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A Trialist Perspective of the Labor Inclusion of Indigenous People in Ecuador through PESTEL and Neutrosophic Cognitive Maps

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Abstract. The purpose of this research was to determine from a trialist perspective what factors currently affect the labor inclusion of people from indigenous cultures in Ecuadorian society and to propose strategies for their mitigation. A broad and generic analysis is carried out to assess whether the norms and the social reality evident in the country effectively adhere to each other. We used a fusion of PESTEL method and Neutrosophic Cognitive Maps, since during the mathematical exercise that endorses the analysis, indeterminacy is incorporated into the modeling of the causal relationships between the factors analyzed. Finally, the figure of indigenous labor inclusion is declared as an unfinished topic. Therefore, the priority factor to consider is the establishment of policies favoring the employment of indigenous people. As a solution, this paper ends with the proposal of compliant strategies to promote improvements in this area.

Keywords: labor inclusion; indigenous people; trialism; PESTEL analysis; neutrosophic cognitive maps.

1 Introduction

Trialist theory or trialism within the legal world is a legal theory developed by the German jurist Werner Goldschmidt [1]. It is also known as legal three-dimensionalism. It states that the legal world consists of three dimensions: facts (conduct or human behavior), norms (descriptions and logical captures of behaviors) and values (justice carried out through evaluations of men's behaviors). By nature, they integrate with each other, since it is the value of justice that allows the conduct and norms to be integrally judged. This is the reason why any branch of legal science must reflect this quality called three-dimensionality, which must not only reflect a certain trialist distribution, but should also show integration. Because of this, many conceptions can be considered three-dimensional in this broad sense: all natural law and a good part of Anglo-Saxon legal realism [2, 3].

Due to the nature of the aforementioned dimensions, we may say that there is a metaphysical union to prevent their political-methodological separation. Therefore, for its application it is necessary to start from the fusion principle of these two spaces. All this without decoupling from the concept of legal space [1, 2, 4]. One of the applications of trialism is the analysis of social phenomena through a formula that demonstrates integration between dimensions from an organic perspective, since “law is not just a set of rules that are established to regulate social behavior, but a complex totality that is called the “Legal World”[1]. [2] declares that, due to the origin and importance given to three-dimensionalism applied to an event within this context, it is necessary to carry out an exhaustive investigation of all the variables inherent to each of the dimensions of the trialist perspective.

From this perspective, the social reality of Ecuador is precisely analyzed. A reality in which takes place a historical-cultural event imposed by the rootedness of its idiosyncrasy: the categorization of people in what today is known as "Independent National States", where inequality, social inequality, racism and discrimination persist. Which contrasts with the premises of "Good living", the fundamental pillar of the Ecuadorian Constitution [5].

Currently, indigenous peoples and nations are the most affected, along with the afro-descendant population, called niggers. In this sense, much of the work of the public or private function, in the Ecuadorian territory there is evidence of the absence of indigenous people who hold positions in such entities. In this framework, the State has the obligation to identify those social groups having special difficulties to share with others on equal terms and thus give an effective guarantee of labor inclusion for this group of people.

Therefore, the main problem object of this study is the insertion of the indigenous population in the Ecuadorian labor environment. A glance at this topic, applying the trialist perspective, exposed that today equality is not applied; there is discrimination for jobs in areas with a greater amount of indigenous culture. The three-dimensional approach showed that the presence of these people practicing in a position is practically null, which is why this vulnerable sector must receive asymmetric, spontaneous participation and equity justice in order to shed legal certainty. The State has the mission of building equal national policies for all. However, researchers are obliged to provide solution strategies to identify, determine, correct and help those social groups and give an effective guarantee of a labor inclusion for this group of people. Then, due to the origin and essential importance of this topic, it was urgent to pay attention to it, so we decided to carry out this study with the objective: to determine what factors affect the labor inclusion of people from indigenous cultures in Ecuadorian society in the topicality and propose strategies to mitigate them[6].

The aforementioned is based on the idea that if we determine the factors that affect the problem and offer a hierarchy according to its negative impact, then we may propose strategies to the State of Ecuador in order to favor the incursion of so-called niggers into the environment of the country. In accordance with this approach, it is essential to study the situation using comprehensive strategic analysis techniques endorsed in mathematical methods compatible with the trialist perspective, to fulfill the stated objective. As well as the following specific objectives:

1. To characterize in an integral way the micro and macro-environment of the problem.
2. To determine the factors that affect the occurrence of the proposed phenomenon.
3. Rank the factors by their level of incidence based on a comprehensive mathematical model that transforms the linguistic results into mathematical ones and includes the notion of indeterminacy.
4. Propose strategies based on the results of the study and the interpretative capacity of the data.

After reviewing the bibliography and consulting several authors [7], we decided to apply the neutrosophic PESTEL analysis, due to its versatility in factor research. PESTEL is a strategic analysis technique to determine the external environment that affects the following factors: namely political, economic, sociocultural, technological, ecological and legal. It consists of determining the forces that affect the specific environment: sector, employment market, target groups, competition, among others. It is a technique to analyze business and determine the context in which it moves, in turn, allows the design of strategies to defend, take advantage of or adapt to anything that affects the sector [8]. The categories under consideration are:

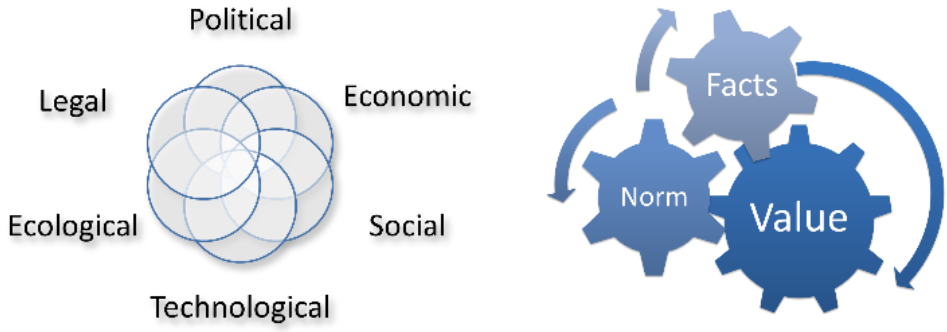

Figure 1. Representations of PESTEL analysis and Trialist Perspective. Source: own elaboration

Due to the need to establish a mathematical model of the linguistic terms that PESTEL offers as an output (factors), indeterminacies my occur and an answer must be required. The theory of Neutrosophy proposed by Florentin Smarandache, for the treatment of neutralities, generalizes clear and fuzzy set theories [9], where indeterminacies are supported. Neutrosophy is a useful theory that is increasing its number of applications in many fields. In this case, the inclusion of this theory enriches the possibilities of the PESTEL analysis, mainly due to two reasons: firstly, the addition of the notion of indeterminacy and, secondly, the possibility of calculating using linguistic terms [10]. That is why, we decided to opt for a fusion of both techniques and to run the study through

the use of neutrosophic PESTEL, that is, the combination of PESTEL analysis with neutrosophic cognitive maps [11].

It is necessary to clarify that the problem under study is based on the interrelation shown by six aspects of the technique that integrate the trialist vision. In this way, a greater capacity for interpretation of the results is that it facilitates and contributes to the correlation between the characteristics of the study factors. Currently, [12-14] considers that the theory of Neutrosophy has significantly improved the techniques, tools and sharp methods, being an example its joint use with TOPSIS, VIKOR, ANP and DEMATEL.

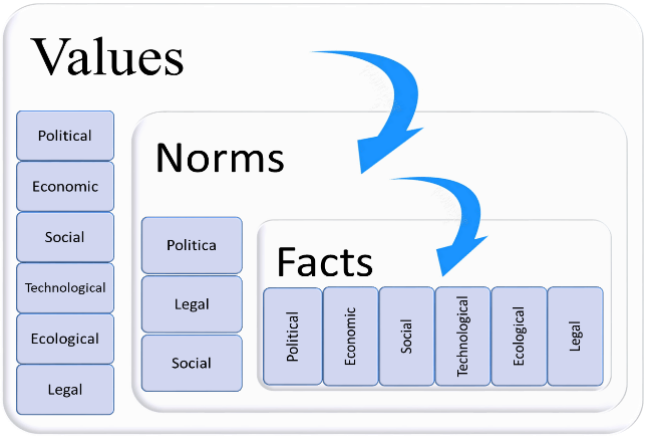

Figure 2. Trialist perspective fusion with neutrosophic PESTEL. Source: own elaboration.

After analyzing the previous discourse, it was necessary to apply the following theoretical methods to write this paper[15]:

- Analysis and Synthesis of the information obtained from the literature review, both international and national, of the specialized documentation, as well as the experience of observers and actors consulted to develop logical and valid conclusions, as well as a set of premises and/or positions generated by relevant actors within the social system, ethnic groups and their labor incursion.
- Systemic - structural for the development of the analysis through its decomposition into the elements that comprise it. It was possible to determine that there are countless unfavorable situations that contribute to the unemployment of indigenous cultures with unavoidable economic effects.
- Hermeneutic to make a comparative interpretation of the legislation applicable to the subject in question.

Based on the previously mentioned, the study is structured as follows: a second section where the basic concepts necessary to achieve the solution of this problem are briefly and compactly described; a third section to describe the results of the application of neutrosophic PESTEL in solving the posed problem. Finally, we state the conclusions reached after executing the analysis and the bibliography that allowed the development of this paper.

2 Materials and methods

Starting from the previous elements, in this particular work the use of Neutrosophic Cognitive Maps (NCMs) is proposed considering the advantages that this technique offers compared to other soft-computing techniques, in terms of interpretability, scalability, aggregation of knowledge, dynamism and its ability to represent feedback and indeterminacy relationships [16].

Neutrosophic Cognitive Maps (NCMs) were introduced by [17] in 2003. NCMs is an integration of the Fuzzy Cognitive Maps (FCM) introduced by Kosko in 1986 and the Neutrosophic Sets introduced by Smarandache in 1995 [18]. This technique overcomes the inability of traditional techniques to represent indeterminacy [19]. The inclusion of indeterminacy establishes that neutrality and ignorance are also forms of uncertainty. [18] declares that FCM constitutes a technique that has received increasing attention due to its possibilities for representing causality. Below is a set of definitions necessary for working with NCMs:

First, let us formally reproduce the original definition of neutrosophic logic as shown in [20].

Definition 1. Let N = {(T, I, F): T, I, F∈ [0,1]}[21] be a *neutrosophic set of evaluation*. v:$\boldsymbol{P}\rightarrow$N is a mapping of a group of propositional formulas into N, i.e., each sentence p∈ $\boldsymbol{P}$ is associated to a value in N, as it is exposed in the Equation 1, meaning that p is T% true, I% indeterminate and F% false.

$$v(p) = (T, I, F) \quad (1)$$

Hence, the neutrosophic logic is a generalization of fuzzy logic, based on the concept of Neutrosophy according to [9, 22].

Definition 2. (See [21, 23]) Let K be the ring of real numbers. The ring generated by K∪I is called a *neutrosophic ring* if it involves the indeterminacy factor in it, where I satisfies $I^2 = I$, I+I = 2I and in general, I+I+...+I = nI, if k∈K, then k.I = kI, 0I = 0. The neutrosophic ring is denoted by K(I), which is generated by K∪I, i.e., K(I) = <K∪I>, where <K∪I> denotes the ring generated by K and I.

Definition 3. A *neutrosophic matrix* is a matrix $A = [a_{ij}]_{ij}$ i =1, 2, …, m and j = 1, 2, …, n; m, n≥1, such that each a_{ij}∈K(I), where K(I) is a neutrosophic ring, see [24].

Let us observe that an element of the matrix may have the form a+bI, where a and b are real numbers, while I is the indeterminacy factor. The usual operations of neutrosophic matrices can be extended from the classical matrix operations.

For example, $\begin{pmatrix} -1 & I & 5I \\ I & 4 & 7 \end{pmatrix}\begin{pmatrix} I & 9I & 6 \\ 0 & I & 0 \\ -4 & 7 & 5 \end{pmatrix} = \begin{pmatrix} -21I & 27I & -6+25I \\ -28+I & 49+13I & 35+6I \end{pmatrix}$.

Additionally, a *neutrosophic graph* is a graph that has at least one indeterminate edge or one indeterminate node [20, 25]. The *neutrosophic adjacency matrix* is an extension of the adjacency matrix in classical graph theory. $a_{ij} = 0$ means nodes i and j are not connected, $a_{ij} = 1$ means that these nodes are connected and $a_{ij} = I$ means the connection is indeterminate (whether they are connected or not is unknown). Fuzzy set theory does not use such notions.

On the other hand, if the indetermination is introduced in a cognitive map as it is referred in [26], then this cognitive map is called a *neutrosophic cognitive map*, which is especially useful in the representation of causal knowledge [9, 27]. It is formally defined in Definition 4.

Definition 4. A *Neutrosophic Cognitive Map* (NCM) is a neutrosophic directed graph with concepts like policies and events as nodes and causalities or indeterminacies as edges. It represents the causal relationship between concepts.

Neutrosophic Cognitive Maps are used in this paper, in accordance to the proposed objective, to include an indeterminate framework in the PESTEL analysis. The proposed framework is shown in Figure 3.

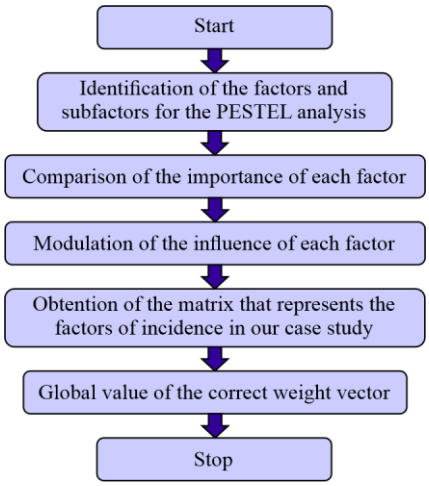

Figure 3. Framework to obtain the characteristics analyzed in each factor of the PESTEL model based on neutrosophic cognitive maps.

Neutrosophic cognitive maps are a generalization of fuzzy cognitive maps. Fuzzy cognitive maps are introduced by Axelrod, see [21], where nodes represent concepts or variables in a particular area of study and arcs indicate either positive or negative influences, considered as causal relationships. They have been applied in numerous areas, especially in supporting decision-making and in the analysis of complex systems as it is referred in [28]. Static analysis in a cognitive neutrosophic map focuses on the selection of the most important concepts, characteristics or factors in the modeled system [25].

The framework proposed in Figure 3 guides the process to obtain the characteristics of each of the factors analyzed with the PESTEL model. Integrated structure factors corresponding to a PESTEL analysis and characteristics are modeled using neutrosophic cognitive maps, which contributes to obtain quantitative information of the characteristics of factor analysis.

The measures described below are used in the proposed model, they are based on the absolute values of the adjacency matrix [26]:

- Outdegree (v_i) is the sum of the row elements in the neutrosophic adjacency matrix. It reflects the strength of the outgoing relationships (c_{ij}) of the variable.

$$od(v_i) = \sum_{i=1}^{n} c_{ij} \quad (2)$$

- Indegree (v_i) is the sum of the column elements. It reflects the strength of relations (c_{ij}) outgoing from the variable.

$$id(v_i) = \sum_{i=1}^{n} c_{ji} \quad (3)$$

- Total centrality (total degree td (vi)), is the sum of the indegree and the outdegree of the variable.

$$td(v_i) = od(v_i) + id(v_i) \quad (4)$$

The static analysis is applied using the adjacency matrix, taking into consideration the absolute value of the weights [25]. Static analysis in Neutrosophic Cognitive Maps (NCM), see [27], initially contains the neutrosophic number of the form (a + bI, where I = indetermination) [29]. It requires a process of de-neutrosophication as proposed in [26], where I ∈ [0, 1] and it is replaced by their maximum and minimum values.

Finally, we work with the average of the extreme values, calculated using Equation 5, which is useful to obtain a single value. This value contributes to the identification of the characteristics to be attended, according to the factors obtained with the PESTEL model, for our case study.

$$\lambda([a_1, a_2]) = \frac{a_1 + a_2}{2} \quad (5)$$

Then,

$$A \succ B \Leftrightarrow \frac{a_1 + a_2}{2} > \frac{b_1 + b_2}{2} \quad (6)$$

3 Results

Once the state of the art of the elements under analysis has been examined, we carry out the extraction of potential factors (variables) applying the following process approach:

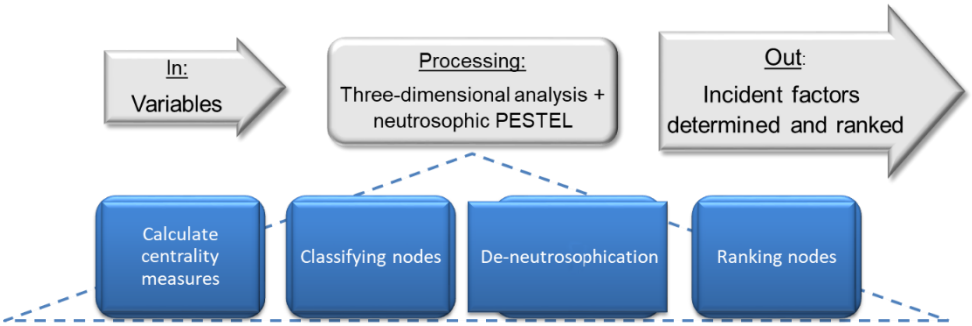

Figure 4. Process approach to data processing with PESTEL merged with neutrosophic cognitive maps. from the three-dimensional perspective. Source: own elaboration

The following table shows the factors and characteristics of the PESTEL model obtained for the analysis:

Dimension	Factor	State
Political	**Establishment of policies favoring indigenous employment (p1)**	• Article 33 of the Constitution of the Republic of Ecuador, declares the right to work, so it becomes a social duty that the government should materialize. Even though the regulations protect and favor these groups of people, in reality their employment rights are undermined. • There are no policies to favor the employment of the indigenous community, obliging companies, regardless of their type, to hire non-white people. Rather, the so-called niggers are undermined. • There is no perceived political interest in establishing parameters in the labor code to consider or favor inclusion, because there is a tendency for the legislator not to limit himself to explain what is happening, but rather to worry about what should be accomplished.
Economic	**Possession of wealth (e1)**	• There is predominance of possession of wealth in people who define themselves as white persons. The primacy of poverty phenomenon is defined as a ratio of 5/10 (45%) in those who call themselves white and 7/10 (55%) in those who call themselves black, non-white.
Social	**Perception of rights in the population**	• The right to work is perceived as a moral and ethical responsibility of Ecuadorian society to guarantee that each citizen has a job, or an activity that generates remuneration in exchange for a provision of a

	(s1)	service, as long as it is not against good customs. • There are no constitutional principles applied to companies, so in practice the access of indigenous people to public or private jobs is very low. • The jobs and employers keep the representatives of the indigenous communities socially confined, restricting them mostly to agricultural work. • At popular level, discriminatory terms such as non-whites or self-proclaimed blacks are ingrained, arising white supremacy. • Marginality imposed by white groups. • Self-recognition and respect of idiosyncrasy in self-defined indigenous or non-white people. According to a census, nine out of ten people define themselves as indigenous.
Technological	**Technical knowledge (t1)**	• Self-proclaimed non-white people do not have technical and/or technological knowledge that demonstrates the universalization of society. Which does not allow a rising professional quarry with the annual promotions of technical careers of the members of indigenous communities who are increasingly illiterate every day because they do not perceive the need to be formally employed in the cities.
Ecological	**Impact of climate change (ec1)**	• The phenomenon of climate change has affected indigenous communities largely dependent on agriculture as a mean of subsistence. This establishes a trend towards migration to cities and the preference for technical careers. Agricultural sustainability, once centered on the forces acting in society, is affected by migration and other social phenomena.
Legal	**Rights (l1)**	• The rights enshrined in the Carta Magna of the Republic of Ecuador, specifically in Article 33, considers work not only as a Right. • In the same way, article 11, numeral 2, declares that all people are equal and have the same rights, duties and opportunities, these being understood as indigenous, foreign, etc. It is emphasized that no one may be discriminated for the sake of ethnicity, place of birth, age, sex, gender identity, cultural identity, marital status, language, religion, ideology, affiliation, etc. • In the Labor Code, the consideration of inclusion as an obligation of public or private companies is not explicitly stated.

Table 1. Diagnosis of variables and interrelation matrix between dimensions, factors and their current condition. Source: own elaboration.

These factors called variables will be denoted by alphanumeric codes (p1, e1, s1, t1, ec1, l1), following the preceding order in the table. There is a group of experts who evaluate the causal relationships between the six variables with neutrosophic numbers. Using an average of the experts' evaluations, we obtained an adjacency matrix and the graph who represents it:

$$E = \begin{bmatrix} 0 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 & 0.4 & 0.9 \\ 1 & 1 & 0 & 1 & 0.9 & 0 \\ 0 & 0 & 0.8 & 0 & 0.7 & 0 \\ 0 & 0.7 & 0.9 & 1 & 0 & 0 \\ 1 & 0.8 & 0.9 & 0.6 & 0 & 0 \end{bmatrix}$$

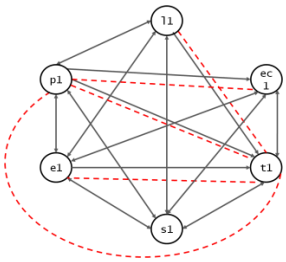

Figure 5. Adjacency matrix and the Neutrosophic Cognitive Map on the causal relationships between the factors identified in the PESTEL (decision nodes).

$$N(E) = \begin{bmatrix} 0 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 & 0.4 & 0.9 \\ 1 & 1 & 0 & 1 & 0.9 & 0 \\ I & I & 0.8 & 0 & 0.7 & I \\ I & 0.7 & 0.9 & 1 & 0 & 0 \\ 1 & 0.8 & 0.9 & 0.6 & 0 & 0 \end{bmatrix} \quad E = \begin{bmatrix} 0 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 & 0.4 & 0.9 \\ 1 & 1 & 0 & 1 & 0.9 & 0 \\ 0.5 & 0.5 & 0.8 & 0 & 0.7 & 0.5 \\ 0.5 & 0.7 & 0.9 & 1 & 0 & 0 \\ 1 & 0.8 & 0.9 & 0.6 & 0 & 0 \end{bmatrix}$$

	td
p1	1.8
e1	1.66
s1	1.7
t1	1.52
ec1	1.22
l1	1.14

Figure 6. Neutrosophic, de-neutrosophied adjacency matrix and the means of the extreme values corresponding to the NCM.

In accordance with the aforementioned, we can partially conclude:

- When p1 is activated, all the other nodes are activated, which means that the establishment of policies favoring indigenous employment will cause all the other problems identified in the other vertices. It will have an optimistic influence due to the causal relationship with positive indices (if p1 increases then e1, s1, t1, ec1, l1 will increase in the same way).
- The relationships with p1 and the rest of the nodes is bidirectional, therefore we can confirm the causal relationship in both directions and magnitude.
- If e1 it is activated, we can verify that there is a strong causal relationship also with the rest of the nodes, but not in both directions, unlike p1.
- It is evident that there is an indeterminacy relationship between t1 and e1.

Result: the order of importance of the factors is: $p_1 \succ e_1 \succ s_1 \succ t_1 \succ ec_1 \succ 1$

Priority factor to analyze: Establishment of policies favoring indigenous employment.

Strategies to consider:

- No.1: Consider a reform to the Labor Code, which establishes a minimum percentage of indigenous people who must be hired in relation to all the workers established on the payroll, both in the public and private sectors.
- No. 2: Implement an ordinance regulating indigenous jobs.

Conclusions

After the analysis of the factors determined from a trialist perspective fused with the neutrosophic PESTEL technique, we can say that:

- Indeterminacy is incorporated into the modeling of the causal relationships between the factors analyzed, where neutrosophic science is an active part in decision-making.
- The labor inclusion of indigenous people in Ecuador is a vague and inconclusive issue since, given the reality and despite the existence of norms that protect indigenous communities, they do not achieve their objective and consequently no plans or actions have been created to give a timely response to the real needs of the community. Despite the existence of regulations and government plans in a broad and generic sense, it is important to consider vertical awards with greater emphasis on plans with areas of special action (local or provincial) for indigenous labor inclusion.
- The work carried out in most of the indigenous culture is agricultural; therefore, free access to education is important for communities with difficult access to it, mainly in provinces where there is a greater concentration of indigenous communities.
- The priority factor to analyze is the establishment of policies favoring indigenous employment, and strategies that are consistent with making improvements in this area.

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