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# Analysis of Crimonogenic Factors in Femicide Crimes

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**Abstract.** Femicide in Ecuador is one of the cruelest manifestations of power exercised over women. Actions have been executed, but they are still insufficient. Therefore, it is necessary to study the factors that cause its high level of incidence. By doing so, we intend to provide the government with a tool that makes it possible to focus some measures in order to reduce and/or eradicate it. The objective of this research is to analyze these factors through neutrosophic cognitive maps. This technique is chosen because of the advantages it offers compared to other soft-computing techniques, in terms of interpretability, scalability, aggregation of knowledge, dynamism and its ability to represent feed-back and indeterminacy relationships. This way, decision-making by the government will be facilitated by hierarchizing the incidence factors, launching new strategies to eradicate femicide and to protect the right to life.

**Keywords:** femicide; factors; hierarchization and interrelation; neutrosophic cognitive maps

## 1 Introduction

Femicide in Ecuador is one of the cruelest manifestations of power exercised over women. For decades, violence against women has been a totally imperceptible problem for society, a product of machismo, supported by inequality and inequity regarding women in the everyday world. Discrimination against women has placed her as a simple object of control and submission to men. This subordination is attributed to gender relations, where the roles of men and women are played according to the social construct of each society [1-3].

It is necessary to clarify that in this investigation, the subject of femicide will be addressed because, although it is related to feminicide, the first one is defined by [2] in page 7 as follows: "*Femicide* seeks to denounce the violent death of a woman because of her condition as a woman and demand that these deaths be stopped". As shown in figure 1.

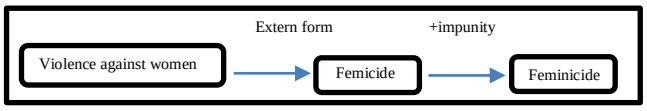


**Figure 1.**Process of delimitation and relation of the concepts femicide/feminicide. Source:[2]

It is a current problem that affects society, since it is stated that approximately 600 children and young people between 2014 and 2019 have been orphaned due to this act, where the right to life is deprived, just because of being a woman. Likewise, about 625 women died from this form of sexist violence in the same date interval.[4, 5]. From March 12 to May 20 at the national level, Ecu911 has reckoned 17,964 cases, about 257 per day. The Judiciary has attended 2,469 cases of violence against women nationwide between March-May 2020, about 41 hearings were held every day[1, 6, 7].

Therefore, given the increasing frequency of this social problem, the state is obliged to protect the life of women. Actions against the establishment of the human rights of Ecuadorian women such as the right to life and the philosophy of Good Living. Certain measures have been established, such as the creation of the Integral Organic Criminal Code (IOCC) and the Integral Organic Law for the Prevention and Eradication of Gender Violence Against Women, both in response to protests initiated by various women's movements. But they are still insufficient, therefore, the Ecuadorian State must improve its legal framework [4, 8-12] based on accurate studies of the phenomenon, so that these measures respond to core problems.

It is a problem that has been accepted by society and classified as normal, which is characterized by the invisibility of its presence in couples' relationships throughout history. According to statistics carried out by the National Institute of Statistics and Censuses, in its first survey on gender violence in Ecuador, it indicates that 60.6% of Ecuadorian women have experienced some type of violence without differences between rural or urban areas[2, 3]. In addition, it has been proposed that for the analysis of the phenomenon, it is important to take into account that the aggressor might be or not of the same gender, as well as those indirectly affected by the aggression, like: parents, children, siblings, relatives[13].

Due to the incidence of several factors, we decided to carry out a review of the literature and then we extracted the following statements that constitute the main characteristics of the factors. [2-5, 10, 13, 14]:

- They refer to them as risk factors or factors that favor victimization, which are nothing more than the conditions that favor the act or make it susceptible to its occurrence.
- Most of them are classified into endogenous and exogenous factors (classification that will be used in this investigation to achieve a better interpretation of the analyzed phenomenon), but others prefer to classify them as temporary or permanent or according to their predispositions (bio-physiological, social and psychological).
- The victim-causing factor should not be confused with a victim-causing cause, because the factor is something that favors victimization, while the cause is what produces victimization.
- Endogenous factors: factors of the individual inherent to the person, the best known are those of a biological nature that make a person prone to being the victim of an attack (age, ethnicity, weakness, disease, disability). In this regard, the following are vitally important:
    - Age, since there is a predisposition to crime and related punishments, for example: in the crime of rape there are ages where this crime is more frequent, but there are other rates in which a number of ages with a lower proportion of the same act is registered.
    - Ethnicity: it is taken into consideration when the crime typology is violent or urban in nature, where behind the aggression there is usually a xenophobic motive. These factors bring together subjective considerations.
    - Psychological and psychiatric factors, this includes assumptions such as depression, phobias, etc., although some authors include the alcoholism of the victim with a factor under consideration. The volitional sphere is included (refers to the will), for example, in the crime of domestic violence, people who are especially vulnerable and identified as victims are: women, children and the elderly, this has been determined according to statistical studies of victimization based on complaints.
    - Another factor is the cognitive one, it refers to the fact that there is a minorization in the mental processes, this leads to the individual being more easily victimized, for example a person with hearing impairment or reduced attention span and especially when the intelligence and memory are limited, such as people with oligophrenia.
    - Exogenous factors: those that are outside the individual and are changing (marital status, economic level, origin, profession, victim space and time, schooling, family, social status, etc.). The most relevant ones are explained below:
    - Marital status: refers to whether the victim is single, married, widowed, separated, divorced, etc.
    - Economic level: interesting both by excess and by default according to the criminal typology, it is a factor that in practice frequently occurs.
    - Provenance: basically refers to whether the victim is national or foreign.
    - The profession: there are certain groups that are more likely to be victims, for example: taxi drivers, gas station employees, prostitutes, etc.).
    - Victim space and time: all victimization takes place in a specific space and time. There are certain areas more criminogenic than others and certain time intervals, according to hours, weather conditions, seasons of the year, etc., in which there is a greater risk of being victimized.
    - "Victim time": refers to the seasons of the year. In spring, there are more sexual assaults, while in summer and on vacations, mistreatment towards the love partner increases, etc.
    - Schooling: basically refers to whether the victim is in school or not and, if so, what level.
    - The family: refers to whether it is structured or not.

It is important to highlight that in the case of endogenous factors, learning plays an essential role in victim prevention, that is, the best way to prevent crime is to act directly on the victim. In criminology the theory of opportunity is described, it basically states that for the crime to be generated, there must be three elements, first,

there must be a predisposed criminal, second, there must be a suitable victim and third there must be an absence of control, when these three elements occur, the crime is automatically generated. Therefore, preventing crime is complicated, because the subject is free to act, it is the subject who decides the time and place (how, where and when); what can be done is to act promoting preventive measures. In cases of absence of control, some measures can be taken, such as: installing security cameras.

Based on the foregoing, it can be said that there is a need to study the factors that affect acts of femicide in Ecuador. Once their incidence and characterization have been determined, measures can be taken aimed at reducing and/or eradicating the phenomenon. The aforementioned is based on the idea that, if the factors that affect the problem are determined and a negative impact hierarchy is presented, strategies may be proposed to the State of Ecuador in order to favor the non-occurrence of femicide in the country. According to this approach, it is essential to study the situation using comprehensive strategic analysis techniques endorsed in compatible mathematical techniques to fulfill the objective set.

After a review of the bibliography and consultation of several authors [15-30], it is decided that, due to its versatility in factor research, the neutrosophic cognitive maps will be chosen from the theory of Neutrosophy proposed by Florentin Smarandache, for the treatment of neutralities, which generalizes theories [29, 31], of number of its applications in many fields[31-33]. In this case, sharp sets, where the indeterminacies have support. Neutrosophy is a useful theory that is increasing. The inclusion of this theory enriches the possibilities of the analysis, mainly due to two reasons: firstly, the addition of the notion of indeterminacy and, secondly, the possibility of calculating using linguistic terms [15, 23, 34-37].

The decision to apply the neutrosophic cognitive maps for this analysis lies in the fact that it is a way of representing knowledge through a directed graph. Each vertex of the graph represents a concept and each edge the causal relationship between the concepts represented by the vertices that it connects. Additionally, each edge is associated with a real value in the interval (-1, 1), where a negative value means that there is an inverse relationship between the concepts and a positive value means that the relationship is direct. The value measures the strength of the relationship. This method has been used successfully in social studies [15, 17-23, 25-27, 29, 30, 38-41]. In this article, Neutrosophic Cognitive Maps (NCMs) are applied to represent the causal relationships between the causal factors of femicide [25, 26, 42-44]. This way, the following are set out as specific objectives to be developed in this paper:

1. Determine and characterize the factors that influence the occurrence of femicide in Ecuador.
2. Model the current situation of factors in Ecuador using the neutrosophic cognitive maps.
3. Propose strategies based on the results of the study.

Based on the above-mentioned, this document is structured as follows: a second section where the basic concepts necessary to achieve the solution of this problem are briefly described; a third section to expose the results of the application of neutrosophic cognitive maps in the solution of the studied problem. Finally, we present the conclusions reached after executing the analysis and the bibliographic references of the consulted sources.

## 2 Materials and methods

To fulfill the proposed specific objectives, it was necessary to apply the following theoretical methods for the elaboration of this paper:

- Analysis and synthesis of the information obtained from the literature review, both international and national, of 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 incursion into work.
- Systemic - structural for the development of the analysis through its decomposition into the elements that comprise it.
- Hermeneutic to carry out a comparative interpretation of the legislation applicable to the subject in question.

In this particular investigation, 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 [30, 45-47]. NCMs were introduced by [48] in 2003. NCMs is an integration of the Fuzzy Cognitive Maps (FCMs) introduced by Kosko in 1986 and the Neutrosophic Sets (NSs) introduced by Smarandache in 1995 [15]. This technique overcomes the inability of traditional FCMs to represent indeterminacy. The inclusion of indeterminacy establishes that neutrality and ignorance are also forms of uncertainty. [15] exposes that FCMs constitute a technique that has received increasing attention due to its possibilities for representing causality. The following

is a set of definitions necessary for working with NCMs. Firstly, let formally expose the original definition of neutrosophic logic as it is shown in [25].

**Definition 1**. Let N =[15, 18, 20-26, 29, 30] [22] be a neutrosophic set of evaluation. v: P→N is a mapping of a group of propositional formulas into N, i.e., each sentence p∈ ***P*** is associated to a value in N, as it is exposed in 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 [24, 29].

**Definition 2**. (See[22, 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 I2 = I, I + I = 2I and in general, I + I + ... + I = nI, if k∈K, then kI = 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 = [aij] ij i = 1, 2,…, m and j = 1, 2,…, n; m, n≥1, such that each aij∈K (I), where K (I) is a neutrosophic ring, see [26].

Let us observe that an element of the matrix can have the form a + bI, where "a" and "b" are real numbers, whereas 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. aij = 0 means nodes i and j are not connected, aij = 1 means that these nodes are connected and aij = I, that means the connection is indeterminate (unknown if it is or if not). 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 [19], then this cognitive map is called a neutrosophic cognitive map, which is especially useful in the representation of causal knowledge [18, 29]. It is formally defined in Definition 4.

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

The measures described below are used in the proposed model, they are based on the absolute values of the adjacency matrix [19]:

- 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.

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

Static analysis is applied using the adjacency matrix, taking into consideration the absolute value of the weights [20]. Static analysis in Neutrosophic Cognitive Maps (NCM), see [18], initially contains the neutrosophic number of the form (a + bI, where I = indetermination) [17]. It requires a process of de-neutrosophication as proposed in [19], where I ∈ [0, 1] and it is replaced by their values maximum and minimum.

Finally, we work with the average of the extreme values, which is calculated using Equation 5, which is useful to obtain a single value as it is referred in [16]. This value contributes to the identification of the characteristics to be attended, according to the factors obtained, for our case study.

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

Then,

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

Finally, the variables are classified according to the following criteria:

a) *Transmitting variables* are those with $\mathrm{od}(v_i) > 0$ and $\mathrm{id}(v_i) = 0$.
b) *Receiving variables* are those with $\mathrm{od}(v_i) = 0$ and $\mathrm{id}(v_i) > 0$.
c) *Ordinary variables* satisfy at the same time $\mathrm{od}(v_i) \neq 0$ and $\mathrm{id}(v_i) \neq 0$.

## 3 Results

Once the state of the art of the studied elements has been analyzed, we proceed to the extraction of potential factors (variables) applying the following process approach, which is present in each of the specific objectives determined in the introduction and which are listed in this part as sub-headings:

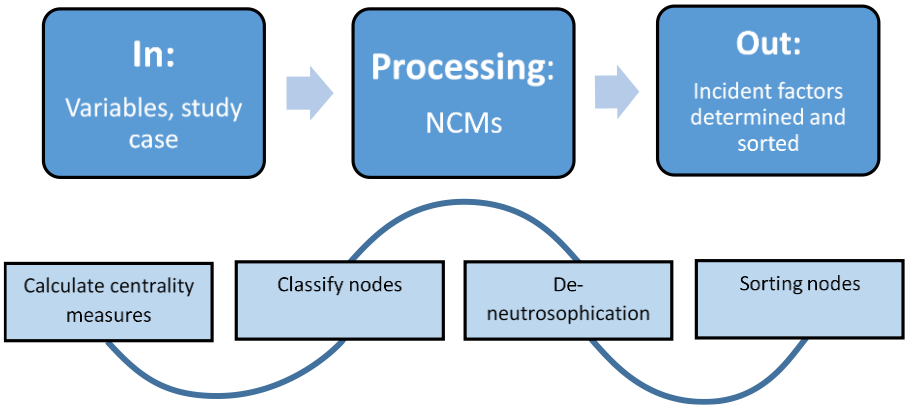


**Figure 2.** Information processing with NCMs. Source: self-made.

3.1. Factors that influence the occurrence of femicide in Ecuador:

A. Physical state of the victim (includes age): there is generally a predominance of physically defenseless people or people who do not put up significant resistance to the aggression. The number of underage girls raped and murdered by their stepfathers due to similar causes is increasing. Statistical studies register that the age range in women where there is a greater probability of being victims is between 31 and 40 years old and in second place between 35 and 20 years, so that the highest rate is centered on 35 years. Today during the COVID-19 quarantine, there is an increase in girls raped and murdered.

B. Ethnicity-Environment: there is a predominance of the victimization index in urban and suburban areas.

C. Personal living conditions: in this aspect the family environment, the power relationship, economic conditions, level of education were included. This scourge is more prevalent where there is economic dependence on women, lack of family financial support and social isolation. In the field of social, public, political and private life exercised by couples, families, co-workers, and different forms of socio-individual interaction, in social life under subordination exercised towards women, incest, etc. There is an increase in the number of cases where the victims are married or accompanied under consensual unions not formally legalized where there is a presumption of adultery or bigamy, as well as dysfunctional families with intrafamily violence even in the children.

D. Profession: a low incidence is defined in economically independent women with the occupation of a socially relevant job. In general, this type of women invests in their personal security and shows dominant traits of low susceptibility to victimization.

E. Cognitive factors: belief of endless love or feelings of infatuation, emotional dependence, excessive fear of partner abandonment, attributional errors, post-traumatic disorder, depression, feelings of helplessness and hopelessness, use of violence with children, low perception of risk. Personality with a high level of introversion and introspection, manipulable and dependent. Many are already victims of previous attacks, of various kinds and origins. The perpetrator often induces self-flagellation.

F. Strength of the legislation and advice: there is a gradual increase in complaints since the previous five-year period due to the strengthening of the legislation, the information and support of assistance from the state to the victims this helps to increase the complaints. Because there is increasing social awareness regarding this crime. In April, the website of the Prosecutor's Office was enabled to report these attacks online. At the national level, 164 judicial units are currently enabled to hear cases. In that city they attend under telephone call modality, meaning that, when there is a flagrancy, the Prosecutor's Office contacts the person in charge of the unit and immediately enables attention.

### 3.2. Modeling of femicide factors using neutrosophic cognitive maps.

They will be called variables/factors to facilitate their processing and will be denoted according to the letter that identifies them in 3.1 (A, B, C, D, E, F). They will be subjected to a group to the criteria of a group of experts that will evaluate the causal relationships between the eight previous variables with linguistic terms equivalent to neutrosophic numbers. For its representation in the NCM, an average of the evaluations of the experts was used. From them, a neutrosophic adjacency matrix[49] and the graph that represents it was obtained, where the indeterminacies are highlighted:

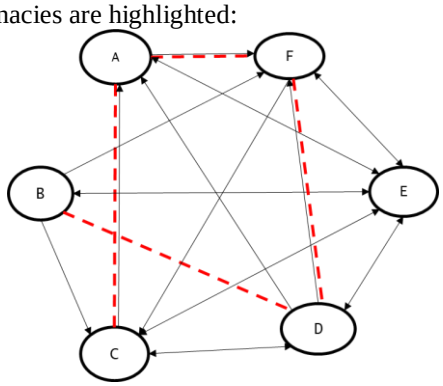


**Figure 3.** NCMs. Source: self made

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| A | 0 | I | 0.5 + I | 0 | 1 | 0.6 + I |
| B | 0 | 0 | 0.4 | 0 | 0.7 | 0.3 |
| C | 1 | 0 | 0 | 0.9 | 1 | 0 |
| D | 0.3 | I | 0.9 | 0 | 1 | 0.8 |
| E | 1 | 1 | 1 | 1 | 0 | 1 |
| F | 0.8 | 0 | 0.8 | I | 0.9 | 0 |

**Table 1.** Neutrosophic Adjacency Matrix. Source: self made

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| A | 0 | 0 | 0.108696 | 0 | 0.217391 | 0.1304348 |
| B | 0 | 0 | 0.086957 | 0 | 0.152174 | 0.0652174 |
| C | 0.21739 | 0 | 0 | 0.195652 | 0.217391 | 0 |
| D | 0.06522 | 0 | 0.195652 | 0 | 0.217391 | 0.173913 |
| E | 0.21739 | 0.217391 | 0.217391 | 0.217391 | 0 | 0.2173913 |
| F | 0.17391 | 0 | 0.173913 | 0 | 0.195652 | 0 |

**Table 2.** De-neutrosophication of the Matrix. Source: self made

Table 3 contains the Outdegree, Indegree, Total Degree and classification values of each variable according to the application of the formulas set forth in Definition 4 of section 2 of this paper.

| Factors | Outdegree | Indegree | Total Degree | Classification |
|---|---|---|---|---|
| **A** | 0.45652174 | 0.673913 | 1.130434783 | Ordinary |
| **B** | 0.30434783 | 0.2173913 | 0.52173913 | Ordinary |
| **C** | 0.63043478 | 0.7826087 | 1.413043478 | Ordinary |
| **D** | 0.65217391 | 0.4130435 | 1.065217391 | Ordinary |
| **E** | 1,08695652 | 1 | 2,086956522 | Ordinary |
| **F** | 0.54347826 | 0.5869565 | 1.130434783 | Ordinary |

**Table 3.** Outdegree, indegree, total degree values by factors and their classification. Source: self made

From the calculation carried out, it can be said that:

- There are indeterminate relationships, of which its level of influence cannot be specified, but it is stated that in general the established relationships are positive, so they are directly proportional to each other.
- The variables, when classified as ordinary, have a double relationship and according to what is stated in figure 3, this relationship is directly proportional. Although some of them do not show interrelationships with the others such as A and B, as shown by their centrality index.
- The factors are ranked as follows:
  - E Cognitive factors
  - C Personal living conditions
  - A Physical state of the victim (includes age)
  - F Strength of legislation and advice
  - D Profession
  - B Ethnicity-Environment
- Provenance is not a serious problem to be analyzed, since its causal influence or dependence on the rest of the factors was not verified.
- It can be verified the fact that, if there is a policy of criminal punishment and strong methods of reporting and counseling, they can be largely avoided, since mothers and relatives will be advised and protected by law. As with the strengthening of punishments, the perpetrators will be judged, with the "burden" of their action falling on them.

3.3. Propose strategies based on the results of the study.

- Consider conducting psychological evaluations with the help of social workers, support groups in the most affected communities
- Implement rigorous laws that imply penalties of greater legislative strength.
- Promote gyms and sports clubs, where it helps the development of the physical and mental state of girls and boys, which promote awareness of culture, sports and good living by achieving a physical state of balance. In the same way, integrate the family in these practices.
- Consider that, due to the relationship between the nodes, jointly strengthen the factors: Personal living conditions, Cognitive factors and Strength of legislation and advice, a synergy could be achieved with a positive impact on the mitigation and future elimination of this factor.

## Conclusions

After analyzing the determined factors, it can be said that:

- The indeterminacy is incorporated into the modeling of the causal relationships between the analyzed factors, where neutrosophic science is an active part and a person who makes decisions. As well as it is verified that the neutrosophic cognitive maps accurately evaluate verbal judgments under an environment of uncertainty.
- It was possible to determine and characterize the factors with the highest incidence in the occurrence of femicides, achieving the mathematical modeling of the phenomenon by applying the neutrosophic cognitive maps. Which served to illustrate the causal relationships of this factor.
- Policies should be aimed at improving and promoting positive impacts on cognitive factors, personal living conditions, physical condition of the victim (including age) and the strength of legislation and advice. Attention should also be paid to policies that enact good economic conditions that increase the level of schooling and favor personal living conditions. Age is a priority factor, so special attention must be paid since girls/elderly women are an easy target for this type of crime.

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