



From Di-alectics to N-alectics: Indigenous Cultures and Ancestral Philosophies in Latin America

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Abstract: This paper explores the n-alectic framework, which extends traditional di-alectic and tri-alectic models by integrating multiple subcomponents through refined neutrosophic logic. Drawing from pre-Columbian philosophies, particularly Mesoamerican, Andean, and Amazonian traditions, the study demonstrates how indigenous worldviews align with n-alectic structures. The figure of Quetzalcóatl/Kukulkán illustrates a triadic balance of sky, earth, and underworld, while Andean Yanantin and Pachakuti reflect complementary duality and transformation. Shuar cosmology further exemplifies a complex n-alectic system, where multiple spiritual and natural forces interact dynamically. The ethical decision-making model, applied to resource extraction and Pachamama principles, utilizes weighted metrics and neutrosophic distance calculations to evaluate sustainable choices. Results highlight n-alectic reasoning as a powerful tool for balancing economic, environmental, and social factors, promoting harmonious integration of opposing forces in decision-making.

Keywords:

n-alectic, neutrosophic logic, indigenous philosophy, ethical decision-making, Andean cosmology, Mesoamerican worldview

1. Introduction

While the **di-alectic** is the dynamic of opposites T and F (or Truth and Falsehood), the neutrosophy is a **tri-alectic**, the dynamic of opposites (T and F) and the neutrality/indeterminacy (I) between them [1].

This broader perspective aligns with the philosophical traditions of Latin America, where pre-Columbian thought systems embraced complex relationships between dualities and intermediate states rather than rigid dichotomies. In *The Dawn of Everything*, David Graeber and David Wengrow [2] explore how pre-Columbian societies have shaped Western philosophy, challenging Eurocentric narratives and offering alternative conceptual frameworks that enrich human thought. A striking example of tri-alectic reasoning is found in the Toltec and Aztec worldviews, particularly in the figure of Quetzalcóatl (or Kukulkán in Maya culture) [3]. The feathered serpent deity who embodies the dynamic interplay of opposites (T and F) and the mediating force of indeterminacy (I), an essential feature of trialectic thinking.



Figure 1. The effect of the descent of the serpent observed at the Temple of Kukulcán during the March 2009 equinox [4].

This scheme illustrates a temporal trialectic, where the balance between opposing forces (light and shadow) is not merely dualistic but includes an intermediate state. In the equinox phenomenon of Kukulcán, this state is the penumbra, where light and shadow coexist and transform each other.

The figure of Quetzalcóatl/Kukulcan represents a dynamic interaction between three forces:

$$(T = \text{Sky}, I = \text{Earth}, F = \text{Underworld})$$

- Sky (T - The quetzal, the divine, and pure wisdom).
- Earth (I - The serpent Coatl, transformation, and the balance between the material and the spiritual).
- Underworld (F - Death, change, and renewal through sacrifice).

Quetzalcóatl embodies the force that maintains the necessary balance to prevent the chaos of the underworld (e.g., Mictlán) from overtaking the human world. This model illustrates how trialectics were inherently embedded in the Mesoamerican worldview, where opposites were not mere contrasts but interdependent forces engaged in a continuous process of transformation.



Figure 1. Quetzalcóatl: The Tri-Alectic Harmony of Earth and Sky at Teotihuacan

Subtitle: Feathers of the heavens and serpent of the earth converge in indeterminacy, symbolizing the intermediary balance between opposing forces on the Pyramid of Quetzalcóatl at Teotihuacan [5].

In the Andean Dialectic [1, 2], the opposites Yanantin and Pachakuti, are not only contradictory but also complementary, as in our real life [6,7].

The woman is the complementary of the man, but sometimes contradictory as well (arguing and fighting).

We may consider, for example, the **Quadruple Neutrosophic Logic**, where (T, F) is refined into (T, I₁, I₂, F), as follows:

T = man

F = woman

I₁ = a type of indeterminacy, called complementary relationship between man and woman (they help each other);

I₂ = another type of indeterminacy, called contradictory relationship between man and woman (they are fighting one with the other).

Therefore, herein one has a **quadr-alectic**, dynamic of four elements.

The most general dynamic is the **n-alectic**, which is the dynamic of n (sub)components of the Refined Neutrosophic Logic [8]:

The Neutrosophic Components (T, I, F) were refined into n Neutrosophic SubComponents

$(T_1, T_2, \dots, T_p; I_1, I_2, \dots, I_r; F_1, F_2, \dots, F_s),$

where p, r, s, n are positive integers and $p + r + s = n$.

In Shuar or Jíbaro, an amazonian culture from Ecuador and Peru (Figure 3), cosmology is based on three primary realms the Upper World (T - The Celestial and Spiritual Realm), the Middle World (I - The Human and Social Realm), and the Lower World (F - The Realm of Chaos, Transformation, and Darkness)—are closely associated with specific deities and spiritual forces that embody their respective characteristics [9]. These deities can be mapped onto the n-alectic structure as described in the refined neutrosophic logic framework. The Shuar worldview extends beyond a simple duality (e.g., good vs. evil) or even a basic triadic

structure (Upper, Middle, and Lower Worlds); instead, it represents a complex n-alectic system where multiple subcomponents interact dynamically.

For instance [10-12]:

- Tsunki (T₁ - The Water Spirit and Guardian of Healing) and Shakaim (F₁ - The Force of Strength and Chaos) are not simply opposites; they interact dynamically through the role of the shaman (I₃ - The Mediating Force Between Worlds), who seeks balance.
- Nunkui (T₃ - The Spirit of Fertility and the Earth's Provider) ensures fertility, but Nekás (F₃ - The Shadow Spirit, the Uncontrollable Wild Forces) represents destruction—both are necessary for ecological balance.
- The physical warrior force (Iwia, I₁ - The Physical World and Warrior Spirit) struggles between the celestial wisdom of Etsa (T₂ - The Sun Spirit, Provider of Life and Strength) and the chaotic transformation of Kakarma (F₂ - The Force of Change and Rebirth).
- The social and cultural world (I₂ - The Collective Spirit and Tradition) serves as the repository of knowledge, customs, and community rituals, which regulate how humans interact with both the spiritual and natural worlds. Through cultural transmission, oral traditions, and collective ceremonies, I₂ stabilizes the balance between I₁ (the physical world), I₃ (spiritual mediation), and the broader cosmological forces (T and F).

This n-alectic framework closely aligns with refined neutrosophic logic, as each deity, force, or spirit does not exist in isolation or as part of a rigid binary system but rather within a relational network characterized by complementarity, contradiction, and transformation.

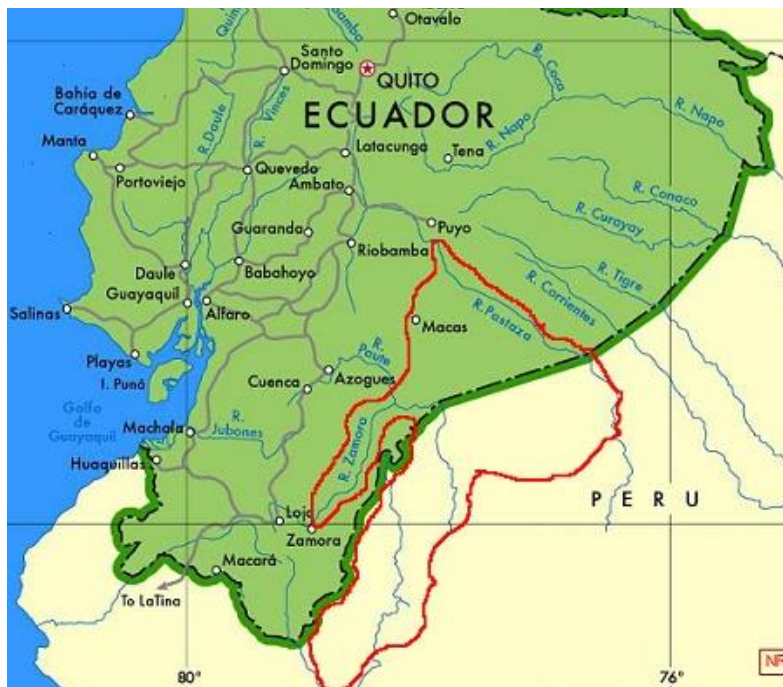


Figure 3. Jivaro Territory highlighted in red, between Ecuador and Peru [13]

The Neutrosophic Components (T, I, F) were refined into n Neutrosophic SubComponents [14]:

(T₁, T₂, T₃; I₁, I₂, I₃; F₁, F₂, F₃),

This n-alectic framework allows for a more dynamic and layered understanding of reality, where each subcomponent interacts with the others in complementary, contradictory, or indeterminate ways. In this way, the Shuar cosmology exemplifies an n-alectic structure, where the interplay of multiple subcomponents creates a rich and dynamic understanding of existence. This goes beyond simple dualities or triadic relationships, embracing a more complex and interconnected view of reality that aligns with the principles of refined neutrosophic logic.

2. Practical Application: Incorporation of Ethical Components of Pachamama in Decision-Making

Making an ethical decision within the framework of n-alectic and respect for Pachamama [15, 16] involves considering multiple interconnected dimensions that reflect both human and non-human aspects. The n-alectic, based on refined neutrosophic logic, allows for the integration of dynamic subcomponents (truth, indeterminacy, and falsity) to address complex problems where absolute truths are scarce, and perspectives are diverse. In this context, ethical decision-making must balance economic, social, environmental, and spiritual interests, especially in settings where indigenous worldviews recognize nature as a rights-bearing entity.

2.1. Define Neutrosophic Subcomponents

In the context of mining and respect for Pachamama, the neutrosophic subcomponents can be represented as follows:

- Truth (T): Economic benefits and social development derived from mining.
Example: Job creation, income for local communities, investment in infrastructure.
- Indeterminacy (I): Ambiguous or uncertain aspects related to mining.
I_T: Indeterminacy leaning toward truth (e.g., mining projects that promise benefits but have not yet demonstrated results).
I: Pure indeterminacy (e.g., lack of comprehensive studies on environmental impact).
I_F: Indeterminacy leaning toward falsity (e.g., potential risks to fragile ecosystems).
- Falseness (F): Negative impacts associated with mining.
Example: Water pollution, deforestation, biodiversity loss, cultural and spiritual harm to indigenous communities.

These subcomponents can be further refined according to the specific needs of the case, following the n-alectic model:

(T, I_T, I, I_F, F)

These subcomponents can be further refined according to the specific needs of the case[17]

2.2. Assign Weights to Components

Weights are assigned to each subcomponent based on the desired emphasis. For example:

$w_T = 0.33$ (for Truth, T),

$w_{IT} = 0.165$ (for IT, indeterminacy leaning toward truth),

$w_I = 0.165$ (for I, pure indeterminacy),

$w_{IF} = 0.165$ (for IF, indeterminacy leaning toward falsity),

$w_F = 0.175$ (for Falseness, F).

The total sum of these weights is:

$$w_T + w_{IT} + w_I + w_{IF} + w_F = 0.33 + 0.165 + 0.165 + 0.165 + 0.175 = 1$$

This ensures that the weight distribution is balanced and that each subcomponent has the desired influence on the outcome.

The weights can vary depending on whether the goal is to minimize risks or maximize benefits.

The assignment of weights to components can be linked to the Andean principle of complementarity, which governs various aspects of life, including political, social, economic, and spiritual dimensions, by reflecting the coexistence and balance of opposing or different elements to achieve a greater purpose 1. For instance, "risks" and "benefits" can be viewed as complementary forces that need to be weighed according to context and priorities, mirroring the Andean approach of balancing opposing forces or interests. This concept aligns with the principle of relationality in Andean philosophy, which highlights the interconnectedness of all elements and the importance of considering how each factor, such as risk or benefit, impacts the entire system, ensuring decisions are made in harmony with Andean principles.

2.3. Determine the Ideal Option

Given a set of options, $X = \{x_1, x_2, \dots, x_n\}$, the ideal solution I is defined as [18]:

$$I = (\max(T_x), \max(IT_x), \min(I_x), \min(IF_x), \min(F_x)) \quad (1)$$

Where:

- T_x : Truth associated with option x.
- IT_x : Indeterminacy leaning toward truth associated with option x.
- I_x : Pure Indeterminacy associated with option x.
- IF_x : Indeterminacy leaning toward falsity associated with option x.
- F_x : Minimum Falseness associated with option x.

This ideal serves as a reference point for evaluating alternatives.

The concept of the "ideal option," which involves maximizing truth (T), minimizing falseness (F), and managing indeterminacy (IT, I, IF), resonates with pre-Columbian philosophical principles, particularly those of the Shuar and other Andean and Amazonian cultures. These worldviews emphasize a dynamic balance between opposing yet complementary forces, such as the spiritual and earthly realms, reflecting an ongoing process of adjustment to achieve harmony. This principle of equilibrium aligns with the pursuit of

an ideal option that maximizes positive outcomes while minimizing negatives and addressing inherent uncertainties. The refined neutrosophic classification of indeterminacy into three types— I_T (leaning toward truth), I (pure indeterminacy), and I_F (leaning toward falsity)—parallels the Shuar cosmovision, where realities are not absolute or binary but complex and context-dependent. For instance, I_T may represent benevolent spiritual forces promoting well-being, I symbolize natural ambiguities like cycles of transformation, and I_F corresponds to chaotic or destructive forces that must be minimized.

This approach also aligns with the Andean principle of complementarity, where opposites coexist and integrate into a harmonious whole, as seen in the concept of Yanantin. Furthermore, the goal of minimizing falseness and maximizing truth in the neutrosophic framework reflects pre-Columbian ethical principles centered on respecting Pachamama (Mother Earth) and collective well-being. These cultures prioritized decisions that balanced human needs with ecological harmony, embodying a holistic ethic that values sustainability and respect for vital universal forces. Such an approach highlights the importance of integrating multiple dimensions to achieve optimal and balanced solutions 4

4. Calculate Neutrosophic Distance

The distance between two refined numbers can be calculated using a weighted metric, such as Euclidean or Hamming distance. The general formula for the weighted distance is [19,20]:

$$d_i^+ = \sum_{i=1}^n \left(w_T |T_{A(x_i)} - T_{B(x_i)}|^\lambda + w_{IT} |IT_{A(x_i)} - IT_{B(x_i)}|^\lambda + w_I |I_{A(x_i)} - I_{B(x_i)}|^\lambda + w_{IF} |IF_{A(x_i)} - IF_{B(x_i)}|^\lambda + w_F |F_{A(x_i)} - F_{B(x_i)}|^\lambda \right) \quad (2)$$

Where:

$\lambda > 0$ defines the type of distance (e.g., $\lambda=1$ for Hamming distance, $\lambda=2$ for Euclidean distance).

A smaller distance indicates greater similarity between the refined numbers. This approach is useful when identifying the option closest to an ideal or reference standard.

The chosen option will be the one closest to the ideal. The calculation of distance between refined numbers using weighted metrics, such as Euclidean or Hamming distance, can be associated with pre-Columbian philosophical principles, particularly the principle of balance and complementarity found in Andean and Amazonian worldviews. This principle emphasizes the dynamic interconnection between opposing or complementary forces to achieve harmony, which is reflected in the way neutrosophic subcomponents (truth, indeterminacy, and falsity) are weighted and compared to find an optimal equilibrium. In Andean philosophy, the principle of complementarity (Yanantin) posits that opposites coexist and balance each other to form a harmonious whole [21]. For instance, the subcomponents T (truth), IT (indeterminacy leaning toward truth), I (pure indeterminacy), IF (indeterminacy leaning toward falsity), and F (falsity) represent complementary forces. The assignment of weights mirrors how these forces are balanced according to context, akin to the adjustment of opposites in Andean thought to achieve a greater purpose.

This approach also aligns with the principle of relationality, central to indigenous worldviews, which underscores the interconnectedness of all elements and the need to consider relationships between components when making decisions 2. The distance calculation carefully evaluates how each subcomponent (T , IT , I , IF , F) impacts the entire system, ensuring coherence with a holistic framework. This reflects how pre-Columbian cultures prioritized decisions that integrated multiple dimensions—human, spiritual, and

environmental—to maintain ecological and social balance. Thus, the use of weighted metrics in neutrosophic logic resonates with traditional principles like complementarity and relationality, highlighting the importance of balancing opposing forces and considering systemic interconnections for sustainable and harmonious outcomes.

3 Illustrative Example: Ethical Decision-Making in Mining Using the N-Alectic Framework

A multinational mining company is proposing a large-scale mining project in a region inhabited by indigenous communities that adhere to Pachamama-based ethical principles. The decision-making process must integrate economic development, social impact, environmental sustainability, and cultural respect while acknowledging the uncertainties and contradictions inherent in mining activities.

Step 1: Defining Neutrosophic Subcomponents

Using n-alectic principles, we classify the potential impacts of mining as follows:

- Truth (T) – Positive Outcomes
- Indeterminacy (I) – Uncertainties and Ambiguities
 - IT (Indeterminacy leaning toward truth): The mining project promises economic benefits, but long-term success is uncertain.
 - I (Pure Indeterminacy): Lack of comprehensive environmental impact studies creates unknown risks.
 - IF (Indeterminacy leaning toward falsity): Unclear legal protections for indigenous land rights and potential policy changes.
- Falseness (F) – Negative Outcomes

Thus, the mining scenario can be structured as:

$$(T, IT, I, IF; F)$$

Step 2: Assigning Weights to Components

To ensure that ethical considerations align with Andean principles of complementarity and relationality, we assign the following weights:

- Economic and social benefits:
 $w_T=0.30$
- Indeterminate factors:
 $w_{IT}=0.15$
 $w_I=0.15$
 $w_{IF}=0.15$
- Environmental and cultural harms:
 $w_F=0.25$

$$W = (0.30, 0.15, 0.15, 0.15, 0.25)$$

These weights reflect an ethical balance where economic and social benefits (T) are important but do not outweigh cultural and environmental sustainability (F), consistent with Pachamama ethics.

Step 3: Identifying the Ideal Ethical Decision

The ideal decision should maximize economic and social truth (T), minimize falseness (F), and manage indeterminacies (IT, I, IF) responsibly.

Using the neutrosophic ideal solution formula:

we evaluate two decision alternatives:

Option A: Sustainable Mining with Indigenous Leadership

- **T:** High (T1=0.8)
- **IT:** Medium (IT=0.5)
- **I:** Low (I=0.3)
- **IF:** Low (IF=0.2)
- **F:** Very low (F=0.2)

$$A = (0.8, 0.50, 0.3, 0.2, 0.2)$$

Option B: Conventional Large-Scale Mining

- **T:** High (T=0.7)
- **IT:** High (IT=0.6)
- **I:** High (I=0.7)
- **IF:** High (IF=0.6)
- **F:** High (F1=0.7)

$$B = (0.7, 0.6, 0.7, 0.6, 0.70)$$

The Idel solution in calculated using Equation 1 (as follows):

$$I = (\max(0.8, 0.7), \max(0.5, 0.6), \min(0.3, 0.7), \min(0.2, 0.6), \min(0.2, 0.7))$$

$$I = (0.8, 0.6, 0.3, 0.2, 0.2)$$

Step 4: Calculating the Neutrosophic Distance

Using the weighted metric formula ($\lambda = 2$), we compute the distance from the ideal ethical decision (I)

$$d_A^+ = 0.0387$$

$$d_B^+ = 0.03369.$$

- Option A (Sustainable Mining with Indigenous Leadership) has a lower neutrosophic distance, making it the ethically preferable choice under Pachamama principles.

This result supports the idea that ethical decision-making should balance economic, environmental, and cultural sustainability, emphasizing harmony and complementarity over pure economic gains.

3. Conclusions

The n-alectic framework offers a sophisticated analytical tool that goes beyond binary opposition by incorporating multiple interdependent subcomponents. Whether in philosophical, cultural, or practical decision-making contexts, this model enhances our ability to navigate complexity and achieve harmonious integration of opposing forces—a principle deeply rooted in indigenous worldviews and refined neutrosophic logic.

Future research can further explore the practical applications of n-alectic models across various domains. In policymaking, the n-alectic framework can be applied to government and environmental policies, enhancing decision-making by integrating multiple dimensions of truth, indeterminacy, and falseness. In the realm of economic sustainability, these principles could contribute to the development of more holistic and adaptable sustainable development models. Additionally, in technology and AI ethics, refined neutrosophic logic may offer valuable insights for ethical decision-making in artificial intelligence, addressing the complexities of uncertainty and bias. From a cultural perspective, further research could examine how indigenous cosmologies align with n-alectic thought, providing deeper insights into their philosophical implications on a global scale. By continuing to refine and expand this approach, we can foster a more inclusive and comprehensive understanding of reality, bridging diverse worldviews and methodologies to promote a sustainable and ethical future.

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