

## Sustainable Risk Management and Rural Tourism as a development and strategic factor of the Reventador parish - Ecuador

Magda Francisca Cejas Martinez,  
Universidad Nacional de Chimborazo UNACH and Universidad de las Fuerzas Armadas ESPE, Ecuador,  
magdacejas@unach.edu.ec  
Juan Pablo Morales Corozo,  
Universidad Central del Ecuador, Ecuador  
j.p.shevarajo@gmail.com  
Mayra Fernanda Quiñónez Bedón,  
Universidad de las Fuerzas Armadas ESPE, Ecuador,  
mfquinonez@espe.edu.ec  
Gabriela Rivas Urrego,  
Universidad Pedagógica Experimental Libertador UPEL, Venezuela,  
gabrielarivasu@gmail.com  
Derling Jose Mendoza Velazco,  
Universidad Nacional de Educación and Universidad UTE, Ecuador,  
derling.mendoza@ute.edu.ec

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### Abstract:

The study is based on the approach proposed by the World Tourism Organization when it emphasizes the value of the tourism sector as an essential activity of modern societies and a determining factor in the quality of life. To this end, this research emphasizes government intervention in environmental, risk and tourism issues, thus preserving the sustainable development of the regions. The method of scientific study is used. Among the results, environmental safety is highlighted as one of the fundamental rights of society and an indispensable requirement for the competitiveness and sustainability of tourism". The great emergency that exists in Ecuador in the "application of public policies of tourist security for the consolidation of the process of regional integration". It is concluded that an integral and systemic approach to social development must be considered, one that links the environmental, economic, productive, socio-cultural, tourism, and institutional dimensions in an insertable manner. Taking advantage of the spaces and channels of community participation with the tourist destinations of the area.

**Keywords:** Rural Tourism; management; sustainable risk; research; Ecuador.

**JEL Classification :** Z000, Z390.

### Introduction

The articulation within the framework of economic growth and conservation of the environment to promote the development of the countries has been gestated since 1940 by UNESCO. This international organization has been dedicated to the search to help less developed countries to take off from the economic and social backwardness in which they found themselves, even though it must be considered for the purposes of understanding this research work that the literature on local development denotes the different factors related to local development, adopting the manifesto of [1] when it assumes that it is an organized effort to improve the living conditions of a community and the capacity for community and self-directed integration, taking into account that it is also part of a strategy designed to improve the standard of living, economic and social of those specific groups that make up a certain population [2].

Likewise, it is necessary to emphasize that one of the key foundations in the framework of the protection of the local economy is precisely to seek alternatives that allow the improvement of the productive, technical and social capacity in the face of future volcanic manifestations and, in turn, guarantee the food security in periods of greatest ash fall, such as Ecuador, which has various volcanic scenarios in different provinces. It is also important to note that in the face of natural events, the protection of the precarious infrastructure of many cantons - aqueducts, hospitals, schools and, in general, homes- forces local / government agencies to adapt said infrastructures to new situations that arise as a result. of various natural settings. Local people and government agencies in the case of Ecuador are part of a fundamental asset in the development of a leadership that affects the rural community so that it takes ownership of the processes of strengthening the local economy and the preparation of possible natural disasters that directly affect sustainable local development, the economy and, consequently, rural tourism development, which implies the awareness of community leaders and residents of these possible events.

In this way, it is very necessary to promote rural practice through collective decision-making and the use of the adoption of preventive measures and the preparation of early responses to situations of fundamental risks. In light of the above, the World Tourism Organization has highlighted the value of the tourism sector "as an essential activity of modern societies and a determining factor in the quality of life, for which governments must act in favor of peace and security, which are essential for the development of tourism, while security is one of the fundamental rights of all people, a non-delegable obligation of the State and an indispensable requirement for the competitiveness and sustainability of tourism ", to the Once the "application of public policies on tourism security is of great importance for the consolidation of the regional integration process."

In this sense, tourism is a global activity that is conceived as an axis of development in those territories that allude to their own conditions and that are often led by local governments, which integrate them and coordinate them with the use of the wealth of a natural potential for local development, in the same way they seek to achieve the wealth of their locality and well-being of the human being, both in balance and with the natural environment, which makes it possible to attend to the different programs and activities of its development. Tourism in recent decades has become a local and regional development strategy taking into consideration that tourism modalities are increasingly expanded, adjusting to the communities' own needs, but in addition to those people interested in that rural place who identifies the locality.

The World Tourism Organization [3], in its report tourism and poverty alleviation, affirms that tourism has advantages for underdeveloped countries, among which the following stand out: the tourist boom that occurs in the locality itself, the Tourism determines an activity of its own with great possibilities to add competitive factors, the development and production of tourism will also depend on the financial and productive level, in addition to the human, but also natural and cultural level that the populations have, it is an activity that takes advantage of resources, It is also an activity that requires the support of international and local organizations.

In this area, tourism linked to risk management implies considering the scope of the meaning of safety as an indispensable requirement for the competitiveness and sustainability of tourism. Therefore, it is a right of visitors and residents that local government agencies, assuming the obligation and responsibility to guarantee security in the localities of the cantons. Therefore, tourist security guarantees the protection of life, health, physical, psychological and economic integrity of visitors, service providers and members of the host community; thus, security will increasingly become the added value that will contribute to the differentiation between quality destinations [4].

Similarly, [3] recognizes that the success or failure of a destination depends on its ability to provide visitors with a safe environment. From this perspective, the proposed study alludes to this universal principle of conducting an analysis of sustainable risk management and rural tourism as a strategic factor for the safety of destinations.

This requires the participation of all in correspondence with the responsibilities of the destination, which must guarantee that crime, acts of violence, military, social, political, religious and ethnic conflicts, as well as the lack of public and institutional protection are matters. properly cared for. In such a way, tourist security must be understood under a comprehensive approach of compliance with rights and guarantee of freedoms for all people, based on the enjoyment of the tourist space by visitors and residents; in actions that respect diversity and compliance with human rights; in crime prevention, in dialogue and permanent help between civil authorities, police and citizens; and in the responsibility regarding the management of information [6], so that situations of violence constitute a limiting factor for the management of the sustainability of destinations and their organizations.

In this vein, it is worth noting the contributions of [7] when assuming in their theoretical positions that natural risks and crisis events are predictable based on scientific studies. The Food and Agriculture Organization of the United Nations also highlights the importance of risk and crisis management, considering its relationship with the principles of sustainability [8].

In this way, the implementation and understanding of the scope derived from those Global Sustainable Tourism Criteria by the Global Sustainable Tourism Council [9], which are an effort to achieve a shared way of understanding what a sustainable and safe destination is, representing the commitments minimum requirements that a tourism management organization, as well as government entities that want to be sustainable, must comply with. To meet the definition of sustainable tourism, destinations must adopt interdisciplinary, holistic and inclusive approaches, including four main objectives: i) demonstrate sustainable management of the destination; ii) maximize social and economic benefits for the host community and minimize negative impacts; iii) maximize benefits for communities, visitors and cultural heritage and minimize impacts; iv) maximize benefits for the environment and minimize negative impacts. The Criteria are designed to be used in destinations of all types and scales. These criteria are an effort to reach a common understanding of sustainable tourism and are organized around four main themes: effective planning for sustainability; maximization of social and economic benefits for the local community; improvement of cultural heritage; and reduction of negative impacts on the environment [10].

## 1. Study approach

In the context of your research paper the literature review should be a critical synthesis of previous research in the subject field. The evaluation of the literature leads logically to the research question. Who is doing what? Who has done what? Who first did it or published it? Taken from published papers, research monographs, catalogues etc. Based on primary sources. Offering a, probably new, structured view of the field of study.

This research work is presented from the approach and study of the El Reventador parish, belonging to the Province Sucumbíos in Ecuador. It is located 90 km from the city of Quito, in the sector between the Coca, Salado and Dué rivers, northeast of Ecuador, northeast of the Eastern Cordillera of the Andes, in the upper part of the Sucumbíos province, has an extension of 97,256.33 hectares, bordered to the north by the parishes La Sofía (Sucumbíos canton), Puerto Libre and Lumbaqui, the latter two of the Gonzalo Pizarro canton, to the south by the El Chaco canton of the Napo province, to the east with the province of Imbabura and to the west with the Lumbaqui parish of the Gonzalo Pizarro canton.

Being part of the Amazon region, you can see several places with a diversity of attractions that can be used for tourism, such as the El Reventador parish, located in the Gonzalo Pizarro Canton, Sucumbíos Province. More than 95% of the territory is part of the Cayambe Coca National Park (PNCC), being one of the most mega diverse areas of the country. In the remaining 5%, the population carries out traditional activities in the field such as livestock and agriculture, deteriorating the environment and pressing the buffer zone more and more, the symbolism of the Reventador volcano, Nevado Cayambe, determines the place from which the Aguarico, a bridge that symbolizes the connecting road between the Andes and the Amazon, as well as a great diversity of agricultural products in the area.

Gonzalo Pizarro parish represents an icon in rural Ecuador and belongs to the Sucumbios province, it should be noted that the parish presents very irregular conditions, given that the existence of the Reventador volcano in said parish has experienced violent eruptions ranging from high explosivity, in 2002 there was one of the most powerful eruptions recorded in the last 100 years in Ecuador, causing earthquakes of magnitude 4.1, to date there have been events where ash columns of an average of 16 km, traveling at a speed of 45 km / h in a southwest direction towards the inter-Andean valley more frequently, the parish intersects with the Cayambe-Coca National Park, which has a great influence since 80% of the parish territory it has a great wealth of flora and fauna. The territory of the parish has a diversity of spaces, landscapes, endemic flora and fauna, water systems, living cultures with indigenous customs and traditions that are elements to consider as potential tourism, which until now has not been given sufficient importance for its development, Hence, there is little use of natural and cultural attractions to promote tourism.

The interest of the researchers is to highlight that within the framework of tourist activities (both internal and foreign visitors) it is possible to assume risks derived from abroad, it could be said that it is one of the sectors that is most sensitive to change and impacts. negatives. Rural tourism is a globally new sector and, to date, in continuous growth, it can be considered a fragile activity, because it is highly vulnerable to external forces and events that, temporarily or permanently, interrupt or decrease tourist flows, for Being a heterogeneous and diverse sector, it is difficult to establish what form of crisis management should be embraced.

In any case, there are many aspects that have a greater impact on the tourist's perception of risks as a result of a natural event, which causes them to become a more vulnerable sector. Tourist destinations around the world face the uncertainty of experiencing a disaster at some point. Despite this, very few destinations have properly developed disaster and / or risk management plans to solve such eventualities.

However, it should be noted that risk management in the Ecuadorian sphere has been improving considerably in regions, parishes, cantons and provinces, this has allowed the creation of tools for intervention from various government figures, whether they are parochial, cantonal, provincial and national [11].

Ecuador is considered one of the 17 most mega diverse countries on the planet [12]. Within its 4 worlds, Coast, Sierra, Amazon and Galapagos, it houses an infinity of species of flora and fauna surrounded by beautiful landscapes: thus, also living cultures with ancient customs and traditions. The natural and cultural tourist potential has made it possible to place tourist activity as one of the main incomes of the country, therefore, it is necessary and immediate to generate a strategy for the protection and conservation of tourist resources, in addition to preserving Protected Areas with different denominations grouped in the Heritage of Natural Areas of the State [13], currently 51 are registered distributed throughout the Ecuadorian territory.

Regarding the Eastern zone and the Sierra in the provinces of Napo, Sucumbíos, Pichincha and Imbabura, the Cayambe Coca National Park (PNCC) is located, created under Supreme Decree No. 818 of November 1970 with 403,103 has. Its surface houses several life zones contained in the irregular orography of the eastern mountain range of the Andes, sub-Andean and Amazon forest.

Regarding the climatic and altitude conditions, it is highlighted that they create ideal spaces and landscapes for the development of ecotourism and adventure activities.

Regarding the protected area, it shares its territory with several communities and populated centers in the four provinces In Sucumbíos, being the El Reventador parish occupying 95.73% of the area.

In the same way, there are five enclosures that make it up, La Libertad, San Francisco, Alma Ecuatoriana, Simón Bolívar and Atenas, dedicated to the development of livestock, agriculture and fish farming activities in a traditional way without the application of appropriate technologies, generating technical and cultural limitations.

The denomination as Cayambe Coca National Park gives the neighboring population the opportunity to implement tourist activities as an economic alternative for family sustenance. The sites managed by the Lower Zone of the protected area, Cascada San Rafael and Volcán Reventador are the only attractions that currently receive visitors, but they do not generate local economic income due to the lack of additional services offered to the tourist route, such as food, lodging, crafts and recreation in other attractions.

However, the Development and Territorial Organization Plans (PDOT) [14], have prioritized projects focused on tourism activity oriented towards tourism development, the determination of tourist routes, implementation of viewpoints, improvement of trails, training, among others; however, they have not been executed due to limited human resources for project management. Private initiatives are also limited and there are few efforts in place, which prevents its economic, tourist and sustainable growth.

## **2. Case Study: Reventador Volcano and its environmental effects**

In 1987, an earthquake of magnitude 6.1 occurred, which caused landslides that resulted in the rupture of the flow line of the SOTE Trans Ecuadorian Pipeline System [15]. There was an oil spill that affected a large part of the communities and sectors of the Napo and Sucumbíos provinces, added to this the economic losses of millions of dollars, affecting the hydroelectric and agricultural development of the region, which were difficult to evaluate according to the Geophysical Institute of the National Polytechnic School. The main economic consequence suffered by the country was the great impact on the Ecuadorian oil production, due to the serious damage to the trans-Ecuadorian oil pipeline. According to the United Nations Economic Commission for Latin America and the Caribbean in 1987, the Ecuadorian oil fields would have produced around 60% of the country's export foreign exchange, so Ecuador's ability to cope was severely affected. to its internal operating costs and to make the interest payments on its external debt. In the weeks following the earthquakes, the National Government issued some severe economic measures, including the suspension of the payment of the foreign debt to private banks, increased fuel prices, a national austerity plan and a freeze on the prices of fuel. a selected set of essential products [15].

In this sense, there are many conditions in the El Reventador parish where there is annual rainfall above 4500 mm, they cause several problems in the sector where landslides frequently occur, causing problems on the road, leaving incommunicado for several weeks to Gonzalo Pizarro canton and Sucumbíos province. In 2013, the El Reventador parish was linked to a rainfall intensity of more than 60 mm / h, according to the report of the Risk

Management Unit of the Autonomous Decentralized Municipal Government of the Gonzalo Pizarro canton, causing soil detachment, resulting in the rupture of the SOTE flow line, spilling ten thousand barrels of oil, which affected the indigenous communities of the Sucumbíos province, generating a great possibility of damage to the ecosystems present in the sector which has not been quantified [16].

Therefore, the Ministry of the Environment, like other control bodies in Ecuador, have not determined the level of impact due to the frequent movements of soil that occur in the sector, hence the need for the Government's Risk Management Unit. Autonomous Municipal Decentralized of the Gonzalo Pizarro canton, in addition to the urgency of carrying out an environmental impact assessment as a proposal to determine the environmental damage caused and intervene with remediation and cleaning activities, taking into account limitations due to the pandemic that is being experienced at the level world.

It is important to note in this regard that sustainable risk management must address three basic principles, these being economic as that activity that is carried out based on appropriate practices, ensuring growth and maintenance over time, benefiting the affected rural community. Environmental, corresponds to that activity that is developed based on the way in which natural resources are used and ideally contributed based on conservation and care. The Socio Cultural, suitable for the activity that is carried out without harming or affecting the existing social fabric in the rural community where it is developed, therefore, all possible actions are foreseen to respect the local culture, preserve it and revitalize it [17].

### 3. Regulatory framework

Within the Constitution of the Republic of Ecuador, in its article 264, expressly in numeral 13, regarding risk management, it obliges the Municipal Governments as exclusive powers to manage the prevention, protection, relief and fire extinguishing services; Following the same legal instrument with respect to food sovereignty, it states that it is a strategic objective and an obligation to guarantee that communities, peoples and nationalities achieve self-sufficiency in healthy and culturally appropriate food [18]. In article 389 of the Constitution of the Republic of Ecuador, it states that the State will protect each of the people and communities, against the negative effects of disasters, be they natural and / or man-made, through prevention, mitigation and extinction of disasters, added to this the recovery and improvement of social, economic and environmental conditions [18].

According to article 390 of the [18], with respect to the principles of decentralization of risk management, the different government figures within their geographical scope are directly responsible for the intervention in the implementation of actions to prevent, mitigate and extinguish natural and / or man-made disasters, in the event that the capacities to manage are insufficient, will be supported by the instances of greater territorial scope, giving a cascading effect in the intervention which is activated gradually, according to the emergency level.

In the Organic Code of Territorial Ordering, Autonomy and Decentralization, expressly in its article 60, with respect to the powers of mayors or mayors, it obliges to dictate in case of serious emergency, take urgent measures in case of emergency and give an account of the same to the municipal council [19]. The exercise of competence in risk management matters states in article 140 that autonomous decentralized municipal governments will compulsorily adopt technical standards for the prevention and management of risks in their territories with respect to protecting people, communities and nature, in their territorial ordering processes [19].

Autonomous decentralized municipal governments will compulsorily adopt technical standards for the prevention and management of seismic risks to protect people, communities and nature. The Autonomous Municipal Decentralized Government of the Gonzalo Pizarro canton, through the Mayor Segundo Jaramillo, as president of the COE, in the face of the situation evidenced at the national level corresponding to COVID-19, has kept the cantonal COE active since March 2, 2020, with a preventive approach, in which, with the collegiate body, it has established resolutions that have been applied, including the suspension of mass concentration events at the cantonal level and the activation of Technical Board No. 2 Health and Pre-hospital Care as the Board Technique 4 Temporary Accommodation and Humanitarian Assistance, in addition to the coordinated work with all the entities that make up the COE [20].

On March 3, 2020, through a work meeting, Technical Table No. 02 Health and Pre-hospital Care was activated, led by Eng. Mayra Santín, Director of District 21D01 Cascales Gonzalo Pizarro Sucumbíos, together with Technical Table 4 Accommodations Temporary and Humanitarian Assistance, establishing a roadmap for what corresponds to training in the institutions of the Gonzalo Pizarro canton.

To follow up on the activities planned with Technical Table 2. Call an extraordinary session on Wednesday, March 11, 2020, consolidating the planned work and adjusting the planning so that the prevention campaign reaches each of the sectors of the Gonzalo Pizarro canton. Through Ministerial Agreement 126

published in the Official Register Supplement 160 of March 12, 2020, it is agreed to declare the State of Sanitary Emergency in all establishments of the National Health System, in laboratory services, epidemiology and control units, air ambulances, services of doctors and paramedics, hospitalization and outpatient consultation due to the imminent possibility of the effect caused by the COVID-19 coronavirus, and to prevent a possible massive contagion in the population [21].

In Supplement to Official Registry N ° 163 of March 17, 2020, Executive Decree N ° 1017 was published, signed by the President of the Republic of Ecuador, Lic. Lenin Moreno Garcés, by which it declares: "State of exception due to public calamity throughout the national territory, due to confirmed cases of coronavirus and the declaration of a COVID-19 pandemic by the World Health Organization (...)", [22]. On March 17, 2020, the Municipal Autonomous Decentralized Government of the Gonzalo Pizarro canton, through Resolution No. 009-2020, declares itself in a state of health emergency, for which it implements the Cantonal Emergency Plan, leaving all technical worktables active. and COE work groups.

#### 4. Methodology and discussion of the results

The geomorphological process is analysed where, due to faults, the soils and rocks exceed the resistance to cutting of the surface and due to the gravitational force, displacements of the surfaces are generated causing risks for the sector community and perhaps much more for those outsiders who do not know the routes they visit and their risks, that is why there are strong movements that sometimes produce large volumes of land at varied and violent speeds (view Table 1) [23].

Table 1 - Types of mass movements

Types of mass movements	Description
Landslides	Rotational
	Translational in rocks and soils
Flows	Mud flows
	Debris flows
	Rocky flows
	Crawling
	Solifluction
Detachment or falls	Landslides of rocks and soil
Overturning	Overturning rocks
	Flexural overturning of rocky massifs
Avalanche	Rock avalanche
	Collapse
Lateral displacements	Rocky soils and blocks

Source: (geologíaweb, 2020)

Table 1 records the types of mass movements that occur in the area: however, these unexpected movements cause damage to essential infrastructure. It will also be necessary to consider the susceptibility of occurrence, which includes the degree of predisposition that an area has to a threat being generated in it due to its own conditions. Similarly, the threat that includes the probability of occurrence of a potentially harmful phenomenon, in each area and within a time interval, to determine this variable must consider the conditioning factors that are related to its own characteristics. of the terrain such as geomorphology, topography, land use, vegetation cover, among others, this must also include the triggering factors defined as those that can cause events, in our research precipitation and the risks that it causes.

In order to generate a greater understanding of the risks that are deduced from the activity of the parish the Reventador at the time of these natural disasters and that entail a risk not only for the communities but also for those people interested in nature tourism or rural tourism.

##### A. Analysis of susceptibility to mass movements

The research consisted of weighing the conditioning and triggering variables for the type of mass movement that occurs most frequently in the area, which is creep flows, where the preliminary information that rests in the Government Planning Directorate was reviewed. Autonomous Municipal Decentralized of the canton Gonzalo Pizarro.

Subsequently, the quantification of the threat was carried out using the Mora - Vahrson method, which allows an analysis of the extensive areas under landslide threats, using morphodynamic indicators, allowing to obtain a zoning of areas susceptible to landslides where the variables are combined.

This methodology is convenient because it needs basic and simple variables, and takes considerable factors based on parameters from the point of view of slope instability, the most considerable advantage is the contribution in determining alternatives and making decisions to prevent dangerous events and consider criteria for territorial planning and risk management plans (View Eq. 1).

$$H = (S_m * S_c * S_l) * (T_s + T_p) \tag{1}$$

Where:

$H$  is degree of threat to geomorphological units

$S_m$  is morphometric factor

$S_c$  is plant cover factor

$S_l$  is lithological factor

$T_s$  is trip factor for earthquakes

$T_p$  is rain trigger factor

In the sector where the landslide originated, which caused the breakage of the flow lines of SOTE, Poliducto and OCP (Heavy Crude Oil Pipeline), on April 7, 2020, considering the previously described methodology, it is obtained the next (view Table 2):

Table 2 - Weighting of the morphometric factor ( $S_m$ )

Range (%)	100
Slope factor weighting (P)	2
Slope length factor weighting (L)	3
Obtained value	11
Weighting of the $S_m$ creep factor ( $S_m$ )	3

Source: Research's, (2020)

These factors that are shown in table 2 correspond to the analysis carried out at the site where there is a slope factor of 2.

Table 3 - Weighting of the lithological factor ( $S_l$ )

Geological formation	Lithology	Ponderación $S_l$ Reptaciones
Volcanic deposits (laharitic)	Volcanic ash with edges and blocks, of marked heterometry	1
Volcanic deposits (pyroclasts)	Pyroclasts, eruptive lithic fragments	1
Volcanic Reventador	Basalt lavas, lahars, and pyroclasts	2
Angochagua Volcanic	Andesites, brechas and agglomerates	1
Mera training	Tubaceous clays and sandstones, with thick conglomerate horizons with cross-stratification	2
Mesa training	Volcanoclastic clays and sandstones, with conglomerates. Large, interspersed blocks of granite and gneiss	2
Average value		2

Source: Research's, (2020)

The lithological factor shown in table 4 represents, for the purposes of this investigation, it shows us the different geological formations and the different values of the weights with respect to risk management that must be considered to mitigate the conditioning factors of a natural or caused disaster.

Table 4 - Degree of Susceptibility ( $S_R$ )

Parameter	Value
-----------	-------

Factor weighting (Sm) Creeps	11
Weighting SI Crawls	2
Sc Weighting Creeps	1
Degree of Susceptibility for creeping (SR)	22
Weighing	3
Grade (GR)	High

Source: Research's, (2020)

The degree of susceptibility of occurrence, well as mentioned, corresponds to the degree of predisposition that an area has to a threat being generated in it due to its own conditions. In this sense, table 4 reflects the value of the degree of susceptibility to the type of ground movements creeping which is high.

Table 5 - Seismicity factor ( $T_s$ )

Modified Mercalli Intensity	Qualifier	Richter magnitude (estimated)
X	Quite strong	7
	Weighing	3

Source: Research's, (2020)

Table 6 - Precipitation trigger factor ( $T_p$ )

Average monthly annual rainfall (mm), N> 10 years	Qualifier	$T_p$ parameter value
> 70	High	3

Source: Research's, (2020)

Thus, these factors reflected in table 5 show the seismicity factor and table 6 shows the degree of impact that rainfall has in the Reventador area, as it has a high rating.

## B. Environmental Impact Assessment

For the evaluation of environmental impact in the affected site, it is carried out through the Global Index methodology, which is based on the determination of the global index, based on the quantification of the impact produced on the physical environment and on the perceptual medium. The method is frequently used to assess effects produced by units or construction elements, so it meets our requirements (View Eq. 2).

The Global Index is calculated based on the following equation [24]:

$$I_g = I_m + 0.5 I_p \quad (2)$$

Where

$I_g$  is Global Index

$I_m$  is impact on the morphology or nature of the constructive element

$I_p$  is landscape valuation index

To calculate the impact on the morphology or nature of the building element, it is done using the following equation (Eq. 3):

$$I_m = I_v + I_a + I_f + I_w \quad (3)$$

Where,

$I_m$  is impact on the morphology or nature of the building element

$I_v$  is impact on vegetation

$I_a$  is impact on air quality

$I_f$  is impact on wildlife

$I_w$  is impact on water

To calculate the landscape valuation index, it is done based on the following equation (Eq. 4):



$$I_p = (I_c + I_m + I_n) (I_i + I_p) \quad (4)$$

Where,

$I_p$  is landscape valuation index

$I_c$  is color difference impact

$I_m$  is impact on the morphology or nature of the constructive element

$I_n$  is impact produced by the nature of the constructive element

$I_i$  is implementation rate

Table 7 - Impact Factor on natural vegetation

Effect on Natural Vegetation	$I_v$
High value tree species	9 – 10
Tree species of average value that are easy to repopulate	7 – 9
Monte Bajo, with some tree	5 – 7
Agricultural or orchard areas	5 – 8
Pastures or rustic areas	3 – 6
Semi-arid areas	1 – 3
Arid zones	0 - 1

Source: Ripoll, (2010)

Within the mass movements, the effects caused by the effects on natural vegetation must be considered, which depending on their conditions have a qualification that is described in Table 7 and is a very necessary variable to consider in the evaluation of susceptibility to mass movements.

Table 8 - Impact factor on air quality

Effect on air quality		$I_a$
Discontinuous	Occasional and short-range dust emissions (<1Km), affecting few goods or people	0 - 2
	Idem affected to large or inhabited areas	2 - 5
Continuous	Occasional and short-range dust emissions (<1Km), affecting few goods or people	3 - 6
	Idem affected extensive or inhabited areas	5 - 8
	In case of bad smells the value will be	1,2 $I_a$
	In case of chemical contamination, with sulfur or toxic agents, the value will be	1,5 $I_a$

Source: Ripoll, (2010)

Table 8 describes the impact factor due to air quality where the incidence of this variable in the sector to be evaluated is rated.

Table 9 - Impact factor on animal life

Effect on fauna		$I_f$
Risk of elimination, displacement or reduction of populations of commercial, tourist or cultural interest		6 - 10
Alteration or elimination of terrestrial or aquatic habitats	Moderate	2 - 5
	Intense with nearby alternatives	4 - 6
	Without alternatives	6 - 9

Source: Ripoll, (2010)

Animal life is part of one of the assets of the Reventador locality because it is located within the Cayambe Coca National Park that is part of the National System of Protected Areas, however table 10 shows the impact of the risks caused in the aquatic habitats present in the water sources such as the Coca River, or terrestrial where there are different mammals, reptiles, amphibians, and birds present in the Reventador parish.

Table 10 - Impact factor on water quality

Effect on water quality		$I_w$
Low impact on surface and groundwater		0 – 2
Interception and reduction of surface flows		2 – 5
Alteration or elimination of terrestrial or aquatic habitats	Moderate	2 - 5
	Intense with nearby alternatives	4 - 6
	Without alternatives	6 - 9
Groundwater contamination affects	Human use	2 - 3
	Irrigation, industrial use	3 - 5
	All uses	4 - 6
Surface and groundwater pollution		Suma $I_w$

Source: Ripoll, (2010)

Table 11 – Impact factor for color difference

Color effect element / environment	$I_c$	Color effect element / environment
Visual similarity (not appreciable more than 1Km)	0 - 1	Visual similarity (not appreciable more than 1Km)
Significant tonality difference	3 – 6	Significant tonality difference
Major color differences	Natural colors	6 - 8
	Artificial colors	8 - 10

Source: Ripoll, (2010)

When an intervention is carried out in a project, it is generally given that it may be in harmony with the environment or in turn not, so the variable that has to do with color is important since it has a considerable influence on the behavior of the fauna wild, this has a qualification according to the color effect of the environment, the same as described in table 11.

Table 12 - Impact factor on the morphology of the constructive element

Constructive element morphology	$I_m$
Element shape assimilable to natural morphology	0 – 1
Divergence only in shape, but not in volume	2 – 4
Divergence in shape and volume	4 - 10

Source: Ripoll, (2010)

When an environmental impact is generated, there is a variation in the shape of an element, which is why the factor due to morphology is a basic variable in the evaluation of environmental impacts and the different weightings that are described in table 12.

Table 13 – Impact factor regarding the nature of the constructive element

Nature of the constructive element		$I_n$
Materials analogous to those of the environment		0 – 1
Materials different from those of the surface according to their degree of differentiation		1 - 4
Elements in arid areas without natural sheets	With natural coloring	1 - 2
	With abnormal coloring	3 - 5
Elements in humid areas with natural sheets	With natural coloring	0 – 1
	With abnormal coloring	2 – 4

Source: Ripoll, (2010)

Table 14 – Implantation index of the constructive element

Nature of the constructive element		$I_p$
Materials analogous to those of the environment		0 - 1
Materials different from those of the surface according to their degree of differentiation		1 - 4
Elements in arid areas without natural sheets	With natural coloring	1 - 2
	With unnatural coloring	3 - 5
Elements in humid areas with natural sheets	With natural coloring	0 - 1
	With unnatural coloring	2 - 3

Source: Ripoll, (2010)

Table 15 - Assessment of landscape quality

Landscape quality assessment index	$I_p$
Areas of high landscape value (forests, parks, monuments, etc.)	0 – 0,9
Area of medium landscape value	0,9 – 0,6
Areas of poor landscape quality (arid with little vegetation, monotonous, etc.)	0,6 – 0,4
Areas damaged by human activities (urban, industrial, mining, etc.)	0,4 - 1

Source: Ripoll, (2010)

Depending on the value of the Global Index, a classification of the Total Impact of the construction element considered on the environmental environment can be made [24]

Table 16 - Classification of Total Impact according to the value of the Global Index

Total Impact	$I_g$
Low	<10
Moderate	10 – 20
Medium	20 - 35
High	35 – 50
Critical	> 50

Source: Ripoll, (2010)

The spill of crude oil and derivatives due to the breakage of the flow lines of SOTE, OCP and Poliducto, caused a strong impact that in the Kiwichuas, Panduyaku, Coca River, San Francisco, Panduyaku, Dashino, River Playas Tiger; San Carlos, Shiuwakucha, Bocana del Río Dashino, the level of affectation is 43.9, which is high, that is, its level of affectation is considerable, so cleaning and remediation must be carried out urgently.

Table 17 - Data obtained from field inspections

$I_v$	$I_a$	$I_f$	$I_w$	$I_c$	$I_n$	$I_p$	$I_i$
10	7,5	7	6	8	4	0,9	1
Impact on morphology							$I_m= 30,6$
Landscape valuation index							$I_p= 26,6$
Global index							$I_g= 43,9$

Source: Research's, (2020)

Finally, these factors indicated in the tables reflected, highlight that the global impact index due to the spill problem is 43.9, high, causing damage to water and soil resources, causing damage to the banks of the Coca River where communities Panduyaku, Beaches of the river Coca, San Francisco, Panduyaku, Dashino, Beaches of the river Tigre; San Carlos, Shiuwakucha, Bocana del Río Dashino, in the Gonzalo Pizarro canton. According to the field visits carried out on April 8, 2020, there is a susceptibility degree value of 22, which is high so that in the future there will be more problems of mass movements that cause considerable damage that will risk essential infrastructure.

In the sector, the problems caused by landslides have been continuous, which is why a geological and geotechnical study to determine vulnerability has not been carried out, and there is great uncertainty regarding the extent of the mass movement problem. which implies that it would continue to affect the area. At coordinates 211144 X: 9988016 Y DATUM WGS 84, zone 18S, it is evident that approximately 2 km away there is evidence of mass movements due to creeping which caused the detachment of large blocks of soil which caused the breakage of the pipes of the OCP, POLIDUCTO and SOTE flow lines, causing a spill of crude oil and derivatives.

The amount of oil spilled in the SOTE line is 350 barrels, on the other hand, the OCP flow line, due to the breakage of the optical fiber, a warning was given, and a contingent measure was taken to close the flow, it is unknown the amount of spilled derivatives.

## 5. Results

El Reventador parish, because it is in the foothills of the eastern mountain range of the Andes, has strong, rugged and sharply dissected reliefs, limiting its use for agricultural activities, in all the relief units there are steep slopes.

In the Simón Bolívar and Atenas Precincts, located in the lowest part of the parish, there are low reliefs, with low hills.

Table 18 - Description of geomorphological units in the parish

Description of the relief	Hectares	Percentage
Discharge cone, slightly wavy	9,48	0,01%
Steep ridges in sandstone rocks	1836,42	1,89%
Abrupt edges, with irregular slopes	9334,68	9,63%
Natural water bodies	606,80	0,63%
Glacial valley bottoms filled with glacial deposits. Wavy relief	3148,74	3,25%
Walls of glacial cirques, ariscas and various volcanic peaks	212,13	0,22%
Rough and unstable relief	760,01	0,78%
Sharp dissection relief, long and strong slopes	2017,72	2,08%
Strong, irregular relief, elongated hills	5591,61	5,77%
Wavy to slightly sloping and dissected relief	439,46	0,45%
Smooth wavy relief, moderate dissection	486,33	0,50%
Wavy relief, smooth, moderate dissection	113,97	0,12%
Undulating sloping reliefs shaped by Quaternary glaciers	2065,27	2,13%
Sharp and rocky reliefs	416,91	0,43%
Sharp dissection reliefs, regular slopes, very dense hydrographic network	4865,80	5,02%
Strong to very strong heterogeneous reliefs, highly dissected	11928,16	12,30%
Low to moderate homogeneous reliefs	56,87	0,06%
Soft to moderate wavy relief, variable dissection	3,75	0,00%
Medium to strong relief, elongated and decreasing ridges of acute dissection	27716,57	28,58%
Upper surfaces, slightly sloping to the east, low, rounded hills	894,98	0,92%
Middle alluvial terrace	243,80	0,25%
Sheds of old cones and boilers	7933,50	8,18%
Slopes and steep slopes of ravines, canyons, chevrons and deeply declined areas	16292,93	16,80%
TOTAL	96975,89	100,00%

Source: Research's, (2020)

In most of the parish territory there are heterogeneous strong to very strong reliefs, very dissected. In this sense, it is highlighted that in the El Reventador parish there are limitations in the productive activity since they are marginal areas for agriculture, 34% are suitable for pasture and 28% comprise conservation areas in order to maintain the flora and the fauna, it must be taken into account that the entire parish is located within the Cayambe - Coca National Park, so no productive activity should be carried out, but in certain regions there are considerable socio-environmental problems.

Table 19 - Description of the Productive Aptitude zones

Description	Área	Percentage
Rocky loosening	11442,53	11,80%
Agriculture with important limitations, very difficult mechanization and specialized irrigation	2612,99	2,69%
Agriculture with important limitations, protection measures, recommended exploitation	61,73	0,06%
Agriculture with moderate soil limitations, easy mechanization, and easy to difficult irrigation	62,99	0,06%
Agriculture with very important limitations, totally specialized irrigation, mechanized not recommended	5878,05	6,06%
Natural water body	606,81	0,63%
Land suitable for protective forests or wildlife maintenance	27370,77	28,22%
Land suitable for forestry purposes, significant constraints (forestry), dual purpose	6250,95	6,45%
Marginal land for agriculture, suitable for pasture, major constraints	33136,6	34,17%
Land not suitable for agricultural or forestry production activities, permanent limitations	9552,47	9,85%
TOTAL	96975,89	100,00%

Source: Research's, (2020)

The lower parts of the parish where the Simón Bolívar and Atenas precincts are located, there are soils that provide facilities to carry out agricultural productive activities, it should be mentioned that, if there are considerable limitations in part of 65% of these sectors, but the section with greater potential to develop this activity. As mentioned in advance, the Cayambe - Coca National Park, 94.13% of the territory, has primary forests so it is covered with natural vegetation, being one of the tourist attractions to highlight in the area, it has an area of 91,550.00 hectares, the rest is covered with grasslands.

Table 20 - Description of the Ecosystems within El Reventador Parish

Ecosystem	Área (Ha)	Percentage
Water bodies	64,2	0,07%
Evergreen shrub and paramo grassland	1480,5	1,53%
Evergreen wasteland forest	31,7	0,03%
High montane evergreen forest in the north of the eastern Andes	24351,4	25,11%
Low montane evergreen forest in the north of the eastern Andes	21605,5	22,28%
Montane evergreen forest north of the eastern Andes	36951,3	38,10%
Evergreen piemontano forest in the north of the eastern Andes	3608,3	3,72%
Páramo grassland	29,8	0,03%
Intervened areas	8548,2	8,81%
Other areas	304,99	0,31%
total	96975,89	100,00%

Source: Research's, (2020)

## Conclusions

Sustainable Risk Management and Rural Tourism as a strategic factor for the safety of destinations determines a before and after when it comes to environmental situations that are fortuitous and foreign. The necessary articulation relationship between economic growth, local development, environmental conservation, and tourist security, increasingly occupies growing spaces in international debates, especially for those countries that have great options for sustainable development. There is no pre-established formula where the area is approached in the same way since local sustainable development would be largely determined by the socio-economic and environmental integration of those factors that are part of a region or a town where local government agents Tasks the use of both endogenous and exogenous resources can create continuous improvement to achieve the optimal state of quality of life in rural communities and consequently strengthen tourism.

In the Stockholm Declaration on the human environment [25], it was characterized as the first response at the international level on environmental problems, recognizing that there was a global impact on this matter. This global collective action, mainly aimed at recognizing common environmental problems, suggested 26 principles to carry out an action plan with 108 recommendations that would lead to the reduction of environmental problems. Likewise, financing mechanisms were proposed to encourage the development of environmental management programs worldwide.

Even though this declaration was an effort to put global environmental problems on the international public agenda, it has not had the expected repercussions, highlighting that the term sustainable development does not appear in the Declaration, the relationship between development and other variables such as social welfare, equity, equality if they are presented in the content and scope of said manifesto [25].

As has been expressed in this paper, there are many aspects that are taken into account in terms of the environment, sustainable development, risk management and rural tourism, however it is necessary to highlight in this analysis in relation to these factors mentioned that the communities Panduyaku, Beaches of the Coca River, San Francisco, Panduyaku, Dashino, Beaches of the Tigre River; San Carlos, Shiuwakucha, Bocana del Río Dashino, in the Gonzalo Pizarro canton, even though the spill occurred upstream in the Gonzalo Díaz de Pineda sector, of the El Chaco canton, of the Napo province, should find answers in public policies. to their needs and aspirations in the municipality, considering that these aspects maintain the most direct link between the communities and the government, hence assuming the importance of addressing these environmental disasters that significantly affect local development and therefore rural tourism in the zone.

However, the analysis should reflect from the governmental, economic, social and rural sphere to consider the following considerations to guarantee sustainable development and avoid the risks inherent in the Reventador area, thus promoting factors such as rural tourism:

- Consider a comprehensive and systemic approach to social development, which will link the environmental, economic, productive, socio-cultural, tourist and institutional dimensions in an insertable way
- Making the most of the spaces and channels of community participation with the tourist destinations of the area.
- Encourage knowledge management, innovation, and technology transfer, seeking appropriate solutions to the environmental risks raised in the Reseller.
- Mobilization of potential productive entities of the geographical and environmental characteristics of the area and / or territory, considering the local / rural human capital with its own indigenous values of the community.
- Need to preserve animal and plant species typical of the El Reventador parish.
- Minimize adverse impacts on air quality, water, and natural elements to maintain the global integrity of ecosystems.

The foregoing reverses the preponderance transferred to sustainable development in those sectors of society that constitute an added value to the economic, social, cultural and tourist growth of the areas. Thus, attending to options to create bases for tourism strategies that are key to sustainability, generating actions towards a planned policy from appropriate government sources to respond to the problems of misuse of natural and human resources, as well as the need to incorporate medium strategic plans. and long term, where community needs and aspirations that promote equity, equality and justice are satisfied, as well as the balance between costs and benefits of the decisions made based on the purposes required to promote development.

## References

1. Sforzi, F. and Amin, A, *The Institutions of Local Development*, Routledge, 2003.
2. Granovetter, M. *The Sociology of Economic Life*, Routledge, 2011.
3. World Tourism Organization, UNWTO. "Tourism Highlights, 2003", World Tourism Organization, <https://www.e-unwto.org/doi/book/10.18111/9789284406647>
4. Reisinger, Y. and Dimanche, F. *International Tourism*. Routledge, 2009.
5. González, M., & Rodríguez, M. (2016). Gestión sustentable de riesgos y crisis en el turismo mexicano y latinoamericano como problema estratégico para la seguridad de los destinos. Implicaciones para Ciudad Juárez, México. Universidad Autonoma de Mexico, 1-25.
6. Herrera Manuel Ramón González and Mercedes de los Ángeles Rodríguez Rodríguez. "Gestión Sustentable De Riesgos Y Crisis En El Turismo Mexicano Y Latinoamericano Como Problema Estratégico Para La Seguridad De Los Destinos. Implicaciones Para Ciudad Juárez, México". *European Scientific Journal*, ESJ 12, no. 11, 183 (2016), <https://doi.org/10.19044/esj.2016.v12n11p183>
7. Keller, E., & Blodgett, R. *Riesgos naturales: procesos de la Tierra como riesgos, desastres y catástrofes*. Pearson Education, 2007.
8. Food and Agriculture Organization of the United Nations, "Food should be a national security issue, 2009," FAO, <http://www.fao.org/news/story/en/item/8967/icode/>
9. Global Sustainable Tourism Council, "Using Standards to Scale Sustainability in Tourism» case study in the One Planet – Sustainable Tourism Programme 2019 Annual Magazine," <https://www.oneplanetnetwork.org/resource/one-planet-network-2019-annual-magazine>
10. Sustainable Tourism & Responsible Travel, "Sustainable Tourism is Wicked, 2017," Sustainability in the Tourism System, <https://sustainabletourismandresponsibletravel.com/sustainable-tourism-is-complex-and-complicated-it-is-a-wicked-problem/>

11. Morales, N. and Gómez, G. "Identification of the tourist's perception towards the destination Cuenca-Ecuador, through "Netnography," *Retos*, 10, no. 19 (2020), <https://doi.org/10.17163/ret.n19.2020.05>
12. Mullo, E. and Padilla, M. "Cultural diversity and its impact on community tourism of Andean region," *Siembra*, 6, no. 1 (2018), <https://revistadigital.uce.edu.ec/index.php/SIEMBRA/article/view/1707/1673>.
13. Reck, G. and Martínez, P. "Áreas protegidas: ¿turismo para la conservación o conservación para el turismo?," *Polémika*, 12, no. 5 (2017), <https://revistas.usfq.edu.ec/index.php/polemika/article/download/955/1135/>
14. Plan de Desarrollo y Ordenamiento Territorial (PDOT) 2019, <https://www.planificacion.gob.ec/wp-content/uploads/downloads/2019/08/Folletos-autoridades-provinciales.pdf>
15. Geophysical Institute of the National Polytechnic School, IGEPN. "The earthquakes in the north-east of the equator on 5 March 1987,". 2012, <https://www.igepn.edu.ec/servicios/noticias/601-los-terremotos-del-nor-orientedel-ecuador-del-5-de-marzo-de-1987>
16. GADP El Reventador. "Development and Territorial Ordering Plan," 2016, <https://gadreventador.gob.ec/wp-content/uploads/2016/03/POA-2014.pdf>
17. Rainforest Alliance. "Estandar de agricultura sostenible de Rainforest Alliance 2020," 2020. [https://www.rainforest-alliance.org/business/wp-content/uploads/2020/06/Esta%CC%81ndar-de-Agricultura-Sostenible-de-Rainforest-Alliance-2020\\_Requisitos-Para-Fincas.pdf](https://www.rainforest-alliance.org/business/wp-content/uploads/2020/06/Esta%CC%81ndar-de-Agricultura-Sostenible-de-Rainforest-Alliance-2020_Requisitos-Para-Fincas.pdf)
18. Constitution of the Republic of Ecuador. National Assembly, 2008. <https://www.cec-epn.edu.ec/wp-content/uploads/2016/03/Constitucion.pdf>
19. UNOHBITAT Ecuador, "Organic Code of Territorial Ordering, Autonomy and Decentralization," 2010. [https://urbanlex.unhabitat.org/sites/default/files/codigo\\_organico\\_de\\_organizacion\\_territorial\\_autonomiautf-8q\\_y\\_descentraliz.pdf](https://urbanlex.unhabitat.org/sites/default/files/codigo_organico_de_organizacion_territorial_autonomiautf-8q_y_descentraliz.pdf)
20. National risk management system, SNGRE, Ecuador, 2020. <https://www.gestionderiesgos.gob.ec/orellana-en-emergencia-por-derrame-petrolero-en-sucumbios/>
21. DerechoEcuador. "Official Register Supplement 160 of March 12, 2020," 2020. <https://www.derechoecuador.com/registro-oficial/2020/03/registro-oficial-no160-jueves-12-de-marzo-del-2020-suplemento>
22. Republic of Ecuador, "Supplement to Official Registry N ° 163 of March 17, 2020, decree no. 1017 (state of emergency for public calamity in the whole national territory by cases of covid-19)," 2020. <https://www.finanzas.gob.ec/wp-content/uploads/downloads/2020/04/ANEXO-No.-1-DECRETO-ESTADO-DE-EMERGENCIA-1017-MARZO2020.pdf>
23. GEOLOGÍAWEB, "Deslizamientos de tierra y sus tipos," 2020. <http://www.geologiaweb.com:https://geologiaweb.com/deslizamientos/>
24. Ripoll, V. *Guia metodológica para la evaluación del impacto ambiental*. Mundi-Prensa, 2010.
25. United Nations. "Declaration of the United Nations Conference on the Human Environment," 1972. [https://www.ipcc.ch/apps/nj-lite/srex/nj-lite\\_download.php?id=6471](https://www.ipcc.ch/apps/nj-lite/srex/nj-lite_download.php?id=6471)