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Environmental Sustainability and Organizational Commitment in Rainbow Trout Production in Junín, Peru: An Approach from Plithogenic Fuzzy Soft Sets

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Abstract. Human resource management could leverage global environmental concerns to promote green practices. Furthermore, ecological sustainability is a major concern in modern society. Among other tools, the affective, normative, and continuance dimensions of organizational commitment are central to organizational implementation. This study aims to determine the relationship between environmental sustainability and organizational commitment in rainbow trout production in the Ingenio-Junín district. For data processing, we use the plithogenic soft set theory. On the one hand, plithogenic theory allows for the modeling of multidimensional phenomena with dynamics composed of elements of diverse origin, where each concept, its opposite, and its neutral are considered. Soft set theory effectively models the uncertainty inherent in data derived from human subjectivity. Plithogenic soft sets are the product of the hybridization of both concepts, which allows us to take advantage of the benefits of both tools. The study we propose to conduct depends on variables of diverse origin, having uncertainty in the measurements. This is why plithogenic soft sets are suitable for performing the proposed study.

Keywords: Organizational commitment, environmental sustainability, plithogenic set, soft set, plithogenic soft set, plithogenic fuzzy soft set.

1 Introduction

The lack of adequate human resource policies has led to growing social and environmental concerns. Organizations must address social, economic, and environmental concerns, particularly in the public sector. Incorporating green initiatives into human resource programs can ensure an organization's sustainability and motivate its employees. Therefore, human resources and environmental management must be integrated to maintain environmental sustainability.

Green human resource management practices contribute significantly to the development of policies that promote sustainable resources. Several steps have been considered to improve organizational performance through environmentally responsible practices. Likewise, it is essential that an organization has the support of its employees, who will be responsible for promoting and implementing a green work environment to achieve a high level of environmental performance. As a result, organizations

must implement human resource programs and encourage employees to adopt green behavior with defined ecological objectives. Environmental protection has shown that employees play a primary role in creating a green organization. Performance can be improved when employees engage in pro-environmental practices, such as water conservation, recycling, and introducing new ideas for environmental sustainability.

Therefore, environmental sustainability has recently captured the attention of scholars and researchers. Several studies have been conducted on environmental sustainability, including in the healthcare sector, the manufacturing sector, and fish farms. Therefore, much remains to be learned about organizational commitment and environmental sustainability. Because sustainable organizations would benefit from integrating green practices into organizational commitment functions. An organization could become more productive while protecting the environment, optimizing overall performance, improving organizational sustainability, and increasing employee productivity and well-being.

Human resource management helps an organization achieve its strategic objectives. In addition, traditional human resources responsibilities include communicating the company's strategy to employees and helping them internalize it. Because the human resources function is critical to achieving environmentally friendly organizational objectives.

Furthermore, the dimensions of organizational commitment directly influence an organization's environmental performance. Therefore, organizational commitment plays a crucial role in influencing environmental sustainability, which is reflected in an organization's environmental performance. Similarly, organizational commitment can be viewed as a determining factor in the success or failure of green efforts within an organization. Social identity theory suggests that employees inclined to embody positive organizational ideals are the most committed to the organization. For example, employees who care about the environment support environmental initiatives; employees who exhibit high levels of organizational commitment are often emotionally attached to their employers. Organizational commitment is the relative strength of an individual's identification with and involvement in a particular organization. It is critical to motivate employees to engage in altruistic or prosocial behaviors, such as organizational citizenship.

Therefore, it is necessary to understand which dimensions of organizational commitment could influence the behavior of green employees. Similarly, several studies have investigated how external factors affect employees' selection of green behaviors based on motivation theory. Furthermore, other approaches and perspectives can enhance our understanding of how organizational commitment contributes to sustainable development. In this article, we address organizational and ecological commitment within the context of aquaculture companies.

To meet the growing demand for aquaculture products and the need for high protein sources, aquaculture is one of the most dynamic animal production sectors, with volumes expanding by 7.7% annually since the 1980s. Aquaculture has been the main source of fish for human consumption since 2015. In 2021, it provided 53% of the world's fish population, a percentage that is expected to increase in the long term as part of the solution to providing sufficient food and protein to more than nine billion people by 2050.

Animal production systems, including aquaculture, are widely criticized for their impacts on environmental sustainability. Aquaculture is responsible for many direct impacts related to the eutrophication of aquatic ecosystems due to the emission of nutrients (e.g., nitrogen (N), phosphorus (P), particulate matter) and intensive use of water, land, and energy; but also for indirect impacts related to the production of fish feed, especially for rainbow trout feed can account for 65%–95% of the environmental impacts of animal products leaving a farm. For rainbow trout, feed production can contribute 73–87% of climate change impacts, 86% of acidification impacts, and 68–96% of net primary production use (NPPU). Aquaculture is also criticized for its heavy reliance on limited resources due to its extensive use of fishmeal and fish oil.

Therefore, a major challenge for aquaculture is to find new practices to make its development more

environmentally friendly. The main way to reduce the environmental impacts of aquaculture is to improve feed efficiency and growth performance. However, since feeds contribute significantly to the environmental impacts of aquaculture production, new feed formulation strategies must be implemented. Since the environmental impacts of feeds are strongly determined by their ingredients, there is potential to reduce the environmental impacts of aquaculture by formulating feeds with lower environmental impacts.

In this regard, this study will analyze organizational commitment to environmental sustainability as a tool for environmental management and behavioral indicators of the intention to use the services offered by aquaculture. This study will contribute to the literature on environmental variables and behavior linked to the environment.

The primary objective of this article is to determine the relationship between environmental sustainability and organizational commitment in rainbow trout production in the Ingenio-Junín district, in Peru. The secondary objectives are:

- To analyze the association between the affective dimension and environmental sustainability in trout production.
- Determine the relationship between the regulatory dimension and environmental sustainability in trout production.
- Identify the association between the dimension of continuity and environmental sustainability in trout production.

The proposed problem is modeled using variables derived from different sources, such as the dynamics between workers in a work organization, the dynamics in an ecological environment, economics, and politics, among others. It involves the interaction between various dynamics of different natures. This is why we chose the theory of plithogeny because its objective is to replace classical dialectics with a mathematical representation of the dynamics between concepts, their opposites, and neutrals, where neutral also means the erroneous, the paradoxical, the unknown, the inconsistent, and so on [1, 2].

On the other hand, Soft sets are a tool that emerged to model uncertainty and generalize fuzzy sets [3-5]. This tool has been hybridized with fuzzy sets, intuitionistic fuzzy sets, and neutrosophic sets [6-10]. Furthermore, we can recently find their hybridization with plithogenic sets in the literature [11-14]. In this way, the uncertainty modeled with soft sets is combined with the multidimensionality represented with the help of plithogenic sets.

To meet these purposes, this paper is divided into a Materials and Methods section dedicated to recalling the main concepts needed to define Plithogenic Soft Sets. The Results section contains the theoretical elements used and the results achieved in the calculations. The article ends with the Conclusion section.

2 Materials and Methods

In this section, we review the main concepts related to soft sets, fuzzy soft sets, intuitionistic fuzzy soft sets, and neutrosophic soft sets. The following subsection contains the elements of the plithogenic sets and plithogenic soft sets.

2.1 Soft Sets and Extensions

Definition 1 ([4]). A *Soft Set* over U is a pair (F, E), where U is the initial universal set, E is the set of parameters, and F is the mapping from E to $\mathcal{P}(U)$, which is the power set of U.

So, given a parameter $\varepsilon \in E$, we have $F(\varepsilon) \in \mathcal{P}(U)$ as the set of ε −approximate elements of (F, E).

Definition 2 ([6]). A *Fuzzy Soft Set* over U is a pair (F, E), where U is the initial universal set, E is the set of parameters, and F is the mapping from E to $\mathcal{F}(U)$, which is the set of fuzzy subsets of U.

Definition 3 ([1]). An *Intuitionist Fuzzy Soft Set* over U is a pair (F, E), where U is the initial universal set, E is the set of parameters, and F is the mapping from E to $\mathcal{IF}(U)$, which is the set of intuitionistic

fuzzy subsets of U.

Definition 4 ([1]). A *Neutrosophic Soft Set* over U is a pair (F, E), where U is the initial universal set, E is the set of parameters, and F is the mapping from E to $\mathcal{N}(U)$, which is the set of neutrosophic subsets of U.

2.2 Plithogenic Sets and Plithogenic Soft Sets

If U is the universe of discourse, then fix P which is a non-empty set of elements, and $P \subset U$ [1, 2]. Furthermore, it follows that A is the non-empty set of *one- dimensional attributes*, such that $A = \{\alpha_1, \alpha_2, \dots, \alpha_m\}$, $m \geq 1$. By each $\alpha \in A$ we have a spectrum of all possible values (or states) S that can be a discrete finite set $S = \{s_1, s_2, \dots, s_l\}$, $1 \leq l < \infty$, or an infinitely countable set $S = \{s_1, s_2, \dots, s_\infty\}$, or an infinitely uncountable (continuous) set $S =]a, b[$, $a < b$.] ... [denotes any open, half-open, or closed interval of the set of real numbers or another general set.

On the other hand, $V \subset S$ and $V \neq \emptyset$ is the range of all attributes that experts need for the given application. Then, for each $x \in P$ the values of all attributes in $V = \{v_1, v_2, \dots, v_n\}$, and $n \geq 1$, are defined.

Generally, there is a value called *dominant attribute value* in V, which is selected by experts according to their criteria of which it is the most important attribute to meet the proposed objective.

The element $v \in V$ has a *degree of approval* $d(x, v)$ of the element x, to the set P, for some assumed criteria.

The degree of appurtenance is classified as *the fuzzy degree of appurtenance*, an *intuitionistic fuzzy degree of appurtenance*, or a *neutrosophic degree of appurtenance* to the plithogenic set.

So, we have the *attribute value appurtenance degree function* as*:*

$$\forall x \in P, d: P \times V \to \mathcal{P}([0,1]^z) \qquad (1)$$

That is, $d(x, v)$ is a subset of $[0,1]^z$, such that $\mathcal{P}([0,1]^z)$ is the power set of $[0,1]^z$, where z determines the type of *appurtenance*. In particular, z = 1 means a *fuzzy degree of appurtenance*, z = 2 denotes an *intuitionistic fuzzy degree of appurtenance*, and z = 3 is for the *neutrosophic degree of appurtenance*.

The function $c: V \times V \to [0,1]$ is the *attribute value contradiction degree function* between any two attribute values v_1 and v_2. This satisfies the following axioms:

1. $c(v_1, v_1) = 0$, i.e., the degree of contradiction between the same attribute values is zero;
2. $c(v_1, v_2) = c(v_2, v_1)$, commutativity.

There is a distinction for the function c according to the value z. The *fuzzy attribute value contradiction degree function* is denoted by c_F, the *intuitionistic fuzzy attribute value contradiction function* is a function $c_{IF}: V \times V \to [0,1]^2$, while the *neutrosophic attribute value contradiction degree function* is defined by $c_N: V \times V \to [0,1]^3$.

In general, it deals with one-dimensional attributes values and the degree of disagreement among them. In the case that we have multi-dimensional attributes values, these can be broken down into one-dimensional attributes values.

The attribute value contradiction degree function allows for greater accuracy when performing calculations about some grouping methods and ordering systems. These values are taken according to the experts' criteria on the specific problem to be solved. If an attribute cannot be determined, value contradiction degree function accuracy will be lost, although all this theory can still be used.

Having defined the previous concepts, (P, a, V, d, c) is a *plithogenic set* that meets the following:

1. P is a set, a is a uni-dimensional or generally multidimensional attribute, V is the rank of the attribute values, d is the degree of appurtenance of the attribute value of each element x to the set P, $x \in P$, for some given criteria. Finally, d is either d_F, d_{IF}, or d_N, when it is a

fuzzy degree of appurtenance, an intuitionistic fuzzy degree of appurtenance, or a neutrosophic degree of appurtenance, respectively, of an element x to the plithogenic set P;

2. On the other hand, we define c either as c_F, c_{IF} or c_N, if it is the fuzzy degree of contradiction, intuitionistic fuzzy degree of contradiction, or neutrosophic degree of contradiction between attribute values, respectively.

Experts define $d(\cdot,\cdot)$ and $c(\cdot,\cdot)$ by the domain of expertise in which they operate.
The notation used is as follows:

$x(d(x,V))$, where $d(x,V) = \{d(x,v),\ for\ all\ v \in V\}, \forall x \in P$.

To calculate the degree of attribute value contradiction is performed on each attribute value in particular and the dominant attribute value, called v_D.

The attribute value contradiction degree function c between the attribute values is included in the definition of *plithogenic aggregation operators* (intersection (AND), union (OR), implication ($\Longrightarrow$), equivalence ($\Leftrightarrow$), inclusion relation (partial order), and other plithogenic aggregation operators combining two or more attribute value degrees acting on the t-norm and t-conorm.

Most of the plithogenic aggregation operators are linear combinations of the fuzzy t-norm ($\wedge_F$), and the fuzzy t-conorm ($\vee_F$). Nonlinear combinations can also be defined.

Having the t-norm and t-conorm calculus between the dominant attribute value (v_D) with another attribute value (v_2), and also $c(v_D, v_2)$ denotes the contradiction between v_D and v_2, then we can define the following operations:

$$[1 - c(v_D, v_2)] \cdot t_{norm}(v_D, v_2) + c(v_D, v_2) \cdot t_{conorm}(v_D, v_2) \quad (2),$$

Or, what is the same:

$$[1 - c(v_D, v_2)] \cdot (v_D \wedge_F v_2) + c(v_D, v_2) \cdot (v_D \vee_F v_2) \quad (3),$$

Also,

$$[1 - c(v_D, v_2)] \cdot t_{conorm}(v_D, v_2) + c(v_D, v_2) \cdot t_{norm}(v_D, v_2) \quad (4),$$

Or,

$$[1 - c(v_D, v_2)] \cdot (v_D \vee_F v_2) + c(v_D, v_2) \cdot (v_D \wedge_F v_2) \quad (5).$$

The *Plithogenic Neutrosophic Intersection* is defined in Equation 6:

$$(a_1, a_2, a_3) \wedge_P (b_1, b_2, b_3) = \left(a_1 \wedge_F b_1, \frac{1}{2}[(a_2 \wedge_F b_2) + (a_2 \vee_F b_2)], a_3 \vee_F b_3\right) \quad (6),$$

The *Plithogenic Neutrosophic Union* is as follows:

$$(a_1, a_2, a_3) \vee_P (b_1, b_2, b_3) = \left(a_1 \vee_F b_1, \frac{1}{2}[(a_2 \wedge_F b_2) + (a_2 \vee_F b_2)], a_3 \wedge_F b_3\right) \quad (7),$$

To define the *Plithogenic Neutrosophic Inclusion* we have:

Due to the degrees of contradiction are $c(a_1, a_2) = c(a_2, a_3) = c(b_1, b_2) = c(b_2, b_3) = 0.5$, then: $a_2 \geq [1 - c(a_1, a_2)]b_2$ or $a_2 \geq (1 - 0.5)b_2$ or $a_2 \geq 0.5b_2$ and $c(a_1, a_3) = c(b_1, b_3) = 1$.

When $a_1 \leq b_1$ the opposite applies for $a_3 \geq b_3$, and then $(a_1, a_2, a_3) \leq_P (b_1, b_2, b_3)$ if and only if $a_1 \leq b_1$ and $a_2 \geq 0.5b_2$, $a_3 \geq b_3$.

Applications of Plithogenic sets and Plithogenic logic can be read in [15-19].

Definition 5 ([1, 2]). Let U be a universe of discourse, $\mathcal{P}([0,1]^z)$ is the z-power of U, such that:

- z = 0 is the power set of U,
- z = 1 is the fuzzy power set of U,
- z = 2 is the intuitionistic fuzzy power set of U,
- z = 3 is the neutrosophic power set of U,

Let $\alpha_1, \alpha_2, \dots, \alpha_m$, $m \geq 1$, be m different attributes, where their attribute values are in the sets $V_1, V_2, \dots, V_m$, such that $V_i \cap V_j = \emptyset$ if $i \neq j$, and $i, j \in \{1, 2, \dots, m\}$. Let us suppose that $V_i = \{v_{i_1}, v_{i_2}, \dots, v_{i_{n_i}}\}$ and also $\Upsilon = V_1 \times V_2 \times \dots \times V_m$. $D = \{v_{D_1}, v_{D_2}, \dots, v_{D_m}\}$ are the dominant attributes elements of A_i, and $c_i(v_{D_i}, v_{i_j})$ is the attribute contradiction degree function such that: $c_i: V_i \times V_i \to [0,1]$. We say the pair (F_P^z, Υ) is the *Plithogenic Soft Set* (PSS) over U, such that:

$$F_P^z: \Upsilon \to [0,1]_D \times \mathcal{P}([0,1]^z) \qquad (8)$$

Definition 6 ([1]). The union of two PSSs (F_P^z, A) and$(\ G_P^z, B)$ over U, denoted by $(F_P^z, A) \vee_P^z (G_P^z, B)$ is the PSS (H_P^z, Ω), where $\Omega = A \cup B$ such that $\forall \varepsilon \in \Omega$,

$$H_P^z(\varepsilon) = \begin{cases} F_P^z(\varepsilon), if\ \varepsilon \in A \setminus B \\ G_P^z(\varepsilon), if\ \varepsilon \in B \setminus A \\ F_P^z(\varepsilon) \vee_P^z G_P^z(\varepsilon), if\ \varepsilon \in B \cap A \end{cases}$$

Where $\vee_P^z$ is the *z-plithogenic union*.

Definition 7 ([1]). The intersection of two PSSs (F_P^z, A) and (G_P^z, B) over U, denoted by $(F_P^z, A) \wedge_P^z (G_P^z, B)$ is the PSS (H_P^z, Ω), where $\Omega = A \cap B$ such that $\forall \varepsilon \in \Omega$,

$$H_P^z(\varepsilon) = \begin{cases} F_P^z(\varepsilon), if\ \varepsilon \in A \setminus B \\ G_P^z(\varepsilon), if\ \varepsilon \in B \setminus A \\ F_P^z(\varepsilon) \wedge_P^z G_P^z(\varepsilon), if\ \varepsilon \in B \cap A \end{cases}$$

Where $\vee_P^z$ is the *z-plithogenic intersection*.

Definition 8 ([1]). Given (F_P^z, E) and (G_P^z, E) are two PSSs over (U, E). The similarity between (F_P^z, E) and (G_P^z, E) is denoted by $\mathcal{S}(F_P^z, G_P^z)$ and defined by:

$$\mathcal{S}(F_P^z, G_P^z) = \frac{1}{|E|} \sum_{k=1}^{|E|} M_k \qquad (9)$$

$$M_k = 1 - \frac{\sum_{j=1}^{|U|} \sum_{i=1}^{|e|} |F_j(e_{ik}) - G_j(e_{ik})|}{\sum_{j=1}^{|U|} \sum_{i=1}^{|e|} |F_j(e_{ik}) + G_j(e_{ik})|}, \text{ for } e \in E.$$

Definition 9 ([1]). Given (F_P^z, E) and (G_P^z, E) are two PSSs over (U, E). It is said that (F_P^z, E) and (G_P^z, E) are *significantly similar* if $\mathcal{S}(F_P^z, G_P^z) \geq \frac{1}{2}$.

Properties: Given (F_P^z, E), (G_P^z, E), and (H_P^z, E), are three PSSs over (U, E), then:

(1) $\mathcal{S}(F_P^z, G_P^z) = \mathcal{S}(G_P^z, F_P^z)$,
(2) $0 \leq \mathcal{S}(F_P^z, G_P^z) \leq 1$,
(3) $F_P^z = G_P^z$ implies $\mathcal{S}(F_P^z, G_P^z) = 1$.
(4) $F_P^z \subseteq G_P^z \subseteq H_P^z$ implies $\mathcal{S}(F_P^z, H_P^z) \leq \mathcal{S}(G_P^z, H_P^z)$.

3 Results

This research sought to link organizational commitment to trout production at the El Ingenio Fish Farm with environmental sustainability. The organizational commitment of the fish farm's employees is to reduce the negative impacts caused by trout production, specifically in water resource management. The instruments were applied to 28 workers. The first part of the instrument determined their

demographic characteristics, and the second part determined the components of organizational commitment and its environmental sustainability.

Sampling was non-probability and used a convenience sampling approach. The authors contacted the fish farm's collaborators to request their participation. Volunteers were not required to undergo ethical review or obtain permission as part of the study. The questionnaires required participants to refrain from providing any identifying or personal information, which was entirely voluntary.

The technique and instrument used was a survey. This technique is one of the ways to study people who retain experiences and perspectives through observation at a deep, detailed, and nuanced level for each participant. Collecting data through the survey was very important for testing the existence and strength of relationships between the affective, normative, continuity, and sustainability dimensions, and even for making predictions based on the correlations.

Workers were interviewed according to the following questionnaire:

Table 1. Questionnaire corresponding to the questions on the affective, normative, and continuity dimensions.

ORGANIZATIONAL COMMITMENT (AFFECTIVE DIMENSION)	
1	You feel satisfied to belong to your institution
2	This company means a lot to you
3	You feel part of this trout production company
4	You feel involved with the successes and problems of this company
5	You enjoy discussing your work with the general public
6	You feel happy to come to work at this company
ORGANIZATIONAL COMMITMENT (NORMATIVE DIMENSION)	
7	You are respectful of your company's internal regulations
8	You come to work because you feel morally obliged
9	If you had another job offer from the company, do you think it would be right to leave your current job?
10	This company deserves your loyalty
11	You wouldn't leave this company because you feel obligated by your colleagues
12	You would feel guilty leaving this company because you would recognize everything this company had given you at the time
13	You think you owe a lot to this company.
CONTINUITY DIMENSION	
14	One of the main reasons to continue working is for the remuneration
15	You think you have very little chance of getting another job like this
16	The main reason you continue working at this company is because it would be difficult for you to get another job like this
17	It would be very hard and painful to leave this company
18	Your goal for your family would be interrupted by stopping working at this company.

Table 2. Questionnaire corresponding to the questions on the environmental dimension.

ENVIRONMENTAL SUSTAINABILITY	
1	When workers begin their cleaning work, they have their PPE (gloves, caps, boots, etc.)
2	Trout production tanks are constantly being maintained (cleaned)
3	The water entering the fish farm is temporarily analyzed (physicochemical and microbiological analysis)
4	The flow leaving the fish farm is under supervision as indicated by the standard

ENVIRONMENTAL SUSTAINABILITY	
5	Reports on activities related to environmental performance are published
6	There are policies and programs to reduce water, soil, and air pollution
7	The fish farm has its environmental assessment impact study or other environmental management document
8	There is an area designated for the treatment of their solid waste
9	In recent years, you have observed that the fish farm has acquired some equipment to reduce its environmental impacts
10	Did you know that eutrophication (green algae) of river water is caused by fish farming activity?

Respondents are asked to respond on a Likert-type scale with the following possible responses:

1. Totally non-agree,
2. In non-agreement,
3. Neither agree nor disagree,
4. Agree,
5. Totally agree.

The universe set is $U = \{u_1, u_2, \dots, u_{28}\}$ made up of the 28 respondents.

The set of parameters $Q = \{q_1, q_2, \dots, q_{28}\}$ corresponds to each of the questions asked.

Each question q_i is associated with a set V_i of possible answers on the Likert-type scale indicated above.

Additionally, we associate a fuzzy value to each of the possible values of the Likert scale as indicated in Table 3.

Table 3. Linguistic values of the proposed Likert scale and their assigned numerical values.

LIKERT SCALE VALUE	**ASSOCIATED NUMERICAL VALUE**
Totally disagree (TD)	0
Non-agree (NA)	0.25
Neither agree nor disagree (I)	0.5
Agree (A)	0.75
Totally agree (TA)	1

The parameter set Q is reduced to the set of parameters $Dim = \{dim_1, dim_2, dim_3, dim_4\}$ such that dim_1 is associated with the median of the Likert scale related to questions $q_1, q_2, \dots, q_6$. Equivalently, dim_2 is associated with the results for $q_7, q_8, \dots, q_{13}$, dim_3 with the results for $q_{14}, q_{15}, \dots, q_{18}$, and dim_4 with the results for $q_{19}, q_{20}, \dots, q_{28}$.

The vector of dominant elements for the four parameters is defined as $D_4 = (TA, TA, TA, TA)$.

Aside from that, let us define the set H_4 as follows:

$$H_4 = \left\{ \begin{matrix} \epsilon_1 = (TA, TA, TA, TA), \epsilon_2 = (A, TA, TA, TA), \epsilon_3 = (TA, A, TA, TA), \epsilon_4 = (TA, TA, A, TA), \\ \epsilon_5 = (TA, TA, TA, A), \epsilon_6 = (A, A, TA, TA), \epsilon_7 = (A, TA, A, TA), \epsilon_8 = (A, TA, TA, A), \\ \epsilon_9 = (TA, A, A, TA), \epsilon_{10} = (TA, A, TA, A), \epsilon_{11} = (TA, TA, A, A), \epsilon_{12} = (A, A, A, TA), \\ \epsilon_{13} = (A, A, TA, A), \epsilon_{14} = (A, TA, A, A), \epsilon_{15} = (TA, A, A, A), \epsilon_{16} = (A, A, A, A) \end{matrix} \right\},$$

Attribute calculations value contradiction degree function are performed with the help of the numerical values shown in Table 3 and Equation 10 below:

$$c(v_a, v_b) = |w_a - w_b| \qquad (10)$$

That is, the contradiction between two Likert scale values is calculated as the absolute value of the difference between their corresponding associated linguistic values. For example, $c(TA, A) = |1 - 0.75| = 0.25$.

With all these notes we have the following:

We will use the plithogenic fuzzy soft sets as follows:

$F_P^{z=1}: H_4 \to [0,1]_D \times \mathcal{P}([0,1])$ for the four dimensions as parameters.

Let us illustrate this with an example,

Example 1. Let us suppose that the interviewee x's evaluations after processing are the following: $eval(x) = (NA, TA, TA, A)$. In this case, we have the element: $\frac{(x,(0.75,0,0,0.25)_D)}{(0.25,1,1,0.75)}$, this means that the elements of $(0.75, 0, 0, 0.25)_D$ are those of disagreement between the evaluation values of x and the dominant value which is "TA" or its numerical equivalent 1. For example, $c(NA, TA) = |1 - 0.25| = 0.75$. On the other hand, since dimension 1 is evaluated as NA, then using Table 3 we have that the equivalent fuzzy value is 0.25.

In summary, we apply the following procedure:

1. We calculate the median of the results for each dimension, for each respondent. That is, for each respondent, u_i we calculate the median of their responses within the questions $q_1, q_2, \dots, q_6$, according to the Likert scale, and this is their response to dimension 1. We do the same for dimensions 2, 3, and 4.
2. We have $F_P^{z=1}(\epsilon_k)$ $(k = 1, 2, \dots, 16)$ which is made up of 28 elements, one for each interviewee.
3. For each fixed k, a single value associated with $F_P^{z=1}(\epsilon_k)$ is calculated as follows:

$F_P^{z=1}(\epsilon_k)$ is made up of values $\frac{(u_i,(c_{i1},c_{i2},c_{i3},c_{i4})_D)}{(v_{i1},v_{i2},v_{i3},v_{i4})}$.

It is performed iteratively using the operation $\frac{(x,(c_{x1},c_{x2},c_{x3},c_{x4})_D)}{(v_{x1},v_{x2},v_{x3},v_{x4})} \odot_p \frac{(y,(c_{y1},c_{y2},c_{y3},c_{y4})_D)}{(v_{y1},v_{y2},v_{y3},v_{y4})} = \frac{(x,(c_1,c_2,c_3,c_4)_D)}{(v_{x1},v_{x2},v_{x3},v_{x4})} \wedge_P^F \frac{(y,(c_1,c_2,c_3,c_4)_D)}{(v_{y1},v_{y2},v_{y3},v_{y4})}$,

Where, $c_1 = \max(c_{x1}, c_{y1})$, $c_2 = \max(c_{x2}, c_{y2})$, $c_3 = \max(c_{x3}, c_{y3})$, and $c_4 = \max(c_{x4}, c_{y4})$,

This is repeated between $\frac{(u_1,(c_{11},c_{12},c_{13},c_{14})_D)}{(v_{11},v_{12},v_{13},v_{14})}$ and $\frac{(u_2,(c_{21},c_{22},c_{23},c_{24})_D)}{(v_{21},v_{22},v_{23},v_{24})}$, the result with $\frac{(u_3,(c_{31},c_{32},c_{33},c_{34})_D)}{(v_{31},v_{32},v_{33},v_{34})}$ and so on until reaching the value $i = 28$.

4. Suppose the result of the aggregation in the previous step is: $h_k^4 = \frac{(\bar{u}_k,(\bar{c}_{k1},\bar{c}_{k2},\bar{c}_{k3},\bar{c}_{k4})_D)}{(\bar{v}_{k1},\bar{v}_{k2},\bar{v}_{k3},\bar{v}_{k4})}$ for the values corresponding to $F_P^{z=1}(\epsilon_k)$. Then the $F_P^{z=1}(\epsilon_k)$ is associated with the crisp value:

$$s_k = 1 - \frac{\left|\frac{\bar{v}_{k1}+\bar{v}_{k2}+\bar{v}_{k3}}{3} - \bar{v}_{k4}\right|}{\left|\frac{\bar{v}_{k1}+\bar{v}_{k2}+\bar{v}_{k3}}{3} + \bar{v}_{k4}\right|} \qquad (11)$$

Which is the degree of similarity between the means of the values of the first three dimensions with their corresponding equivalent values of the fourth dimension.

5. Similarity total value is calculated equal to:

$$s_T = \frac{\sum_{k=1}^{16} s_k}{16} \qquad (12)$$

Note that the h_k^4 are only those values corresponding to the responses of TA and A. If all possible combinations of response quatrains had been chosen, the result would be equal to $5^4 = 625$, which is extremely cumbersome.

Let us now present the results of applying the previous algorithm.

Tabla 4. Results obtained for the s_k for each of the elements belonging to H_4. See Equation 10.

k	s_k
1	0.9533654
2	0
3	0.9473684
4	0
5	0
6	0.9590909
7	0
8	0
9	0.9007398
10	0.8968621
11	0
12	0.9805713
13	0.9473684
14	0
15	0.8809183
16	0.9495856

Applying Equation 11, we have $s_T = 0.52599189 > \frac{1}{2}$, this is interpreted as the organizational commitment.

4 Conclusion

Based on the results obtained in the affective, normative, and continuity dimensions, the components of organizational commitment show a positive relationship or play an important role in environmental sustainability at the El Ingenio fish farm. Employees feel committed to ecological and sustainable behavior in water management, with environmentally friendly attitudes and positive self-esteem. Regarding the findings in the affective dimension of the fish farm's employees, they have a good level of belonging, loyalty, and satisfaction with the El Ingenio fish farm and environmental sustainability. The normative dimension of the fish farm's employees shows an interest in complying with established directives, norms, and guidelines. To process the data, we used a fairly recent tool, plithogenic soft sets. This allows us to take advantage of the uncertainty inherent in soft sets, with the multidimensionality of plithogenic sets, especially plithogenic fuzzy soft sets. We recommend carrying out the following tasks to improve performance within the institution studied:

- Strengthen employee engagement by boosting motivation not only through alternative actions but also by improving communication channels and promoting a strategic plan for water sustainability.
- Empower employees in the regulatory dimension with actions to maintain loyalty to the fish farm and the balance of natural resources during their economic activities.
- Increase environmental commitment and employee well-being during crisis events, which will help improve employees' tendency to engage with organizations.

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