Artículo de Investigación

Análisis de Vulnerabilidad Socioeconómica ante Eventos Climáticos en los Cantones Santa Elena y La Libertad

Analysis of Socioeconomic Vulnerability to Climate Events in the Cantons Santa Elena and La Libertad

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Resumen: La manifestación de los diversos eventos climáticos que se han producido en Ecuador ha ocasionado numerosas pérdidas económicas y humanas. Mediante el presente estudio se pudo determinar los sectores vulnerables de los cantones Santa Elena y La Libertad, mediante la evaluación de factores físicos, humanos y sociales. La investigación se analizó en base a una data histórica que comprenden los años desde 1970 hasta 2010, además de los datos censales del INEC a nivel nacional, de los que se tomaron los pertinentes a los cantones estudiados. El resultado obtenido determinó que el sector con mayor vulnerabilidad socioeconómica se localizó en el cantón de La Libertad en el sector de las instalaciones de la Refinería de La Libertad, cercana a la Plaza de La Libertad.

Palabras clave: Eventos climáticos, sectores, vulnerables.

Abstract: The manifestation of the various climatic events that have occurred in Ecuador has caused numerous economic and human losses. Through this study, it was possible to determine the vulnerable sectors of the Santa Elena and La Libertad cantons, by evaluating physical, human and social factors. The research was analyzed based on a historical data that includes the years from 1970 to 2010, in addition to the census data of the INEC at the national level, from which those pertinent to the cantons studied were taken. The result obtained determined that the sector with the greatest socioeconomic vulnerability was located in the canton of La Libertad in the sector of the La Libertad Refinery facilities, near the Plaza de La Libertad.

Keywords: Climate events, sectors, vulnerable.

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Introduction

The United Nations Framework Convention on Climate Change, in its Article 1, defines climate change as “climate change attributed directly or indirectly to human activity that alters the composition of the world's atmosphere and adds to natural variability. of the climate observed during comparable periods of time ”. The latest report from the Intergovernmental Panel on Climate Change (IPCC) points out that the warming of the climate system is unequivocal and that observations made around the globe show that many natural systems are already being affected by the increase in temperature. [1], Therefore, the United Nations Framework Convention on Climate Change (UNFCCC) recognizes that "low-altitude countries and other small island countries, countries with low-lying coastal areas, arid and semi-arid areas, or areas exposed to floods, drought, and desertification, and developing countries with fragile mountain ecosystems are particularly vulnerable to the adverse effects of climate change " [2].

The greatest exposure to risk from natural hazards in the region is manifested in a series of extreme events that have increased in frequency and intensity over the years, their most dire consequences generate human losses and considerable material damage to the population [3]. Regarding the issue, the working group II of the Intergovernmental Panel on Climate Change (IPCC), dedicated to assessing the impacts and adaptation to climate change, concluded that this phenomenon "will have the greatest impacts on those peoples with less capacity to protect itself against rising sea levels, increasing diseases and decreasing agricultural production, in the case of developing countries "[2]. The following sectors have been identified as especially vulnerable to the impacts of climate change in Ecuador: agriculture, energy, forestry, water resources and coastal marine. In addition, droughts, floods and landslides associated with climate variability affect large regions of the country [1]. The effects of these processes are intensified by social, economic and regional inequalities and by the persistent of pverty conditions [3]

Initiatives such as the National Climate Change Strategy-ENCC 2012-2025 are applied through the Ecuadorian Ministry of the Environment, establishing the adaptation axis as one of its main foundations, defining as a goal the reduction of vulnerability in the different dimensions of social development [4}. In this line, it would be relevant and timely an adequate diagnosis that includes the measurement of risk and socioeconomic vulnerability considering physical, social, human and economic factors, which affect the capacity of a population to absorb and recover from the impact of an associated event. to a threat, to determine vulnerability indices in the urban area of a very important sector due to its geographical location such as the cantons of Santa Elena and Libertad.

Vulnerability

The term vulnerability can be defined from different perspectives, considering different arguments, being necessary to clarify and clearly determine the conceptual framework in which vulnerability studies are developed. From a scientific point of view, the use of the term vulnerability has its roots in the study of geography and natural risks, although it is currently included in studies of risk management, ecology, public health, poverty, famine, changes in the use of soil, climate change and adaptation, among others [6,7]

Thus, other contextualizations of vulnerability are applied in various methodological approaches for studies of risk, political economy, disasters, and ecological resilience. [8]

In each of these approaches, the variables analyzed are different and also pursue different objectives. This is why there is often confusion in the definition of vulnerability [9].

In Ecuador the risk approach has been widely used. In this approach, two factors are clearly analyzed: "threat" and "vulnerability" [9].

Vulnerability = f (Exposure, Climate sensitivity, Adaptive Capacity)

Where:

Exposure: The degree, duration and or scope in which a system is in contact with a disturbance, in this case it refers to the character, magnitude, duration and variability of climate change.

Climate sensitivity: The degree to which a system is affected either negatively or positively by climate variability or change.

Adaptive capacity: The ability of a system (both human and natural) to adjust to climate change and climate variability, in order to reduce potential damage, take advantage of opportunities and face the consequences. The differences that are found between these two moments, will be able to show which, where and in what magnitude future impacts of climate change will be observed [10].

Methodology

Determining factors in Vulnerability

The factors that were used to determine the socioeconomic vulnerability of the study area, the information was obtained from a secondary source from the National Population Census of 2010. This indicator depends on the behavior of human, physical and social factors, which are associated with people's capacities, family structure, physical infrastructure, economic capacity, socially vulnerable groups, access to health services. The results were expressed spatially, which allowed to visualize the Index of socioeconomic vulnerability of the Santa Elena and La Libertad cantons.

Study Area

The present study was carried out in the cantons of La Libertad and Santa Elena, in the province of Santa Elena. The cantons were chosen considering that they are small cities, with most of the urban population settled in low places, it does not exceed one million inhabitants, and their income is medium or low.

Vulnerability Indicators

Since the mid-1990s the focus on vulnerability changed from an exclusive focus on meteorological and biophysical factors, to a comprehensive focus that includes social, economic, physical, and even political factors [11].

The variables used were normalized and the weights were calculated based on their relative variability, which was the total cantonal population.

From the variables described, three types of vulnerability factors were formed:

Physical factors: Material components that make communities vulnerable were evaluated, considering the deficiencies and limitations of resources such as: paved roads, access to drinking water, sewerage, garbage disposal. These are the tangible factors, which is why cantonal and community decision makers and administrators tend to focus on them.

Formula for calculating the physical factor:

IVF: F1 + F2 + F3 + F4

Where IVF is Physical Vulnerability Index

Focus group: Some of the communities were exposed to unsanitary conditions that made them vulnerable, and their vulnerability is exacerbated under certain environmental conditions of humidity related to rainfall and temperature variation. The variables used to calculate the indices are described below.

F1: Without access to Drinking Water inside the House.

F2: No access to sewer

F3: Access to garbage disposal by collector truck

F4: No access to roads

Social Factors: Variables that affect the resilience of communities were considered, due to the fact that they impact on their social and political structure, affecting their decision-making and leadership capacity, such as: illiteracy, women heads of households, households with more than four people per bedroom, retired, unaffiliated.

Formula for calculating the social factor:

IVS = S1 + S2 + S3 + S4 + S5 + S6

Where IVS is Physical Vulnerability Social

Focus group: Empowerment and representativeness of the community. The variables used to calculate the indices are described below.

S1: Total cantonal population

S2: Illiteracy

S3: Women Heads of Household

S4: Homes with more than 4 people per bedroom

S5: Retired

S6: No Affiliates

Human Factors: This analysis was carried out within the field of personal development, which is less perceptible than the previous two, determining human components evaluated by their capacities and vulnerabilities, these being groups of residents under 14 years of age, adults over 65 years and people with special abilities.

Formula for calculating the human factor:

IVH: H1 + H2 + H3

Where IVH is Physical Vulnerability Human

Focus group: Susceptibility of the population. The variables used to calculate the indices are described below.

H1: Under 14 years old

H2: Adults over 65 years of age

H3: People with disabilities

In order to achieve a consistent vulnerability indicator, the factors were normalized, applying the following formula:

F. Normalized = ΣF1i - min F1

Max F1 - Min F1

The factor is normalized and takes the form of ratios, delimited between 0 and 1, following a beta distribution, which assumes a normal distribution that would lose generality and avoid incurring in possible specification errors in the case of asymmetries, leaving open the possibility to approximate the beta version to a normal distribution in case the parameters a and b are approximately equal [1], the errors of this approach are insignificant and allows to establish levels of vulnerability [2].

Natural Hazards produced by Variability and Climate Change

According to the DesInvetar database, 2015, the cantons of Santa Elena and La Libertad in the period 1970-2010 were vulnerable to four threats, according to the terms of reference prepared by the Ministry of the Environment [4]

Factors that determine Vulnerability and its different aspects in Urban Systems.

Many global risks of climate change are concentrated in urban areas (medium confidence). Actions that increase resilience and enable sustainable development can accelerate successful adaptation to climate change globally. Heat stress, extreme precipitation, continental and coastal flooding, air pollution, drought, and water scarcity pose risks in urban areas to people, assets, economies, and ecosystems (very high confidence). The risks are amplified for people who lack essential infrastructure and services or live in substandard housing and in exposed areas. By reducing basic service deficits, improving housing and building resilient infrastructure systems, significant reductions in vulnerability and exposure could be achieved in urban areas. Urban adaptation is enhanced by effective governance of urban risk at various levels, fine-tuning of policies and incentives, strengthening the adaptive capacity of local governments and communities, synergies with the private sector, and adequate financing and institutional development (medium confidence level). Increased capacity, voice and influence of low-income groups and vulnerable communities and their partnerships with local governments also work for adaptation.

The vulnerability of the urban systems of the study area was determined from the data of the Population Census of Ecuador 2010, considering the pertinent information to the Santa Elena and La Libertad cantons, classifying it in physical, social and human factors, to deduce and reveal the risk through social situations between similar populations and environments and how they are differently exposed to suffer damages in the face of a potential threat, considering their resources and needs [12], since vulnerability is not an equivalent to poverty and marginalization, it is rather the consequence of a set of aspects related to social, economic and political structures [12], where according to several studies it has been observed that the trend of vulnerability varies little over time, with the possible exception of climate change [12].

As mentioned, the census data were analyzed under three categories [5]:

Physical factors: Material components that make communities vulnerable were evaluated, considering the deficiencies and limitations of resources such as: paved roads, access to drinking water, sewerage, garbage disposal. These are the tangible factors, which is why cantonal and community decision makers and administrators tend to focus on them.

Social factors: Variables that affect the resilience of communities were considered, due to the fact that they impact on their social and political structure, affecting their decision-making and leadership capacity, such as: illiteracy, female heads of household, homes with more than four people per bedroom, retired, unaffiliated.

Human factors: this analysis was carried out within the psychological field, which is less perceptible than the previous two, determining representative human components for their capacities and vulnerabilities, these being groups of residents under 14 years of age, adults over 65 years of age and people with special abilities.

Results

Cantons in Ecuador with greatest vulnerability to Climatic Events

Table 1 presents the cantons with the greatest vulnerability to climatic events, where it was evidenced that the cantons La Libertad and Santa Elena are among the most affected.

TABLE 1
List of Cantons with the Most Vulnerability in Ecuador

N.	Province	City
1	Santa Elena	La Libertad
2	Guayas	San Jacinto de Yaguachi
3	Guayas	Santa Lucía
4	Guayas	Salitre (Urbina Jado)
5	Guayas	Durán
6	Guayas	Balzar
7	Guayas	Balao
8	Loja	Quilanga
9	Los Ríos	Palenque
10	Guayas	Colimes
11	Manabí	Olmedo
12	Los Ríos	Baba
13	Guayas	Colimes
14	Manabí	Olmedo
15	Los Ríos	Palenque
16	Santa Elena	Salinas
17	Guayas	Isidro Ayora
18	Guayas	Daule
19	Guayas	Lomas de Sargentillo
20	Los Ríos	Vinces
21	Guayas	Palestina
22	Guayas	Alfredo Baquerizo Moreno (Jujan)
23	Chimborazo	Pallatanga
24	Guayas	El Triunfo
25	Bolívar	Chillanes

Physical Vulnerability Index

Figure 1 shows the vulnerability index to physical factors of the Santa Elena and La Libertad cantons, where it was evidenced that the La Libertad canton had the greatest vulnerability to urban physical factors. The main cause of the vulnerability found in the canton La Libertad is due to the fact that it was formed without a planned urban development, since it was the product of irregular settlements that were founded during the first decades of the 20th century by people who emigrated from the surrounding rural sectors. or from

other cities in order to take advantage of job opportunities in the English company ANGLO, which was operating at that time. [5]

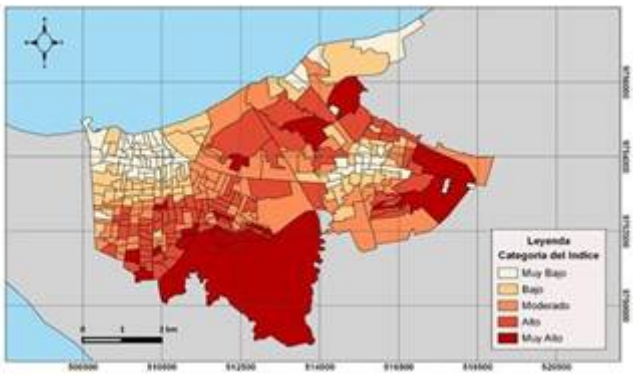

FIGURE 1
Physical Vulnerability Index of the Cantons Santa Elena and La Libertad.

Social Vulnerability Index of the Cantons Santa Elena and La Libertad

Figure 2 presents the social vulnerability index of the Santa Elena and La Libertad cantons. It was determined that the canton La Libertad presents greater vulnerability in social factors, according to what is stated in the map corresponding to physical factors, because the population of this canton has a high illiteracy rate that varies between 9 to 13% depending on INEC data - 2010. This information was verified with surveys of a group of residents between an average age of 20 to 30 years to determine their level of education, and as a result of which 70% of the respondents have secondary education, 12% have university studies and the remaining only primary studies.

Delving into the effect of social vulnerability on the population, it is worth mentioning that the population groups detected as most vulnerable would be associated with conditions of poverty, due to an effective lack that would make present and future sustainability and development impossible [6].

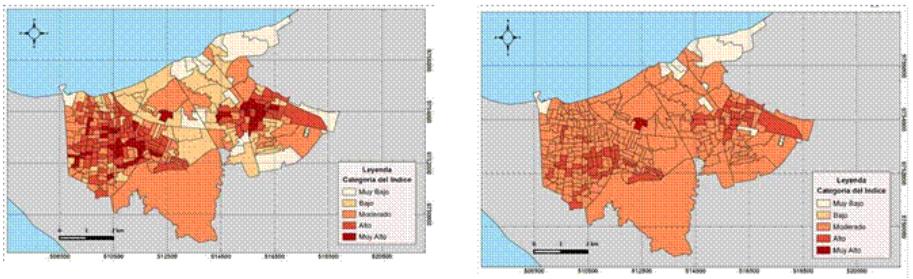

FIGURE 2
Social Vulnerability Index of the Cantons Santa Elena and La Libertad

Socioeconomic Vulnerability Index of the Cantons Santa Elena and La Libertad

The three spatial graphs corresponding to the physical, social and human vulnerability indices, the Socioeconomic Vulnerability Index of the Santa Elena and La Libertad Cantons was spatially generated, which identified the most vulnerable sectors, showing that the place with the greatest vulnerability is located at the La Libertad Refinery facilities near Plaza La Libertad (Figure 4).

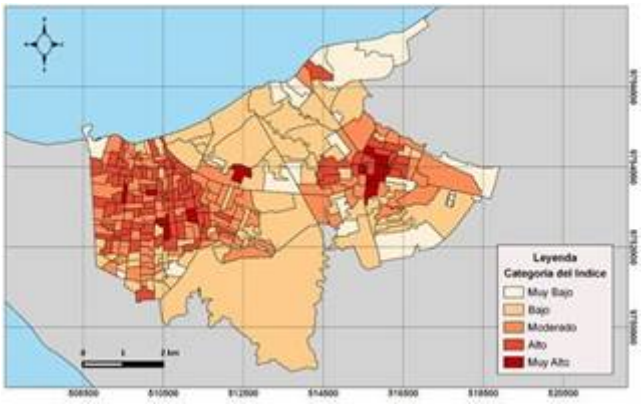

FIGURE 4
Socioeconomic Vulnerability Index of the Cantons Santa Elena and La Libertad.

Conclusions

1. The physical, social and human vulnerability indices are exposed to be affected by climatic variables, such as precipitation and temperature.

2. An increase in rainfall would increase the physical vulnerability index, generating potential damages in public works and economic losses to the central government.

3. The increase in temperature would affect both the social and human vulnerability index, due to the fact that at higher temperatures the growth of microorganisms is favored, impacting in a directly proportional way to health, exacerbating the presence of febrile diseases, especially in the most vulnerable populations (under 14 and over 65).

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