.50, -0.30 - 0.50, -0.70 - 0.30, -0.90 - 0.30] \\ &= [1.20, 0.60, 0.80, -0.80, -1.00, -1.20] \end{aligned}$$

We perform similar operations for all corresponding elements in the arrays to obtain the result.

Table 1. The decision matrix.

MATRIX 1							
	D-EV	D-EV	D-EV	D-EV	D-EV	D-EV	D-EV

	1	2	5	4	5	6	8
MEC 1	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]
MEC 2	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]
MEC 5	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]
MEC 4	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]
MEC 5	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.50, 0.50, 0.50, 0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]
MEC 6	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]
MEC 8	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.50, 0.50, 0.50, 0.80, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]
MATRIX 2							

	D-EV 1	D-EV 2	D-EV 5	D-EV 4	D-EV 5	D-EV 6	D-EV 8
MEC 1	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.50, 0.50, 0.50, -0.50, 0.50]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]
MEC 2	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.50, 0.50, 0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]
MEC 5	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.90, 0.50, 0.50, 0.50, -0.80, 0.90]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]
MEC 4	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.50, 0.80, 0.50, 0.90, -0.50, 0.50]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]
MEC 5	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.80, 0.50]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.50, 0.50, 0.50, 0.50, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]
MEC 6	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.50, 0.80, 0.50, 0.90, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]
MEC 8	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.50, -0.50, 0.50]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, 0.50, -0.50, 0.50]	[0.80, 0.50, 0.50, -0.50, -0.80, 0.80]
MATRIX 5							

	D-EV 1	D-EV 2	D-EV 5	D-EV 4	D-EV 5	D-EV 6	D-EV 8
MEC 1	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.50, 0.50, 0.80, -0.50, 0.50]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]
MEC 2	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.80, 0.80, 0.50, -0.80, 0.80]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]
MEC 5	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.90, 0.50, 0.50, 0.50, -0.80, 0.90]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]
MEC 4	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.80, 0.50, 0.90, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]
MEC 5	[0.50, 0.80, 0.50, -0.90, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.50, 0.50, 0.50, 0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]
MEC 6	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.80, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.50, 0.80, 0.50, 0.90, -0.50, 0.50]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]
MEC 8	[0.90, 0.50, 0.50, -0.50, -0.80, 0.90]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, -0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]	[0.50, 0.50, 0.50, 0.80, -0.50, 0.50]	[0.80, 0.80, 0.80, -0.50, -0.80, 0.80]

1. **Normalization of values:**

We will add the absolute values of each row to obtain the total sum.

We will divide each value in the row by the total sum to normalize the values.

2. **Weighting calculation:**

We will average the normalized values of each column to obtain the weighting of each MEC.

Let us start.

Step 1: Normalization of values

For each row of Matrix 1:

For the row corresponding to **MEC 1:**

$$|0.90| + |0.50| + |0.50| + |-0.50| + |-0.80| + |-0.90| = 3.30$$

We will perform this calculation for each row.

Step 2: Weight Calculation

Now, we will average the normalized values of each column to obtain the weight of each MEC.

- **MEC 1** : $(0.273+0.273)/2=0.273$
- **MEC 2** : $(0.152+0.152+0.152)/3=0.152$
- **MEC 3** : $(0.152+0.152+0.152)/3=0.152$
- **MEC 4** : $(0.152+0.242)/2=0.197$
- **MEC 5** : $(0.242+0.273)/2=0.257$
- **MEC 6** : $(0.273+0.273)/2=0.273$
- **MEC 7** : $(0.273+0.273)/2=0.273$

Step 3. Calculate the initial weight.

Step 4. Calculate the proximity of the alternatives to the best solution of the equation. .

Calculate the value of S_i

Calculate the value of R_i

Step 7. Calculate VIKOR index

Step 8. Arrange the options.

Table 2: Strategies and values

Strategies	Values
Nutrition improvement	0.273
Genetic improvement	0.152

Proper space management	0.152
Disease and pest control	0.197
Efficient reproductive management	0.257
Training and technical assistance	0.273
Diversification of products and markets:	0.273

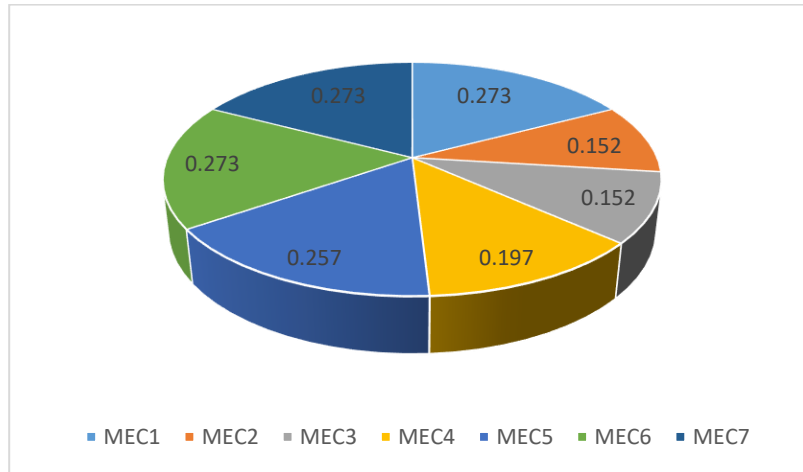


Figure 1. Basic weight.

In the vast landscape of agribusiness, strategies and values are intertwined like threads in a complex tapestry, with each strand playing a crucial role in the overall fabric of productive development. In this web of decisions and actions, improving nutrition stands out as one of the main resources to enhance animal production, with a significant weight of 0.273. Adequate nutrition is the vital lifeblood that fuels the growth and performance of animals, and in the specific case of guinea pig breeding systems, this strategy becomes unavoidably relevant.

At the same time, genetic improvement, and efficient reproductive management stand as backbones of productive efficiency, with weights of 0.152 and 0.257 respectively. The careful selection of specimens and the optimization of reproductive cycles are two fundamental gears in the machinery of animal breeding, where genetic quality and reproductive efficiency largely determine the success of the enterprise. In the same order of ideas, disease and pest control and adequate space management are presented as two essential retaining walls to safeguard the health and well-being of animals in guinea pig production systems. With weights of 0.197 and 0.152 respectively, these strategies constitute defensive barriers against threats that could undermine the stability and productivity of the system.

However, the strategic framework goes beyond mere technical and health management. Training and technical assistance, with a weight of 0.273, represent a bridge of knowledge between theory and practice, providing producers with the necessary tools and skills to optimize their operations. In the specific context of guinea pig farming, where tradition is intertwined with innovation, continuous training is a fundamental pillar to promote progress and sustainability in the sector.

Finally, the diversification of products and markets emerges as a beacon of opportunities in the economic horizon of guinea pig farming, with a weight of 0.273. Exploring new market niches and expanding the range of products can open new doors for producers, diversifying their sources of income and strengthening their resilience to market fluctuations. In conclusion, increasing production in small guinea pig breeding systems requires a comprehensive approach that ranges from nutrition and genetics to health management and technical training. The synergy between these strategies and values is the key to promoting sustainable growth and competitiveness in the sector, while guaranteeing the well-being of animals and balance with the environment. In this sense, it is essential to promote policies and actions that encourage the integration of knowledge, collaboration between actors and continuous innovation, with a view to building a prosperous and sustainable future for guinea pig farming and its communities.

5. Conclusion

In the fertile terrain of agricultural research, the amalgamation of strategies and values stands as a crucible of possibilities, with a vast spectrum of implications that range from genetic improvement to the diversification of products and markets. In this scenario of intertwined complexities, the search for synergies between different strategies and their concrete application in specific contexts, such as increasing production in small guinea pig breeding systems, emerges as an imperative challenge. In this context, the improvement of nutrition, with its weighting of 0.273, is revealed as a crucial starting point, since adequate nutrition is the cornerstone for the optimal development of animals and, therefore, to maximize their productivity. On the other hand, genetic improvement, with its relative weight of 0.152, emerges as a powerful and promising tool to enhance the resistance and performance of guinea pigs in breeding systems. The selection of specimens with desirable characteristics and the application of assisted reproduction techniques can contribute significantly to obtaining more robust and productive animals, adapted to the specific demands of each production context. Likewise, efficient reproductive management, with a weighting of 0.257, acquires even greater relevance in this context, since the optimization of reproductive cycles can have a direct impact on the quantity and quality of offspring, as well as overall efficiency of the productive system. In this complex network of strategies, disease and pest control emerges as a critical challenge, with a weighting of 0.197. The implementation of preventive measures and constant monitoring of animal health are essential aspects to safeguard the integrity and productivity of the guinea pig farming system, mitigating the risk of economic and health losses. Likewise, the proper management of space, with its weighting of 0.152, takes on relevance in intensive production systems, where the optimization of each square meter can make the difference between success and failure. At the same time, training, and technical assistance, with its weight of 0.273, stand as fundamental pillars for the development and professionalization of the guinea pig breeding sector. The transfer of knowledge and skills, as well as access to appropriate technologies, can empower producers and strengthen the economic and environmental viability of their ventures. In this sense, it is crucial to promote collaboration between academic, government and private sector institutions to design training programs adapted to the specific needs of guinea pig producers. Finally, the diversification of products and markets, with its weight of 0.273, is presented as a key strategy to increase the resilience and competitiveness of guinea pig farming systems. Exploring new market niches and diversifying supply can open new revenue opportunities and reduce vulnerability to fluctuations in demand or product prices. In this sense, it is necessary to promote innovation and entrepreneurship in the sector, as well as establish strategic alliances with other actors in the value chain to expand commercial opportunities and promote the sustainable development of guinea pig farming.

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