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Risk Management on Territorial Planning Galeras Volcano Case, Colombia

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Abstract: Concerning the latent issue originated by the reactivation of Galeras Volcano (Colombia), that endangers more than 500.000 inhabitants, and considering the need to contribute with some theoretical and methodological arguments. This research was developed in order to provide a clear picture of the generalities of the variables that intervene in the risk management of volcanic risk, so that, a qualitative research can reflect on its particularities understanding how they can modify its entirety, and then make concrete proposals for territorial planning.

A matrix of the most important variables that intervene on risk management is proposed, considering issues such as inclusion on territorial planning where the set of interrelationships, the role of each actor can be understood as well as how the use of a specific variable in the whole chain can be reactivated both in positive and negative ways. The matrix is explained by concrete experiences of the application of risk management in the Galeras Volcano case.

Keywords: threat, risk, risk management, resilience, regional planning

1. Introduction

The Galeras Volcano is located at Los Andes Mountain Range in the Southern part of Colombia. Galeras is considered as one of the most active volcanoes of the Country, according to the Catalogue of Active Volcanoes of the World (CAVW) of the International Association of Volcanology and Chemistry of the Earth's Interior, it receives the code 1501-08, and on its slope is located the city of San Juan de Pasto. From its last reactivation, on 1988 until now, very little has been learnt on volcano risk management. Thus, considering the need to contribute with some theoretical and methodological elements that help to minimize the risk to a population of more than five hundred thousand inhabitants, located under its influence area, this research was developed from an

urbanism perspective. Here, using the Complex System Theory, behaviour and interrelations of the main variables that intervene on risk management are explained, in order to make proposals on territorial planning working towards a more resilient region.

In the case of the Galeras Volcano, this project analyses the progress of inclusion of volcanic risk management on territorial planning, which are the contributions and shortcomings both, on deployment and on practical applications. By means of the application of the Comprehensive Assessment (CA) methodology, which has been used to study environmental issues, this paper tries to understand the perspective of each one of the players and their performance concerning volcanic risk, in order to provide proactive proposals that consider all the players to reduce risks.

In order to apply the Comprehensive Assessment method, a matrix is proposed that incorporates political-administrative, socio-cultural and physical-

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natural components with the most important variables that intervene on risk management and the inclusion on territorial planning. In order to understand the set of interrelations, the role each actor plays, the intervention needs of disciplines associated to both social sciences and Earth sciences and to explain how, from a specific variable, it is possible to reactivate the whole chain in both positive and negative manners. Matrix behaviour is explained from the application to different examples of concrete experiences on risk management in the Galeras Volcano case, as a starting point to enunciate proposals for the sake of resilience of the city of Pasto and the influence region of the volcanic threat (see Fig. 1).

2. Semantic Clarifications

Concerning the confusion usually found regarding the application of different terms related with risk management, that is, those that are used indistinctly and confused as synonyms, it is worthy to add the meaning related with the technical specificity of this case, supported by the definitions of the Secretariat of the National Strategy for Disaster Risk Reduction EIR-UN (2014) [1]:

Threat: (1) Something evil or harmful: A situation that is impending for someone or something. (2) Physical event potentially harmful, natural phenomenon and/or human activity that may cause death or lesions,

material damages, interruption of social and economic activity or environmental degradation.

Disaster: (1) Heavy disgrace, unhappy and unfortunate event. (2) Serious interruption of the functioning of a community or society that causes human losses and/or important material, economic or environmental losses; exceeding the capacity of the affected community or society to cope with the situation using its own resources.

Resiliency: (1) Adaptation capability of a live being against a disturbing agent or an adverse state or situation. (2) The capability of a system, community or society, potentially exposed to threats, to adapt to an adverse situation resisting or changing in order to reach and keep an acceptable level of its functioning and structure.

Risk: (1) Contingency or proximity of harm. (2) The probability of harmful consequences or expected losses (deaths, lesions, damage to properties, sustenance, and/or interruption of economic activity or environmental decay) result of interactions between natural or anthropogenic threats and vulnerability conditions.

Vulnerability: (1) Susceptible of being hurt or harmed in a physical or moral manner. (2) Conditions determined by physical, social, economic and environmental factors or processes that increase susceptibility and exposure in a community to the negative impact of threats.

3. The Relevance of Risk Studies

The issue of risk and its management associated to the natural origin phenomena becomes relevant due to the importance of planetary changes on an international level, which are highly connected to the environmental issues of biosphere integrity, sustainable development, urban resiliency and sustainable city among others. Risk management deals with sustainability. For sustainable societies, the paper considers them as culturally diverse communities that cohabit in diverse territories identifying themselves as



Fig. 1 Location Galeras volcano.

part of the environment, that acknowledge and operate inside ecological and planetary frontiers, being less reactive and more preventative against natural origin phenomena that create risks.

Risk management also makes part of Sustainability Sciences, an emerging knowledge field that analyses interactions among social and natural systems and how these interactions affect economic, social and environmental sustainability. The inclusion of the human and ecological dimensions in the analysis makes sciences and risk management a mandatory topic for an interdisciplinary approach. A genuine sustainability includes risk management on its interest to build a diversity of proposals, both social, historical and culturally heterogeneous, that strive to transcend the transgression of the planetary ecological frontiers, where natural phenomena set limits against the land occupation.

4. On resiliency and Resilient Communities

Resiliency has been a trending topic at a national level due to programs like those launched by the United Nations regarding city resiliency and due to sponsorships issued by the Rockefeller Foundation, for the program 100 Resilient Cities in the world. Currently, the term is strictly associated with the field of risks and disasters in cities: “for some years now, the notion or concept of resilience is everywhere in the rhetoric of disaster reduction. The growing mobilization of this term is evident in the discourses and actions of international institutions regarding public policies and the scientific field. This discourse is especially notable concerning cities” [2].

When certain types of political rhetoric associated with resilience are assumed, it is easy to fall prey to danger and deviations. More frequently, the impossibility of eliminating risks and limitations on public prevention policies is admitted and responsibility is shifted to individuals and local communities and the focus moves to prepare for crisis management and development of adaptation

capabilities. Resiliency, unlike some people, want to show, is not the opposite of vulnerability, as someone can be very vulnerable and very resilient at the same time. The normal functions can be recovered after a disaster, but people can still be vulnerable; this kind of risk cannot be suffered by the communities of this area as they count with scarce resources, therefore, being vulnerable on physical and socioeconomic terms. Thus, “socioenvironmental resiliency” cannot be built in a comprehensive way but from the co-production of knowledge through a praxis focused and backed by social consensus” [3], where the State and its institutions with their public and planning policies play an essential role.

Resiliency cannot fall prey to only acting reactively, waiting for the disaster to happen, resiliency, above all, shall be in the capability to anticipate and plan. “A plan that anticipates the effects of future disasters can help a city to endure them and to be rebuilt whenever it is necessary. Therefore, recovering capability is strongly influenced by the quality of local management, the capability to anticipate to events and to fulfil the plans, the information availability, the infrastructure capability and the services the city provides” [4]. In addition, it is relevant to clarify that the entire burden does not rely solely on the local management, the region and the national levels also have importance and responsibilities; the public policies are the first guardians of the life and welfare of the citizens.

Specifically speaking about volcano risk management, instead of resilient communities understood as those that adapt to the consequences of a disaster, Communities should be aware of risks and willing wherever possible, to evade them, avoiding inhabiting or increasing the demographic density on clearly identified threat areas, counting with support from local, regional and state public policies. The danger of interpreting resiliency as the capability to recover after an accident, and waiting for it to happen before highly destructive threats such as a flow of

pyroclastic material and lava, where no living being can survive, if people were aware of the risk they represent, the best resilient attitude would be to evacuate the exposed areas.

5. The Volcanic Threat

Even though this paper arises from the interest to study the latent issue originated by the reactivation of the Galeras Volcano, and its effect on the city of Pasto. Located in the Southern part of the Republic of Colombia with more than 500.000 inhabitants, settled in its influence area with 11 municipalities. The volcanic risk is a reality that affects many populated areas and it shall be tackled by the commitment of all the actors that participate, whether institutional or individual.

There are hundreds of active volcanoes around the world associated to withdrawals of tectonic plates and part of the ever-shifting geological structure of planet Earth, as natural phenomena, they have always existed, and are inherent to the geomorphological evolution of the Earth. Moreover, given that the soils of the influence areas are usually rich on organic matter, historically populations have always preferred them to settle; for the indigenous communities located there, a volcano represents a milestone in their worldview. There are many cities and millions of inhabitants that, due to their status under the influence area of an active volcano have been threatened by possible eruptions with a large magnitude. In the American continent, capital cities such as Mexico City, Quito and San José de Costa Rica and tens of intermediate cities and towns are associated to volcano influence areas, especially in Los Andes Mountain Range.

So far not much has been done on volcano risk management, as the scientific progress on volcano knowledge is recent and the incorporation of technological advances for real-time monitoring of their behaviour started at the end of the last century. This, in turn, has affected the lateness of public policies that involve risk management on territorial

planning as an urgent measure to minimize the vulnerability of the populations that settle in those areas.

6. Social Construction of Risk Perception

When the determination of cultural patterns is considered, one should think about risk management, and in order to do so, understand how a society has built its own concept of risk is essential. People experience different extreme circumstances; from those that do not perform any action, as they take for granted the natural threat as part of a mythical-religious vision; to natural scientist rigour perspectives that consider as a sole purpose the definition of a risk degree. Including the current era of the neoliberal globalization where from an economist point of view everything is governed by the market criteria and the responsibility of each individual.

Only until the sixties, a sociological trend started that was bound to the social research of disasters, the studies developed were located in a marginal field in comparison with those performed by the natural and engineering sciences. As Social Sciences flourished from the philosophical contributions presented by Feyerabend (1991) [5] with his knowledge ethnography and Habermas (1988) [6] with his dialectics of the whole, a new paradigm appears to understand the notion of risk and its expression on disaster, where different cultural, political and socioeconomic visions are considered, on what is considered as the social construction of the risk notion.

To move forward on the commitment of the affected population with risk prevention, it is important to arbiter on the social construction of risk; this construction shall incorporate the understanding of target phenomenon and the subjective perception of risk that the affected communities have. Even though the contribution of the Earth sciences is going to be essential to evaluate the threat, the contribution of the

social sciences will be just as important to be able to determine vulnerability.

7. Current Paradigm on Risk Management

Risk management, in a wide sense, has been tackled recently, just after the declaration of United Nations of the decade of disaster management and risk prevention in 1990, and particularly with the United Nations Environment Program UNEP. The program fostered, promoted and supported the States so that they commit to including risk management in their territorial planning systems; for example in Colombia's case, only after the enactment of decree 1807 of September 19, 2014, a normativity was set forcing the municipalities to incorporate risk as an important variable to take into account in the Land Development Plans. Specifically for volcano risk management, the consideration of its relevance is even smaller, as this variable, being less recurrent on time (but even more catastrophic when happens) is handled by including it on the generality of risk management, without considering the precisions deserved by its specificities.

On an international institutional level, there have been great strides from the inception of risk management of a reactive perspective, where the focus was on acting after a disaster happened, to a proactive approach that strives for prevention above all in order to avoid or minimize the risk. This situation among others results of different international commitments such as The Millennium Development Goals (2000), Rio plus 20 (2012), Sustainable Development Goals (2015), Resilient Cities (2015), among many others, bind the States and their institutions to undertake tasks and assign resources to prevent risks.

The work of A. Quispe (2011) [7] in Brazil proves that in terms of risk management experiences on land planning, specifically for Latin America the normativity is new and is just being included on the Ecological and Economic Zoning and Land Management. Those tools that favour the application

of risk management approach, when the negative effects of the human intervention on the territory are reduced, also show that, while normative frameworks have been created under the risk management and adaptation to climate change topics on a national and subnational level. It is still needed to foster changes and some adequate measures through which such standards can become effective.

8. Risk Management and Regional Planning

The global neo-liberal rationales that currently prevail in the policies of our States, forces them to use fewer resources in correlation to the welfare of its residents, because of deregulation and privatization. This, in turn, limits its welfare-oriented approach to education, health and social services, and imposes the determination to transfer to the individual all the responsibility for his/her well-being including taking all types of risks. In line with this logic, regarding risk management and planning, the state wants the individuals to undertake the largest share of the risks, opening a space for the insurance markets to act in the protection field, which in turns ends up transforming the security into another commodity. In order to guarantee the mobility of the assets between regions and countries, the economic globalization demands from the countries that barriers such as "Planning and environmental controls, as well as other focused impediments were to be eliminated, except in those areas that are essential for the national interests" [8].

As a response against this dichotomy posed by the global phenomenon, it is important the role presented by the locality and the region. The global market cannot exist without the contribution of the infrastructure provided by the location, as the former is the place where production processes are developed, the two trends, globalization and localization became two faces of the same coin: one needs the other. Understanding how these dilemma and gathering guidelines contribute to creating criterion to understand which shall be the answer from the regions

as they move towards a sustainable development on a human scale is the challenge that encourages the reconceptualization of many disciplines that in their fields of study are related with the spatiality phenomenon. As Escobar (2000) [9] puts it, conceiving the return to the location or the defence of the location as projects are not irrelevant questions, this is a known trend that proposes a “resistance theory as a response to the globalization theories”. The ‘local’ knowledge, in itself, is a proper label for the cognitive and experimental mechanisms that are at stake in the relations of people with non-human environments.”

9. Integrated Assessment (IA) Method

In the search for a new approach demanded by the complex problems, there are methodological approaches such as the Participatory Integrated Environmental Assessment, used for the analysis of environmental issues. It is inspired by the theoretical framework of the integrated assessment IA and aims to go beyond the research that is done from a single disciplinary approach or from the typical triangulation of social sciences. This approach develops dialogical participation procedures and aims to interconnect non-expert knowledge with expert sources.

This new research line arises due to the nascent existence of structured processes to tackle high complexity issues interconnected in different levels, in temporal, spatial and social terms, and goes beyond the situation analysis, adding a higher number of variables and relations, and above all considering the largest diversity of social, economic and political interests; and as such, it tries to produce new knowledge. In the last years, it has been applied as a new method to solve complex environmental issues and it is positioned as a new perspective for risk management.

Comprehensive Assessment tops the linear scientific model that provides expert input to the politician as it takes into account the inclusion of new

phenomena and the opinion of new agents through oral stories, reports from local newspapers and beliefs and values of the communities. As Tàbara (2003) [10] states it, on its implementation three stages are developed: first, it structures the problem, analyses it from its different variables and finally, communicates its results to the concerned users. IA’s main purpose is to become a new way to integrate qualitative and quantitative knowledge; it is not limited only to know the view of the people or what they need to know to give an opinion.

10. Risk Management Matrix

From the synthesis of different schemes and diagrams about how to tackle the risk such as Cardona (2010) [11], IAR-UN (2014) and Lavell (2011), and facing the need to integrate different dimensions that generally work in a sectioned manner from each one of the disciplines, this matrix is proposed (see Fig. 2) which includes the most important variables that intervene both on risk management in general, as on its inclusion on the territorial planning. The matrix comprises three large categories called political-administrative conditions, where variables related with the State role and its institutionality to guarantee the citizen security are included; as well as cultural and socio-economic conditions that gathers the variables related with the vulnerability of the inhabitants; and the physical-natural conditions that have a relationship with the variables that help to determine the level of threat.

If the Matrix is seen in depth, the complexity of the risk management can be understood when showing the set of interrelations, both direct and indirect between the different variables, the role of each player and how from a specific variable the whole chain can be reactivated in a positive and negative manner. As a practical exercise, the Matrix is explained from different concrete experiences on the application of risk management and territorial planning for the case study of Galeras Volcano.

A single natural phenomenon can produce more than one type of threat. This necessarily implies analysis and proposals clearly differentiated for each particular risk generated. The application of the proposed matrix should be executed for each type of specific threat, for example, for the case of volcano

activation, ash fall, pyro clast fall, lahar fall, lava flow and shockwaves it has to be applied on each one. Each case requires its own treatment and therefore not only several threat maps are produced but different risk maps for a single phenomenon as well.

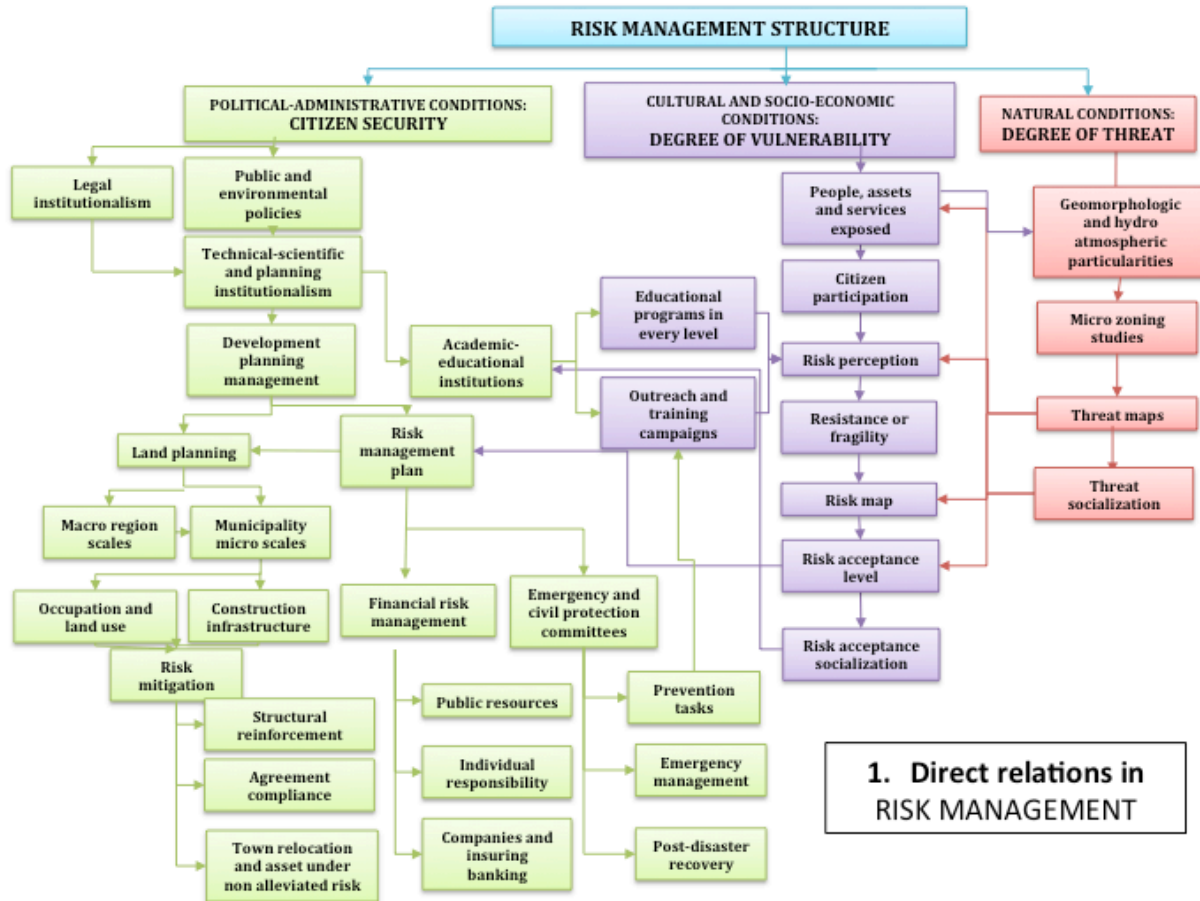


Fig. 2 Risk management Matrix

The proposal of the Risk Management Structure Matrix helps to understand the complexity of the big set of variables associated with the different dimensions. Transformed into a guide to visualizing the path to follow on risk management and as a methodological tool, the Matrix helps both to visualize intervention alternatives as to evaluate progress, merits and drawbacks on risk management and on its proper inclusion on territorial planning.

11. Different Ways to Activate the Risk Management Matrix

In a normal process, risk management interrelations function according to the matrix in a direct manner and on its vertical structure, but the ways in which the process is activated from any of its variables can be quite diverse; an example below is how the matrix is activated from a citizen partition (see Fig. 3).

For the analysis of the Galeras volcano risk management, an exceptional situation occurred: during the relocation process executed by the Colombian State of the population located in the Area of High Volcanic Threat of the Galeras Volcano (ZAVA), the state was negotiating with each one of

the inhabitants and their families to purchase their properties. Each family had to solve its housing situation individually. This process has been heavily questioned for breaking the social tissue of the sector, and this process especially received a lot of rejection by the Jenoy indigenous community. On the other hand, some inhabitants that were left at the other side of the borderline that established the division of the high threat zone, were excluded from the relocation program and faced a complete refusal for their inclusion, therefore organizing and requesting a writ of protection for the right to decent housing (Item A in Fig. 2) against the Colombian Risk Management Unit, responsible of the resettling process. After a whole process of negatives, the writ came to ears of the supreme jurisdictional entity of Colombia (item B, Fig. 2), using as main rationale that the information with which ZAVA was defined was obsolete as it belonged to the 3rd version of the Galeras Threat map that was created on 1997. In fact, the Constitutional Court in its Ruling T-269/15 of 2015 ruled in favour to the claimants and urges the technical-scientific institutionality in charge to produce the official maps

of volcanic threat, specifically the Colombian Geological Service (item C, Fig. 2) to produce a new map. Thus, in December 2015 an update of a new set of volcanic threat maps is released. This map keeps elements of the prior map but effectively increases notoriously the delimitation of the threatened areas, for example, the strip of the lahar flow zone that crosses the city of San Juan de Pasto which was considered as a middle threat zone now is considered a high threat zone. Therefore, if the main inputs used to build the risk scenarios are considered: risk management and relocation programs and specially the Land Development Plan of the municipalities in the influence area of Galeras Volcano; clearly all the norms, rulings, plans and programs that make a reference to the volcanic threat maps also need to be updated. This is an example of how a small-organized group that uses the mechanisms provided by the law can effectively act so that its rights are upheld, mostly by making use of the new information and technology available to update the risk management and territorial planning inputs.

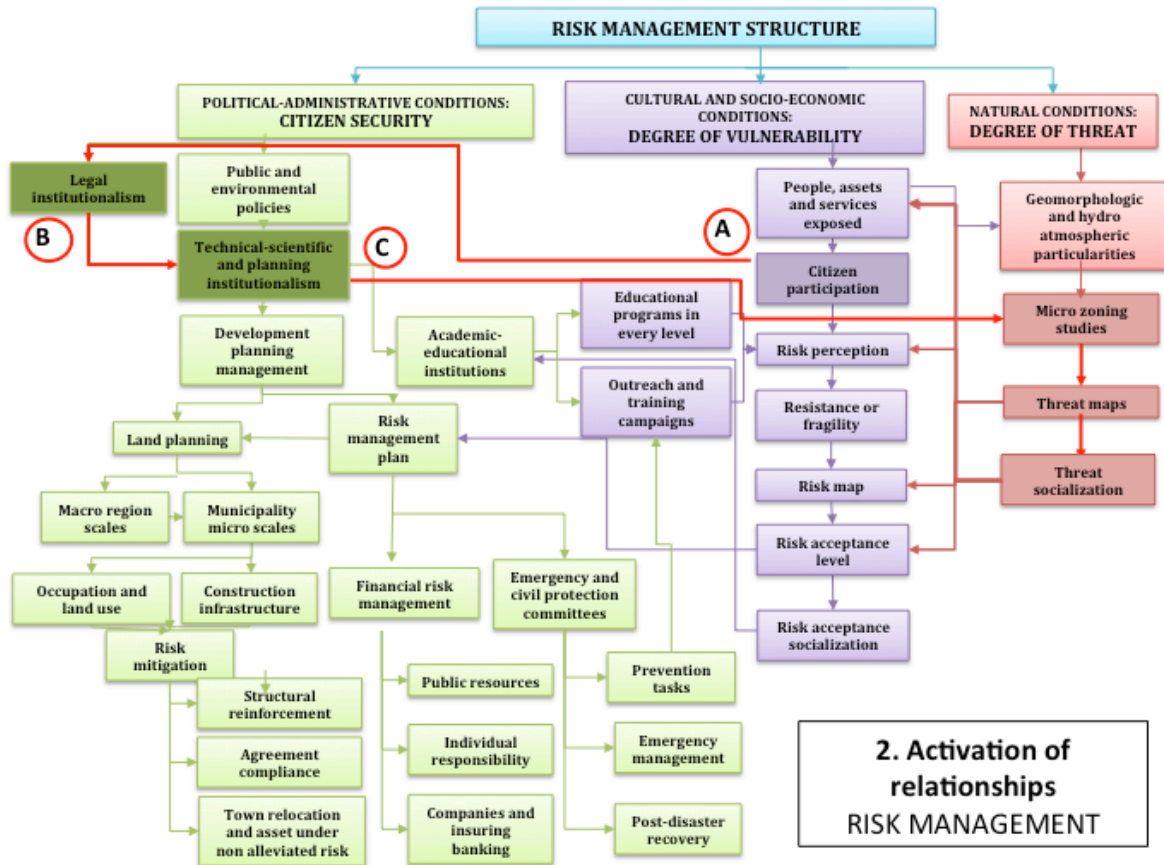


Fig. 3 Risk management matrix activation.

12. The Wide Range of Interdisciplinary Nature on Risk Management Matrix

In the former matrix, the exercise of understanding which is the role that each professional of the different disciplines shall play is posed. Territorial planning is not a topic that is seen from a sole sector but from real interdisciplinary teams, and when the risk management variable is incorporated, there are many more specialists from other fields that would help to understand and to propose explanations of its function and the interaction of the social being with the territory he/she inhabits. For example, in the specific

case of the study of the different threats and therefore of the different risks caused by a volcanic activation phenomenon there are many multidisciplinary teams that intervene; professionals from very specific knowledge fields such as volcanologists and geophysicists are not only added to the staff, but they start interacting with other teams, because it is not only about incorporating new knowledge, but how it is provided and adopted by the other actors, and above all, how are they understood by the communities affected by the possible risks (see Fig. 4).

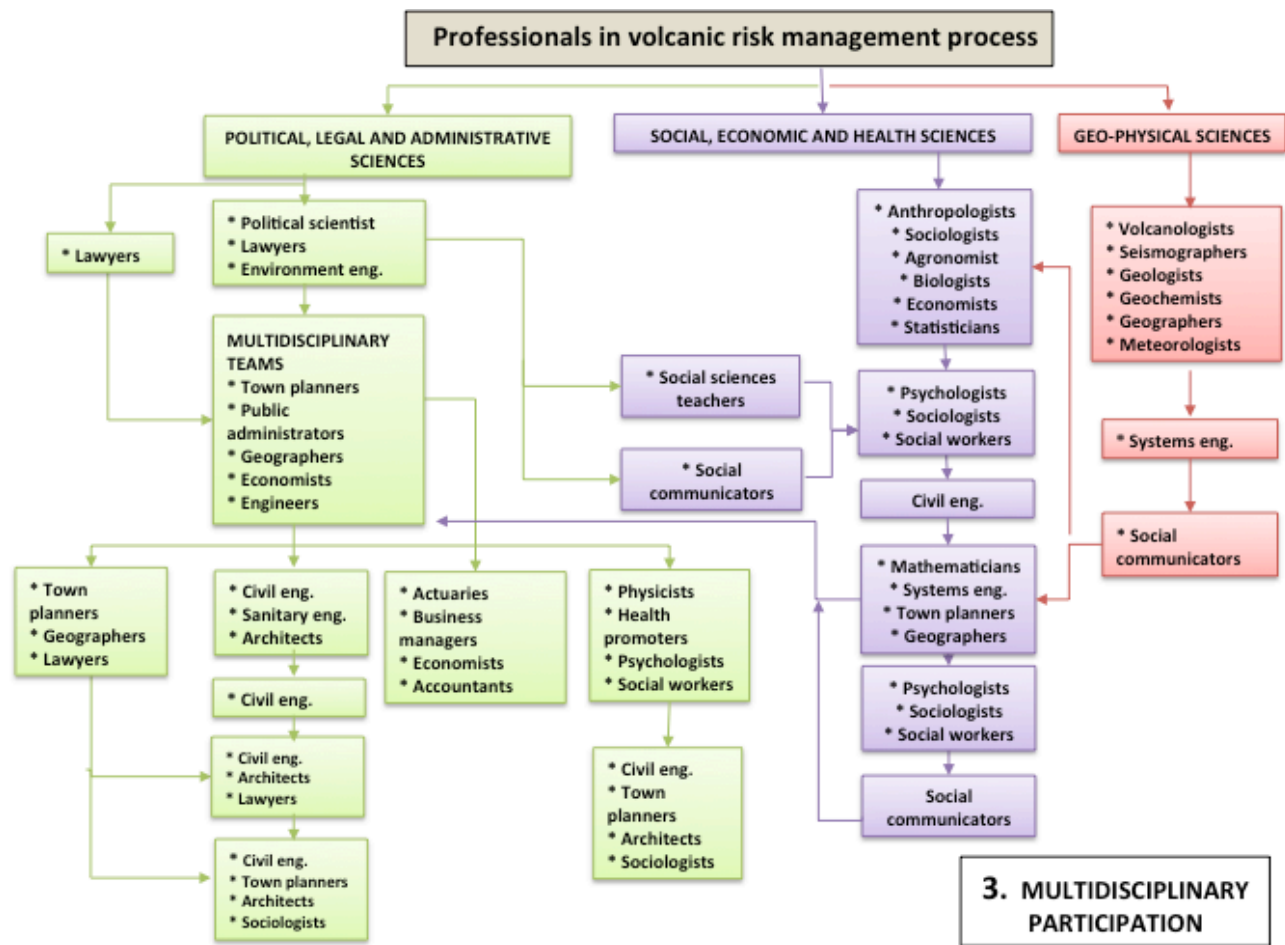


Fig. 4 Risk management multidisciplinary participation.

13. Final Remarks

The inclusion of the risk management variable, on territorial planning, is a relatively new component. It has to deal more with the association made with sustainability issues and urban resilience, which are in vogue nowadays, than to the high pertinence concerning securing the lives of the inhabitants. Especially, when the population exposed increases in a more urban society, their theoretical and methodological proposals under elaboration and within, the role of the different space and territory designers bear a higher transcendence.

Risk as one of the largest variables of the environmental dimension became important in land sustainability and in that sense the contribution it can make from the land use or occupation to minimize or avoid the risk associated with the natural phenomenon

is big. Moving towards risk management process implies its inclusion on territorial planning, but to do so it is essential the commitment of all the players that intervene in the territory, considering public policies, with their staging of institutions and laws, with organized and participative communities and interdisciplinary planning teams. To do this the challenge of integrating the different design fields to other disciplines in the study of structures and urban processes in the contemporary city has to be considered.

A comprehensive risk management questions the understanding of the land as a whole, as a planning unit that is not fragmented by political administrative divisions, which in several cases follows arbitrary decisions on land fragmentation that follow different interests other than its own nature. A risk management

perspective can provide an input to regional planning that, without prejudice to the local theme, will comprise an area influenced by a risk originated in a natural phenomenon on its physical-spatial integrity.

When resilience becomes a keyword in the rhetoric of the public action and the sustainability programs of the international organizations, it shall be more than the sole search of recovery capabilities before a disaster. People should know when a social system is resilient, if it is capable of absorbing shocks and at the same time it is capable of keeping its main structure and trajectory, which, above all means preserving its social tissue and cultural identity.

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