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Gender Gap in SME Ownership: An Analysis of Female Entrepreneurship in Santa Elena Canton, Ecuador, Using TreeSoft Sets

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Abstract. The paper we present here is an approach to the problem of gender inequality in the artisanal production association called ASOPROMAHER, located in Santa Elena Canton, Ecuador. It is a pretext to address the issue and extrapolate it to the current situation of the entire country. Without a doubt, gender inequality persists in Ecuador today, including an important sphere of economic development in the country such as entrepreneurship in SMEs. There are multiple issues to address in this situation, ranging from psychological, economic, social, cultural, and political issues. Each of these spheres is related to each other in a complex way. In this work, we propose to study the situation regarding female entrepreneurship in ASOPROMAHER. To meet this objective we use the tool known as TreeSoft Set, which allows the representation in the form of trees of relationships among attributes, sub-attributes, sub-sub-attributes, and so on. We propose an algorithm where we use the evaluation of ten experts on the situation of women in this association, as well as analyze other important issues.

Keywords: Gender gap, SME, entrepreneurship, female growth, TreeSoft Set.

1 Introduction

Over time, social, political, cultural, and economic changes in Latin America have shown that women are responsible for the care of their children, which allows them to play a leading role in society. Therefore, the quality and efficiency of their work are essential to complement the family environment, benefiting its economic growth, whether through saving or entrepreneurship. Likewise, throughout the world, the promotion of entrepreneurship has become a public policy measure. In countries, it is a business activity stimulated by educational systems and programs of public or private entities, which are intended to create new companies and introduce innovations in existing small and medium-sized companies.

In the last two decades, women's participation in the labor market and business activity has increased significantly, contributing to the strengthening of local economies. Currently, the value of the growing participation of women in the development of companies has been highlighted, which has sparked the interest of research. Likewise, entrepreneurship has a significant impact on job creation and the economic growth of a state, but to all this, the values that women represent are added.

It is for this reason that activities related to female entrepreneurship contribute to improving their quality of life since they currently represent an important means of adding constant value to the performance of their various roles of change. Nationally, the current government has developed programs at all levels to educate, train, and inspire all people to generate future business ideas and to provide them with financial means for the initial investment.

Internationally, entrepreneurship is one of the income-generating activities for all countries that support it. Ecuador is no exception, as it is known as one of the most entrepreneurial countries in the

world, especially in its urban and rural areas. The country has also attracted the international interest of many tourists, in fact, travel agents can create low-cost packages to generate income and these tourists, in turn, invest in rest and entertainment.

However, the institutional environment in Latin America is not particularly favorable for women entrepreneurs, since there is a negative influence of informal institutions on formal institutions, that is, cultural and social influences are immersed in the development of government policies in different countries.

Locally, the province of Santa Elena stands out for having several ways to generate income, including entrepreneurship, which is currently a non-oil source of income in the country. It has been studied that 29% of the population aged 18 to 64 has started a business. This demonstrates the strong entrepreneurial spirit of Ecuadorians. From this we can ask ourselves if institutional factors are immersed in the development of some type of entrepreneurship.

The issue is based on the fact that entrepreneurship is gaining a high significance for the residents of the Canton of Santa Elena. However, there are factors and some areas that have not been widely recognized within it. Such is the case of our object of study, which is located in the Dos Mangas commune of the Canton of Santa Elena, Manglaralto Parish, and communes located within the Colonche Parish. The first one is the main commune where the headquarters of the association is located. This has approximately 950 residents, whose main source of income is crafts and livestock, for this reason, they seek new ways to improve their development through entrepreneurship where there are great disadvantages. Several institutional factors prevent adequate development and prevent providing stable and effective results, which manage to exploit the entrepreneurial progress of the community, especially of the members of the association of artisanal production ASOPROMAHER, of the Canton of Santa Elena.

The purpose of this study is to identify the formal and informal institutional factors in the entrepreneurial process developed by the ASOPROMAHER Association, in the Canton of Santa Elena, and to determine which factors have the greatest impact on entrepreneurship, to consequently analyze them and then propose the corrective actions that the research entails.

So, the objectives of this article are:

- Identify the institutional factors that promote or limit the artisanal production association ASOPROMAHER, through an internal and external analysis.
- To analyze the institutional factors that affect the entrepreneurship of women from the ASOPROMAHER association, in the Canton of Santa Elena.

This paper compiles data on ASOPROMAHER. To do so, we hired ten experts who evaluated different aspects to measure the problems, challenges, and achievements of entrepreneurship in the association. In addition, we identified criteria, sub-criteria, and sub-sub-criterion to measure to carry out the study. The criteria, sub-criteria, and sub-sub-criteria are represented using the tool created by F. Smarandache called TreeSoft Set, which is a tree where this model is represented simply.

TreeSoft Sets are the result of a series of mathematical tools that start from Molodtsov's Soft Sets, as well as HyperSoft Sets, and SuperHyperSoft Sets, among others by F. Smarandache [1-5]. These theories are generalized in SuperHyperStructures, where relations are extended to the field of power sets of power sets, where the empty set may be present, indicating indeterminacy and uncertainty [6].

For the evaluation of the results, we propose an algorithm that we introduce in this paper, where we rely on the criteria of several experts to evaluate the collected data and in this way determine what remains to be done and what has been done regarding the subject of study.

This paper contains a section of Preliminaries, where we present the most important concepts within SuperHyperStructures, especially TreeSoft Sets as an alternative to the theory of HyperSoft Sets and SuperHyperSoft Sets [7-11]. The Study and Results section is dedicated to the presentation of the proposed algorithm and to showing the results of the study. The last section is Conclusions.

2 Preliminaries

This section contains the basic elements of the TreeSoft Sets theory developed by F. Smarandache. We start from the formal definition given by him on TreeSoft Sets ([7-17]).

Let $\mathcal{U}$ be the universe of discourse, and H is a nonempty set, a subset of $\mathcal{U}$, where $\mathcal{P}(H)$ is the power set of H. Let A be the set of attributes (parameters, factors, etc.), $A = \{A_1, A_2, \dots, A_n\}$, for an integer $n \geq 1$, where $A_1, A_2, \dots, A_n$ the *first-level attributes* are considered, which is indicated by the single-number indices.

Each attribute A_i $1 \leq i \leq n$ is made up of sub-attributes:

$A_1 = \{A_{1,1}, A_{1,2}, \dots\}$

$A_2 = \{A_{2,1}, A_{2,2}, \dots\}$

…….....

$A_n = \{A_{n,1}, A_{n,2}, \dots\}$

Where $A_{i,j}$ are sub-attributes or *second-level attributes* (since they have two-number indexes).

Again, each sub-attribute $A_{i,j}$ is made up of sub-sub-attributes or *third-level attributes*:

$A_{i,j,k}$

So on, when we have sub-sub-…-sub-attributes or *m-level attributes* (has m numbers as indices):

$A_{i_1,i_2,\dots,i_m}$.

This is how the graph tree is formed, which we denote by $Tree(A)$, whose root is A (which is considered level zero), then the nodes of level 1, level 2, up to level m are located.

We call *the leaves* of the graph tree all the terminal nodes (nodes that have no descendants).

So the TreeSoft Set is:

$F: \mathcal{P}(Tree(A)) \to \mathcal{P}(H)$

$Tree(A)$ is the set of all nodes and leaves (from level 1 to level m) of the graph tree, and $\mathcal{P}(Tree(A))$ is the power set of $Tree(A)$.

All node sets of the TreeSoft Set of level m are:

$Tree(A) = \{A_{i_1} | i_1 = 1,2, \dots\}$

The first set consists of nodes of level 1, the second one are nodes of level 2, the third ones are nodes of level 3, and so on, such that the last set consists of nodes of level m. If the graph tree has only two levels, then the TreeSoft Set is reduced to a MultiSoft Set [18, 19].

Example 1: This is an example that appears in [13]. See Figure 1.

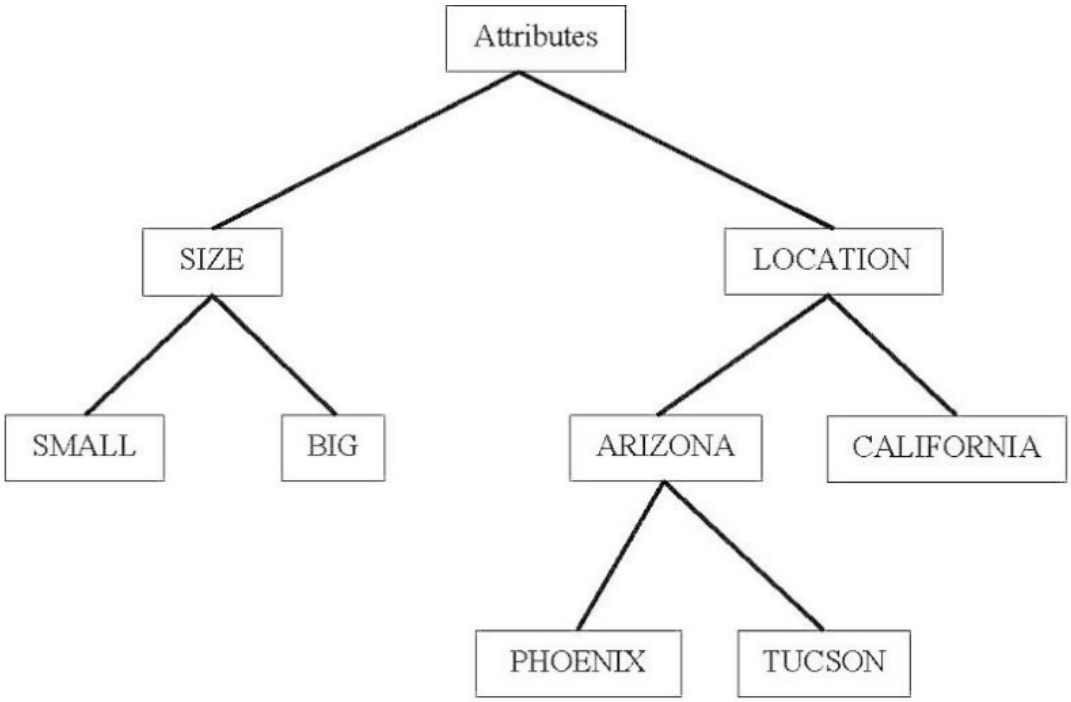

Figure 1: A Level 3 TreeSoft Set. Source: [13].

This is a tree such that:

Level 0 or the root is the node called "Attributes";
Level 1 consists of the node's Size, Location;
Level 2 consists of the Small, Big, Arizona, and California nodes;
Level 3 consists of the Phoenix and Tucson nodes.
Let $H = \{h_1, h_2, \ldots, h_{10}\}$ be a set of houses and the power set $\mathcal{P}(H)$ of the set H.
In addition, we have the set of attributes: $A = \{A_1, A_2\}$ where A_1 = Size, A_2 = Location.
So $A_1 = \{A_{11}, A_{12}\} = \{Small, Big\}$, $A_2 = \{A_{21}, A_{22}\} = \{Arizona, California\}$ as American states.
More precisely, $A_{22} = \{A_{211}, A_{212}\} = \{Phoenix, and\ Tucson\}$ as cities in Arizona.
Let us assume that the function F takes the following values:
$F(Big, Arizona, Phoenix) = \{h_9, h_{10}\}$
$F(Big, Arizona, Tucson) = \{h_1, h_2, h_3, h_4\}$
$F(Big, Arizona) =$ all big houses from both cities, Phoenix and Tucson $= F(Big, Arizona, Phoenix) \cup F(Big, Arizona, Tucson) = \{h_1, h_2, h_3, h_4, h_9, h_{10}\}$.

3 Study and results

In this section, we start with some fundamental concepts on which we base our determination of the degree of participation of women in the artisanal production association ASOPROMAHER.

Context (A_1): Context refers to the idea of an organization's capabilities to meet its goals and objectives, as well as the circumstances, time, place, people, or events involved.

Institutional Context (A_{11}): The institutional context plays an extremely important role in the internal and external development of the company. It can influence the focus of the organization, understood as the set of agents, activities, and mechanisms that regulate and support the activities and companies.

Entrepreneurship (A_2): It is an attempt to create new businesses or new companies, self-employment, new business organization, or expansion of an existing business, by an individual, a team, or an established business. Therefore entrepreneurship not only helps to generate more profits but also to create products that are different from the competition that cover satisfaction and a new form of added value.

Female entrepreneurship (A_{21}): refers to business activities in which women effectively participate in business innovation. In addition, entrepreneurs are considered to be people who create and manage companies for profit, development, and growth purposes. They are characterized by innovative and integrative behavior, based on the use of strategy in business organizations.

Decision (A_3): It is an information process developed by individuals or groups to solve problems and exploit organizational opportunities. Therefore it is vitally important to know that in this process the members select among alternatives those that meet the purpose, needs, and goals of the organization.

Skills (A_4): Skills have been considered habits or capacities; as morphological, structural, or mental properties associated with action and manipulation that require conscious control, manifested both in theory and in practice, subordinated to a purpose, and formed in actions that lead to the solution of problems to change reality. On the other hand, they can be grouped into one or different areas of aptitudes, dexterity, and intelligence.

Knowledge (A_{41}): It is one of the most important human skills because it allows us to judge the nature, relationships, and properties of the things around us. It is also essential to develop critical thinking, problem-solving, and creativity. Therefore it is important for every human being to always know because it will be useful when creating or undertaking some idea in the course of their life.

Autonomy (A_{42}): It is a specific human ability, which allows adjusting the behavior of an individual or a social being. However, it is made very clear that autonomy allows a person to act within certain limits that are attributed to norms and regulations. In addition, it is the imperative capacity that any business has to satisfy its operational and financial needs.

Proactivity (A_{43}): It refers to a collection of different behaviors that are motivated by change and directed at the environment to achieve specific individual, group, or organizational objectives. Therefore being proactive takes time because it involves weighing several options, and possible alternatives and making our own decisions to achieve our objectives.

Initiative (A_{44}): Involves paying attention to a dynamic process in which individuals recognize opportunities for innovation and act by converting ideas into practical activities within a social, cultural, and economic environment in which they can cultivate their entrepreneurial spirit.

Anticipation (A_{45}): Refers to the ability to foresee possible future events and act before they occur, alerting about current events. The importance of this is to try to explore and forecast the future to identify potential risks and opportunities that we may face, helping us to make decisions, plan in advance, and carry out operations so that we can achieve our planned goals and safeguard the interests of the organization.

Freedom (A_{46}): This means the ability to make decisions and act without external pressures. This is based on the knowledge of the needs of nature, control over oneself and external nature; while for organizations, freedom lies in forming or dissolving, without being committed to the limitations derived from social functions that must be considered an integral part of their configuration.

To evaluate (A_5): Ultimately, it is the center of the entire system, whose theory and practice is based on valuation, that is, assigning value to things, phenomena, or people. Similarly, corporate values are the characteristics that define a company and serve as the axis of its growth.

Normative (A_{51}): They are the degree to which the inhabitants of a given country evaluate and value both entrepreneurial activity and the creative and innovative mindset of people. On the other hand, some norms fit a prescriptive, evaluative, and mandatory dimension in social life. Understanding how laws and regulations can affect the economic and social development of a nation is crucial in terms of their influence on entrepreneurial and innovative culture. It is a crucial factor in political decision-making and the formulation of policies that foster innovation and entrepreneurship.

Innovation (A_{511}): It is a key process for companies since it can create competitive advantages by introducing new or improved products and services to the market. In addition, innovation is based on production and organizational efficiency, specifically on improvements within production processes, basically in production and delivery. Perhaps the most promising part of the innovation process is turning ideas into concepts.

Regulation (A_{52}): They are the different general rules or specific actions applied by entities that are part of the Public Administration. These interfere directly in the market price allocation mechanism, and indirectly in the supply and demand decisions of consumers and producers. In addition, these rules preserve social, economic, political, and technological aspects related to the public interest.

Cognitive (A_6): Includes the processes of acquiring, transforming, organizing, storing, retrieving, and using information. Agents actively acquire information from the environment, process it, and use it to acquire new knowledge and then act. They are also closely related to intelligence, learning, and experience through which people can grow and learn to perform complex tasks.

Creativity (A_{61})**:** It is a human potential, composed of cognitive, emotional, intellectual, and will components, which manifests itself in a creative environment, to create new products of great social value and communicate them at certain moments in the social and historical context of life. It is worth mentioning that it is also the capacity of employees to generate ideas develop new channels, technologies, and products, and achieve visual perception.

Laws (A_7): Laws are legal measures that organize the facts and regulate the behavior of people and situations that live within the same environment, and also establish the operation of institutions such as schools, hospitals, civil registry offices, and the powers of state and government institutions.

Legal basis (A_{71}): A legislative framework is taken into account that supports the growth of companies or organizations; which includes relevant aspects such as the creation of solidarity investment funds, a set of policies, the promotion of social innovation, and the exploitation of popular and solidarity economies.

Policies (A_8): These are the different processes of actions and decisions that the state takes to change or modify a specific situation, to respond to different segments of the population. Also, policies are the responses of the state to certain interest groups in the same way they give solvency to different matters of institutional or social order. In addition, they help to develop individual capacities and guarantee the regulation of an environment.

Advantage (A_9): It can be interpreted as the implementation of strategies, that is, implementing a tactic or technique that creates value through the development of internal and external competencies that are competitive and unattainable for competitors, so that through this the company can become a leader in its managed industry, thus achieving high profitability.

New products (A_{10}): The development of a new product or service is a systemic task that requires constant engineering, marketing, and commercialization skills. Therefore, all members of the organization must be involved in the production of other elements that modify an existing product or create completely new and original products; to compete with other companies based on innovation; but this requires a proactive business culture.

Figure 2 contains the graph tree representing this TreeSoft set.

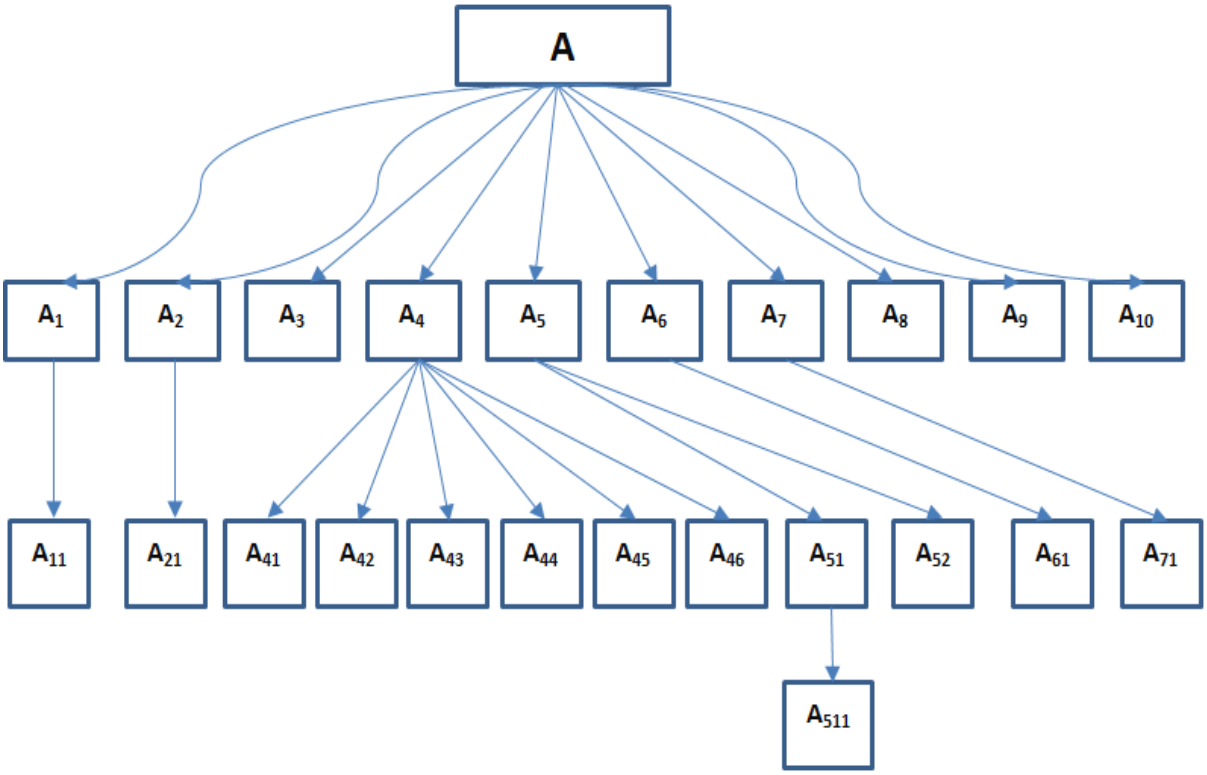

Figure 2: TreeSoft Set of the study carried out.

To perform the calculations we designed the following algorithm:

1. There were ten experts, let us denote them by the set: $E = \{e_1, e_2, \cdots, e_{10}\}$.
2. Each of them evaluates the 125 members (companies) of the artisanal production association ASOPROMAHER, according to those that meet each of the criteria, sub-criteria, and sub-sub-criterion that appears in each branch of the graph tree. That is, if $M = \{m_1, m_2, \cdots, m_{10}\}$ denotes the set of members of the association, then those that satisfy them are selected:

   $F_i(A_1, A_{11}) \subset M$, $F_i(A_2, A_{21}) \subset M$, $F_i(A_3) \subset M$, $F_i(A_4, A_{41}) \subset M$, $F_i(A_4, A_{42}) \subset M$, …, $F_i(A_4, A_{46}) \subset M$, $F_i(A_5, A_{51}, A_{511}) \subset M$, $F_i(A_5, A_{52}) \subset M$, $F_i(A_6, A_{61}) \subset M$, $F_i(A_7, A_{71}) \subset M$, $F_i(A_8) \subset M$, $F_i(A_9) \subset M$, and $F_i(A_{10}) \subset M$.

   Here the ith subscript denotes the evaluation of that expert, with $i = \{1,2,\cdots,10\}$.
3. The intersection sets of each of the expert sets are calculated and this is the final value which is denoted by F, for example, $F(A_1, A_{11}) = \cap_i F_i(A_1, A_{11})$, $F(A_2, A_{21}) = \cap_i F_i(A_2, A_{21})$, and so on.
4. The cardinality of each of the above sets is calculated and divided by 125. In this way, each

element of the lowest level within the tree has an associated number between 0 and 1, where 0 denotes that no company satisfies that combination of criterion, sub-criterion, and sub-sub-criterion, according to each case; while the value 1 means that all of them satisfy it for all experts.

If we denote by S = $\{p_1, p_2, \cdots, p_{16}\}$ each of the combinations evaluated, then the results were the following as shown in Table 1:

Table 1. Results of the evaluations of the 12 combinations carried out by the experts.

Combination	Algorithm result
p_1	0.64
p_2	0.336
P_3	0.216
p_4	0.6
p_5	0.112
p_6	0.56
p_7	0.184
p_8	0.44
p_9	0.616
p_{10}	0.296
p_{11}	0.448
p_{12}	0.704
p_{13}	0.536
p_{14}	0.336
p_{15}	0.288
p_{16}	0.888

As can be seen, the worst results are for p_2, p_3, p_5, p_7, p_8, p_{10}, p_{11}, p_{13}, p_{14}, and p_{15}, which are lower than 0.56. This means that Female Entrepreneurship, Autonomy, Decision, Initiative, Anticipation, Innovation, Regulation, Policies, and Advantage are the elements of the companies in the association in the worst conditions.

4. Conclusion

Female entrepreneurship in Ecuador is limited, as is the limited capacity of women to develop in a predominantly male and patriarchal environment. Above all, women's entry into the business world is still frowned upon, as this is a male-dominated space par excellence. This article consists of a study of this situation in the 125 member companies of the artisanal production association ASOPROMAHER. To do so, we use the tool known as TreeSoft Set, which is used to create tree-shaped representations when there are cases that need to be evaluated according to criteria, sub-criteria, sub-sub-criteria, and so on. Additionally, we propose an algorithm that is useful for determining to what extent each of the possible combinations is fulfilled, where the nodes of the tree that cross all levels intervene, according

to the evaluation of 10 experts on the subject.

The result was that there are problems in Female Entrepreneurship, Autonomy, Decision, Initiative, Anticipation, Innovation, Regulation, Policies, and Advantage, with less than 56% of companies evaluated as successful by the 10 experts. On the other hand, Institutional Context, Knowledge, Proactivity, Freedom, Creativity, Legal basis, and New products obtained results of more than 56%. Note that female entrepreneurship is below what is desired.

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