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Examination of Disappeared Individuals in Ecuador Using Orange Data Mining

Examen de las personas desaparecidas en Ecuador mediante la minería de datos de Orange

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Abstract. This study examines the issue of disappearances in Ecuador in 2024 using open data and the Orange Data Mining tool. It reveals that adolescents are the most vulnerable group, followed by young adults and children. Key findings include an 82.1% resolution rate, with 12.2% of cases remaining unsolved and 5.7% resulting in death. Geographic analysis indicates higher disappearance rates in border, urban, and coastal regions, while gender differences show that although 56.7% of the disappeared are women, men comprise 80% of unresolved and fatal cases. A notable contribution of the study is the validation of the Orange Data Mining tool using a neutrosophic multicriteria analysis. This approach incorporates degrees of truth, falsity, and indeterminacy to manage data uncertainty, confirming the tool's robustness and accuracy in handling complex information. The combined methodology offers valuable insights for enhancing search protocols and developing differentiated preventive strategies, ultimately guiding more effective public policies to address and reduce the incidence of disappearances.

Keywords: Disappearances, teenagers, gender, vulnerability, prevention, neutrosophic validation.

Resumen. Este estudio examina el tema de las desapariciones en Ecuador en 2024 utilizando datos abiertos y la herramienta Orange Data Mining. Revela que los adolescentes son el grupo más vulnerable, seguido de los adultos jóvenes y los niños. Los principales resultados incluyen una tasa de resolución del 82,1%, con un 12,2% de los casos sin resolver y un 5,7% con resultado de muerte. El análisis geográfico indica mayores tasas de desaparición en las regiones fronterizas, urbanas y costeras, mientras que las diferencias de género muestran que, aunque el 56,7% de los desaparecidos son mujeres, los hombres representan el 80% de los casos no resueltos y mortales. Una contribución notable del estudio es la validación de la herramienta Orange Data Mining mediante un análisis multicriterio neutrosófico. Este enfoque incorpora grados de verdad, falsedad e indeterminación para gestionar la incertidumbre de los datos, lo que confirma la solidez y precisión de la herramienta en el manejo de información compleja. La metodología combinada ofrece información valiosa para mejorar los protocolos de búsqueda y desarrollar estrategias preventivas diferenciadas, orientando en última instancia políticas públicas más eficaces para abordar y reducir la incidencia de las desapariciones.

Palabras clave: Desapariciones, adolescentes, género, vulnerabilidad, prevención, validación neutrosófica.

1. Introduction

The disappearance of persons is a complex phenomenon that affects many societies, including to Ecuador [1]. This concept HE refers to the absence of a person whose whereabouts HE unknown and whose situation generates uncertainty and suffering for their families and loved ones. The disappearances they can occur by various reasons, as issues social, conflicts interpersonal, human trafficking, irregular migration, kidnappings, gender violence, among other factors [2].

The studies indicate that certain groups are further vulnerable, like women youths, adolescents and children, due to factors such as sexual exploitation, domestic abuse or the search for better economic opportunities.

On the other hand, there are also reports of disappearances of adults in contexts of social violence or crimes related to drug trafficking and organized crime:

- **Volunteers,** when a person decide move away by reasons personal either emotional.
- **Involuntary,** associated to kidnappings, violence either treats of people.
- **Forced,** that involve to agents of the State either groups armed, especially in contexts of repression.

Within the Ecuadorian regulations, specific provisions are established to address the issue. of the people missing, focusing in the prevention, the search, and the protection of rights of the victims and their families.

- **Alba Protocol:** Designed for the urgent search for missing girls, boys and adolescents, in coordination with the National Police and specialized agencies.
- **Internal protocols of the Prosecutor's Office:** They guide investigations to address disappearances from a human rights and gender perspective.

Constitution of the Republic of the Ecuador (2008):

- **Right to the integrity staff:** HE prohibit the disappearances forced in any form (Art. 66, numeral 3).
- **Right to the truth:** Victims of forced disappearances or their families have the right to know the truth about what happened, within the framework of the right to justice (Art. 80).[3]

Duty of the State: He State this obliged to investigate and sanction the disappearances, guarantee human rights and prevent this type of crime.

Code Organic Comprehensive Penal (COIP):

He COIP includes provisions specific about the disappearance:

- **Crime of disappearance forced (Art. 84):** HE punish with grief private of freedom of 22 to 26 years for State agents or those acting on their behalf who deprive a person of their liberty and refuse to acknowledge the fact or provide information about their whereabouts.
- **Crime of disappearance involuntary:** HE sanctions to who is it, without be agents of the State, deprives a person of liberty with the intention of hiding him or her and there is no information about his or her whereabouts.
- **Treats of people (Art. 91):** Bound in some cases to disappearances, HE established as a serious crime.

Law Organic of Performance in Cases of People Missing and Lost (2019):

This regulations is specific for guarantee a answer effective forehead to the disappearances:

- **National Search System:** Establishes the creation of an integrated system for the search for missing persons, coordinated between various institutions, such as the National Police, the Prosecutor's Office, and specialized agencies [4].
- **Immediate action protocol:** It requires authorities to act without waiting for prior deadlines (such as the traditional 24 or 48 hours).
- **National Registry of Missing Persons:** Maintains statistical control and allows for more efficient coordination.
- **Protection of the families:** Ensures support psychological, legal and economic to the relatives of missing persons.

In the case of Ecuador, the situation is alarming. According to recent data, there are thousands of cases of missing persons. remain without solve, generating a crisis trustworthy in the institutions in charge of the search and the justice [5]. Factors as the lack of resources, deficiencies in the The lack of search protocols and the possible complicity of criminal networks make it difficult to comprehensively address this problem. In addition, civil organizations and family members have denounced an insufficient response from the of the State, it that reinforces the need of policies public further effective and a elderly social cooperation.

Ecuador faces a challenge enormous: guarantee he right to the TRUE and the justice for the affected families while strengthening preventive tools and improving search and rescue strategies investigation. He freak of the people missing ha shown tendencies worrying in recent years [6]. Between 2017 and 2022, the annual average of disappearances was high, reaching figures of 7,493 people reported missing in 2022, with 594 cases still unsolved that year. In 2023, the daily average of disappearances rose to 22 cases, indicating an increase compared to previous years [7]. In 2024, adolescents were the most affected group, representing 44% of the total disappearances, followed by young adults and children under 12 years of age.

2. Materials and methods

Open data is digital data made available to citizens, without any restrictions, where public information is available on a technological portal and has characteristics techniques and legal that allow that any citizen can download them and use them.

This research is quantitative because as Alan and Cortes (2018) express it, it is based on the collection and analysis of data obtained from different sources, for which the use of computer, statistical and mathematical tools is necessary to obtain results, for this we will use the database of data of people missing in he Ecuador in he year 2024 the which us provides the Necessary data for analyze the situation of people missing that there is in he Ecuador through the help of the Orange Data Mining tool [8].

This research is of a descriptive type which seeks to specify the properties, characteristics and profiles of people, groups, communities that HE submit to an analysis. (Hernández et al, 2018) In this case, the aim is to describe which groups of people disappear the most and in what age range they are, as well as which are the provinces with the highest number of missing people and what is the main reason for disappearance.

For the development of this research, the Orange Data Mining tool will be used , which is a data analysis and visualization software that allows users to build data analysis workflows, as well as detect inconsistencies that subsequently allow them to predict the behavior of their existing or potential clients, and in this way make decisions that allow them to maximize their resources.

3. Results.

As mentioned in the previous section, a Pipeline was developed in Orange which allows to extract, transform data for carry out he analysis of the information desired of the missing, he pipeline used is observed in the following figure

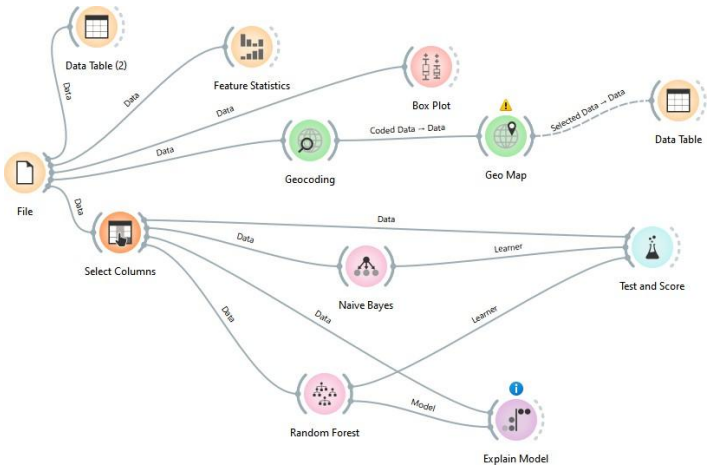

Figure 1 Pipeline of analysis

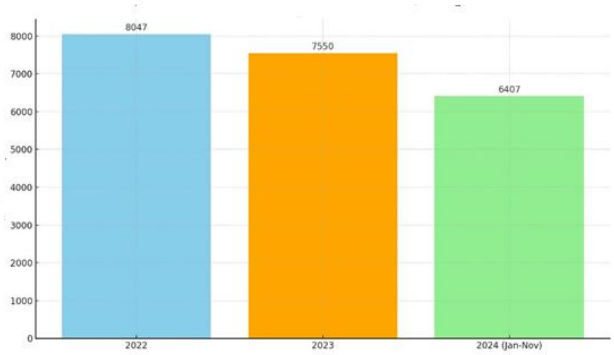

Figure 2 Number of people missing between the years 2022 – 2024

The graph presented shows the analysis of cases of missing persons in Ecuador in the last three years. It shows 8,047 missing persons in 2022 followed by a drop of 1,640 in 2024.

Table 1 shows that 12.2% of registered persons are missing, 82.1% have been found and 5.7% have died.

Table 1. *State current of the people registered as missing*

State	Amount	%
MISSING	838	12.2%
FOUND	5642	82.1%
DECEASED	394	5.7%
Total General	6874	100.0%

Looking at the data histogram, it can be seen that there are people reported missing between the ages of 1 and 170, which indicates that there may be errors in the database when recording the age of missing people. On the other hand, it can be seen that the age range where the largest number of missing people are found is between 13.4 and 16.5 years.

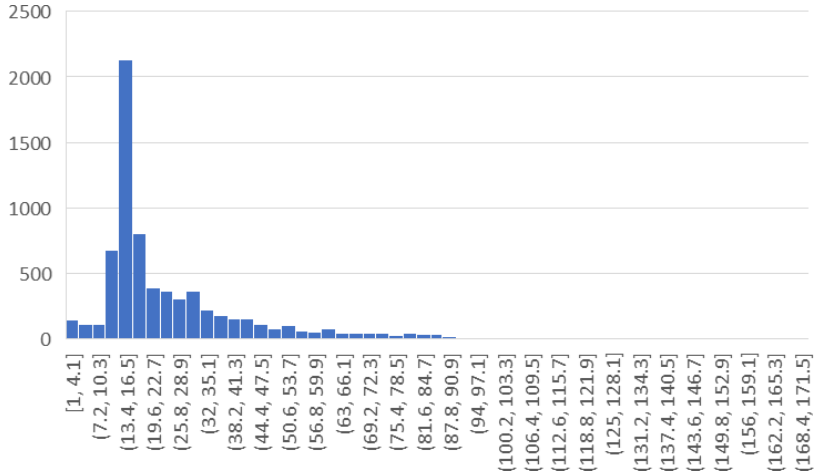

Figure 3 *Histogram of the people declared as missing by age*

The month with the highest number of reported missing persons is February; in every month, more women disappear than men.

Table 2. *Amount of people declared as missing by month and sex*

Month of disappearance	MAN	WOMEN	Total General
January	274	348	622
February	247	384	631
March	248	339	587
April	242	333	575
May	260	327	587
June	261	358	619
July	228	332	560
August	268	318	586
September	236	302	538

Month of disappearance	MAN	WOMEN	Total General
October	243	320	563
November	235	286	521
December	236	249	485
Total general	2978	3896	6874

Geographically, the provinces of Guayas and Pichincha concentrate the highest number of unsolved cases, reflecting their population density and possible socioeconomic and security factors. In terms of gender, approximately 65% of missing persons who have not been located are women, and 61% of cases involve children and adolescents.

Figure 4 *Numbers of missing by provinces*

In he map HE can notice that the elderly amount of missing persons reported have been found, there are very few blue dots on the map, however, some of them can be seen in provinces such as Imbabura, Loja, Zamora Chinchipe, Guayas and Manabí.

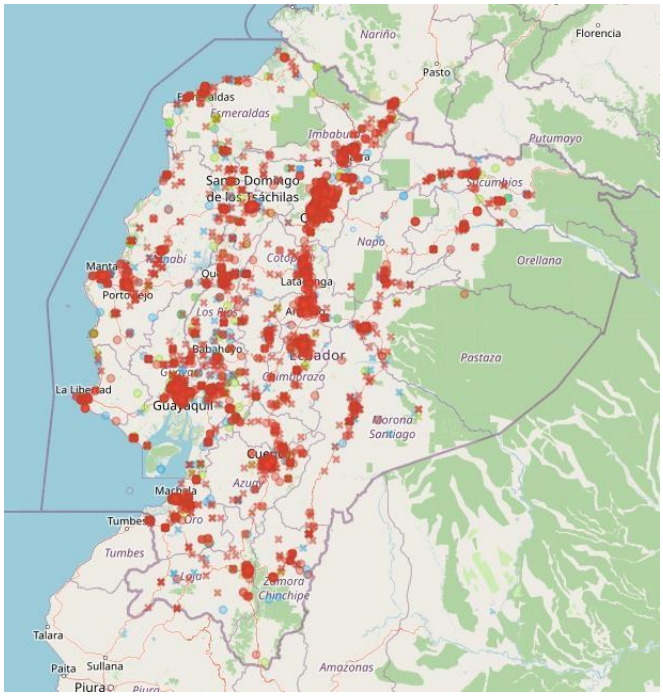

Figure 5 *Map by sex and state current of the people registered as missing*

The graph shows significant differences by gender in the three categories: missing, found and deceased, with a clear predominance male in all the cases (χ^2=494.21, p=0.000, df =2). The men represent approximately he 80% of the missing, 60% of the found and 85% of the deceased, while women constitute smaller percentages in each category: 20% of missing, 40% of found and 15% of deceased, being the category of "found" the one that shows a more balanced distribution between genders.

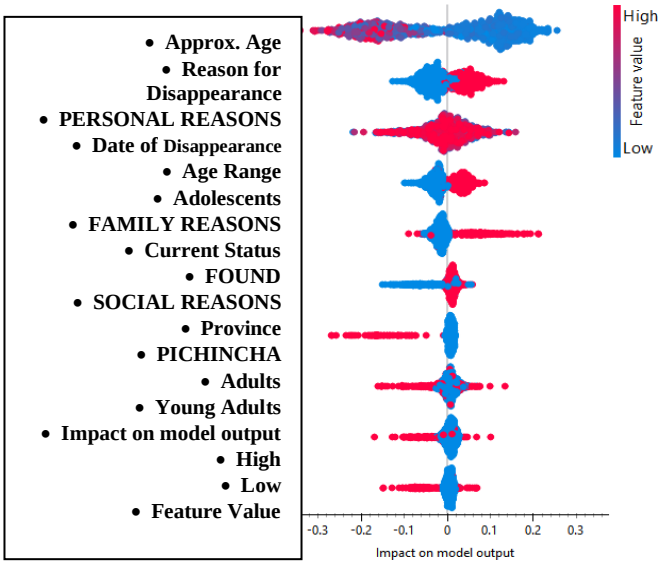

Figure 6 *Model explained for women*

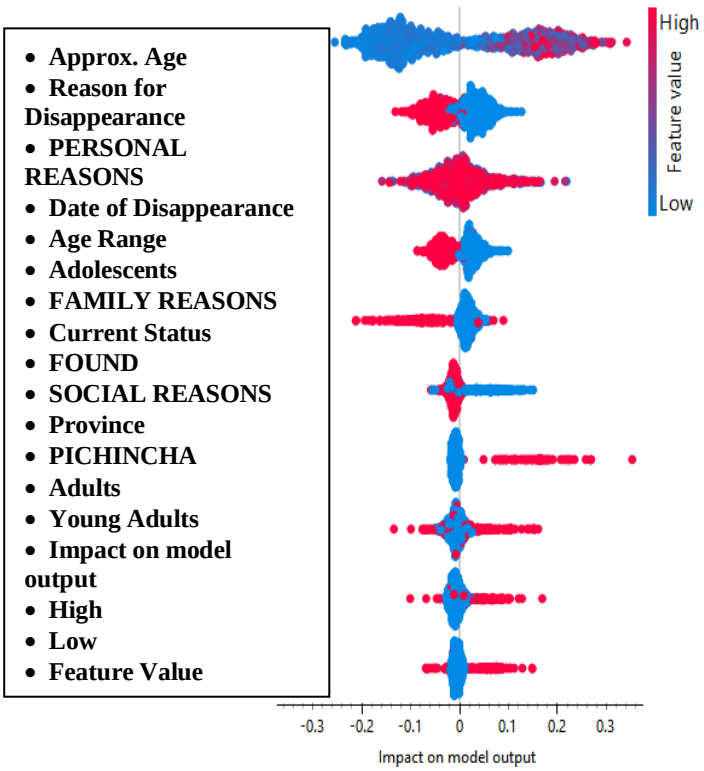

Figure 7 Model *explained for men*

4. Validation of the Method Used in the Research: Evaluation of Orange Data Mining Using a Neutrosophic Multicriteria Analysis

Orange Data Mining tool is validated as the main method for analyzing data on disappearances of people in Ecuador. To do so, a **neutrosophic multicriteria analysis [11-20] is applied** , which allows evaluating the robustness, precision and applicability of Orange Data Mining in the management of data with uncertainty and imprecision. Next, the validation of the method is presented, highlighting its use and effectiveness in the context of the research.

1. Justification for the Use of Orange Data Mining and Neutrosophic Analysis

a. Orange Data Mining as a Main Tool:

- Orange Data Mining is a data analysis and visualization platform that allows you to build workflows for data processing, analysis and visualization. Its graphical interface and its ability to integrate data mining, machine learning and visualization techniques make it an ideal tool for quantitative and descriptive research.
- In this study, Orange Data Mining is used to process the database of missing persons in Ecuador, identify patterns, detect inconsistencies and visualize results in a clear and effective way.

b. Neutrosophic Multicriteria Analysis:

- Since data on disappearances often contain uncertainty (for example, in location, time elapsed or status of cases), a neutrosophic analysis is applied to assess Orange Data Mining's ability to handle this uncertainty.
- Neutrosophic logic allows the incorporation of degrees of truth, falsehood and indeterminacy, which reinforces the evaluation of the tool in complex contexts.

2. Data Generation and Application of Orange Data Mining

a. Data Used:

- The database of missing persons in Ecuador in 2024 is used, obtained from the government's open data platform (https://www.datosabiertos.gob.ec/). The data includes information on province, age range, reason for disappearance, and case status (solved or unsolved).

b. Processing with Orange Data Mining:

- **Preprocessing: Orange's** preprocessing module is used to clean the data, handle missing values, and normalize the variables.
- **Descriptive Analysis:** Widgets such as " Distributions " and "Box Plot " are used to visualize the distribution of cases by province, age range and reason for disappearance.
- **Clustering:** Clustering techniques (e.g., k- means) are applied to identify groups of cases with similar characteristics.
- **Display:** Widgets such as " Scatter" are used Plot and Heatmap to visualize relationships between variables and patterns in the data.

c. Transformation of Data to Neutrosophic Intervals:

- To assess uncertainty in the data, the results obtained with Orange Data Mining are transformed into neutrosophic intervals. For example:
    - **Percentage of Resolved Cases in Pichincha:** [88%, 93%], with a degree of truth of 75%, a degree of falsehood of 15% and a degree of indeterminacy of 10%.
    - **Distribution by Age Range:** Between 28% and 32% of cases have a 70% probability of being in the 18 to 25 age range, with 15% of indeterminacy.

3. Orange Data Mining Neutrosophic Multicriteria Evaluation

a. Criteria Evaluated:

- **Criterion 1:** Accuracy in data analysis.
- **Criterion 2:** Ability to manage uncertainty.
- **Criterion 3:** Ease of use and interpretation of results.
- **Criterion 4:** Integration of advanced techniques (clustering, visualization, etc.).
- **Criterion 5:** Applicability in real contexts.

b. Neutrosophic Weights:

- **Criterion 1:** Weight [0.4; 0.5] (high importance).
- **Criterion 2:** Weight [0.3; 0.4] (medium-high importance).
- **Criterion 3:** Weight [0.2; 0.3] (medium importance).
- **Criterion 4:** Weight [0.1; 0.2] (low importance).
- **Criterion 5:** Weight [0.1; 0.2] (low importance).

c. Neutrosophic Scores:

- **Data Analysis Accuracy:** [0.85; 0.90] (high accuracy).
- **Ability to Manage Uncertainty:** [0.75; 0.80] (good ability).
- **Ease of Use and Interpretation of Results:** [0.90; 0.95] (very easy to use).
- **Integration of Advanced Techniques:** [0.80; 0.85] (good integration).
- **Applicability in Real Contexts:** [0.85; 0.90] (high applicability).

4. Validation of the Use of Orange Data Mining

a. Robustness in the Face of Uncertainty:

- Orange Data Mining demonstrates a good ability to handle uncertainty in data, especially when complemented by neutrosophic analysis. This reinforces its validity in contexts where data is imprecise or incomplete.

b. Consistency with the Study Objectives:

- The results obtained with Orange Data Mining are consistent with the objectives of the study, as they allow patterns to be identified, data to be visualized and informed decisions to be made.

c. Comparison with Other Tools:

- Unlike other data analysis tools, Orange Data Mining offers an intuitive graphical interface and a wide range of integrated techniques, making it easy to use in quantitative and descriptive research.

5. Discussion and Conclusions

a. Method Validation:

- Neutrosophic multicriteria analysis validates the use of Orange Data Mining as the primary method in research, demonstrating its robustness, accuracy and applicability in handling complex data.

b. Contribution to the Field:

- The application of Orange Data Mining in the context of missing persons is a significant contribution to the field, as it allows large volumes of data to be analysed efficiently and effectively.

c. Recommendations for Future Research:

- Data Mining is recommended for future research into complex social issues where data is often subject to inaccuracies and ambiguities.

Validating the use of Orange Data Mining through a neutrosophic multi-criteria analysis demonstrates its robustness and applicability in contexts where data are uncertain and complex. This tool not only facilitates data analysis and visualization, but also enables informed and robust decision-making on complex social issues, such as missing persons. Its use in future research could significantly improve the understanding and management of similar issues in other geographical or social contexts.

5. Discussion

Analyzing the case resolution rate, which represents 82.1%, the indicator is significantly positive of the System National of Search and the protocols implemented, by a side, we have the implementation of the protocol dawn and the protocols internal of the prosecution, that they have immediate action was taken, eliminating the traditional 24-48 hour wait. This meant that an early response has a positive and crucial impact on locating people.

Similarly, we can understand that there is an increase in reported cases (22 cases daily in 2023), this increase represents a pressure on the resources available for the search and location of missing persons, making the efficiency in resolved cases visible.

In counterpart to the 82.1% of cases resolved, HE observe that a 12.2% of cases are without resolve and 5.7% of cases end in death, although they are minorities, this represents a violation of human rights.

In the histogram it is observed that the most frequent age range of disappearances is between the ages of 13.4 - 16.5 years, representing and confirming the information that early adolescence and middle adolescence are the most affected by disappearances, having to analyze which would be the factors that affect to this stage of the life of the individuals for can carry out and apply effective plans for prevention.

These factors are considered to be able to suffer from greater susceptibility to the influence of others. teenagers, search of identity and autonomy either also being able to be factors socioeconomic factors, such as school dropouts, family finances or, finally, the social environment in which individuals find themselves.

Analyzing the graphics of the model Random Forest , HE observe that exist some patterns in the disappearance by gender, where the women that disappear represent a 56.7% but are the Men are the ones who remain missing or deceased (80%), with this appearing as a significantly higher location rate. different. The causes of disappearances in the women are heterogeneous and diverse, in comparison to the men the which HE center mainly in the factors social and also being age a determining variable in their disappearances.

By last, to level territorial also HE present patterns of vulnerability territorial, observing greater concentration in border areas (Loja, Zamora Chinchipe), areas of high urban density, regions coastal (Manabi) and runners of mobility human. Although in the province of Pichincha There is a high impact on disappearances.

In general, with this information there are implications that should be considered for the protocols. of performance and prevention in the policies public, being able to be differentiated by gender,

consider social factors and preventive approach in the patterns already detected and tells us that, although the protocols serve to the population HE must strengthen the protocols of prevention and early protection.

6. Conclusions

The results of this study show that the National Search System and the implemented protocols, such as the Alba Protocol and the internal procedures of the Prosecutor's Office, have achieved a case resolution rate of 82.1%, highlighting the importance of an immediate response to improve the location of missing persons. However, the increase in reported cases (22 per day in 2023) puts pressure on available resources, underlining the need to optimize efficiency in case resolution. Although most cases are satisfactorily resolved, 12.2% remain unsolved and 5.7% end in death, which represents a violation of human rights and a critical area that requires urgent attention. The practical relevance of these findings lies in their potential to guide more effective public policies and action protocols. The identification of specific patterns, such as the greater vulnerability in adolescents between 13.4 and 16.5 years of age, as well as significant differences in location by gender (56.7% of missing women versus 80% of missing or deceased men), offers valuable elements for designing differentiated preventive strategies. In addition, the detection of areas of high territorial vulnerability, such as border areas, coastal regions and human mobility corridors, provides a clear geographic framework for focusing efforts. Among the most notable contributions of this study is the identification of socioeconomic and psychological factors that influence disappearances, as well as the application of advanced techniques such as the Random model. Forest to analyse complex patterns. These contributions not only enrich theoretical knowledge on disappearances, but also offer practical tools to improve the effectiveness of search and prevention systems.

However, the study has limitations that must be considered. The variability in the data and the possible subjectivity in the interpretation of social and territorial factors may affect the generalizability of the results. In addition, the focus on a specific context limits the applicability of the findings to other regions or countries with different dynamics. For future research, it is recommended to explore complementary approaches, such as neutrosophy, which can handle the uncertainty and ambiguity inherent in data related to disappearances. This methodology could be integrated with artificial intelligence techniques to improve the accuracy in identifying patterns and predicting risks. It is also suggested to expand the study to other geographic and demographic contexts to validate and generalize the results. Finally, it is crucial to strengthen early prevention protocols, considering gender, age and territorial vulnerability factors, to reduce disappearance rates and ensure the protection of human rights.

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