

**PREVENTION AND ANALYSIS OF NATURAL HAZARDS – THE ARTICULATION
BETWEEN THE MUNICIPAL MASTER PLANS AND THE MUNICIPAL
EMERGENCY PLANS**

EXTENDED ABSTRACT

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ABSTRACT

The growing land consumption due to an unprecedented establishment of human communities, as occurred in the twentieth century, led to an increased exposure to natural hazards, as well as a larger number of natural disasters. Hazard prevention has become a globalized activity, in order to reduce the loss of people and property, and aiming to minimize consequences, such as loss of land, resources, and environmental damage. However, there have been separate approaches between these two domains in prosecution of its objectives, notably at municipal level, with the Municipal Master Plans and the Emergency Master Plans.

The aim of this dissertation is to understand how similar the characterization and the hazard analysis between those two plans of municipal scope, and how the articulation of strategies for the prevention of natural hazards is carried out. In addition, it is also intended to propose ways forward for the prevention and hazard analysis between the two plans at municipal scale. The municipality of Lagoa (Azores archipelago), was chosen as an example to apply the proposed methodology, in the pursuit of the main goal of this dissertation.

Keywords: Municipal Master Plans, Emergency Master Plans, Natural Hazards, Hazards Prevention, Hazards Analysis.

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INTRODUCTION

Natural hazards have always assumed a determinant factor to human populations lifestyle. The search for a safer environment is a constant pursuit, and over time, several techniques were being used, from the most basic up to science more advanced (Proske 2008). Ancient civilizations have learned to deal with the presence of natural hazards, like the Ancient Egypt, adapting to the cycles of flooding of the Nile River, taking benefits of the flooded soils for farming (Saraiva 1999).

In the twentieth century, with the growing land conception was also observed a fast growth of urban areas. Coastal areas are an example, which combine the risk of coastal flooding (tsunamis and storms), or coastal erosion. The combination of these events with intense rainfall, associated with the natural dynamics of river basins, changes in land use (such as construction, deforestation and agriculture) accelerates soil erosion and landslides (Cunha 1997 in Vitte and Mello 2007).

Since 1950, the population living in urban areas increased about fivefold (IPCC 2012). According to The International Disaster Database, although the average annual number of deaths from natural disasters has been declining (above 120 000 deaths in 1975 and down from 40 000 in 2011), the number of events recorded as well as the affected persons, increased. In 2011, damage costs reached an historical level, estimated at 366 100 million dollars, more than the previous maximum (around 246 800 million dollars) in 2005 (Guha-Sapir et al. 2012). In Portugal, the occupation of coastal areas increased since the 1970's, but became more intense from then until 2011, where the number of inhabitants increased from 738 000 to 1,2 million, a growth of 68%. The number of buildings increased from 254 000 to 855 000 units². Since 1865, natural disasters have killed more than 1300 people and left about 42000 with no home³.

In order to understand natural hazards and vulnerabilities in a given territory, the physical and socio-economic studies became a support for planning, in spatial planning and for emergency planning for civil protection. This activity has been developed in Portugal since the second half of the twentieth century, with an expansion at the end of that period, either with the development of the Municipal Master Plans (MMP) in the 1990's, either with the development of the Municipal Emergency Plans (MEP), in the same period.

OBJECTIVE AND METHODOLOGY

The hazard analysis is a tool that has been applied in the emergency plans for civil protection. This is a process to identify hazards in a territory and to detail them, in order to make better prevention and better assistance in case of disasters (Ayala-Carcedo 2002 in Barros 2010). However, this is not applied on land use planning by the authorities with such responsibilities in Portugal.

This study comes at a crucial period in terms of land use planning in Portugal. Only 14% of the new MMP were approved. The PNPO⁴ (Programa Nacional da Política de Ordenamento do Território)

² Portugueses vivem cada vez mais perto do mar. Jornal Público, Lisboa, 24 Nov. 2012

³ Chuvas mataram 1310 portugueses nos últimos 150 anos. Jornal Público, Lisboa, 25 Nov. 2012

⁴ Lei n.º 58/2007 de 4 de Setembro

provides, since 200, national strategies for hazards prevention, by linking the new MMP and the MEP. Recently, the decision for the release of the Sectorial Plan for Prevention and Risk Reduction (PSPRR), came against the objectives of the PNPOT.

The aim of this study is to analyze and understand the gaps in the development of hazard analysis and how the articulation of strategies for the prevention of natural hazards is carried out between the MMP and the MEP.

The methodology followed in this dissertation was a crossed study among different subjects. The subject and objective proposed in this dissertation forced an approach that sought to join concepts of risk, land use planning, civil protection and emergency planning, and hazard analysis. The methodological steps that were taken were:

1. Study of risk: concepts, types of hazards/risks, their origins, effects and approaches;
2. Analysis of legislation and instruments with authority in the land use planning activity and civil protection activity;
3. Study of the articulation between the MMP and the MEP, about the hazard analysis;
4. Interviews with public technicians in the fields of land use planning and civil protection activities;
5. Interviews content analysis, setting parameters for the assessment and choice of the case study;
6. Analysis of the characterization, hazard analysis and hazard prevention in the case study;
7. Discussion of results and recommendations to the articulation between the MMP and the MEP, for the prevention and analysis of natural hazards;

NATURAL HAZARDS IN LAND USE PLANNING AND EMERGENCY PLANNING

Despite a presence dating back several centuries, the hazard awareness has become higher since the last decades of the twentieth century. Ewald (1993 Mendes in 2002) stated that the notion of risk is no longer focus only and exclusively on nature. The concept of risk is felt in everyday life of modern society, being associated with work, personal safety, health, housing, economy, environment, among others.

The natural hazards are probably the best known and feared by society for longer, given the lack of ability to control, its unpredictability and awareness of its effects. Hazards are associated with internal and external geodynamic of the Earth, and the effects of their occurrence can either be tenuous, as can be quite devastating, depending on the intensity, location and period in which they occur. According to Julião et al. (2009, p.24), natural hazards are "the result of the functioning of natural systems (eg, earthquakes, landslides, coastal erosion, floods)." To Egler (1996, p.34) the natural hazard is "associated with the dynamics of natural systems, considering the degree of stability/instability, expressed in its vulnerability."

The higher is the intensity of a natural phenomenon occurred and the higher is the degree of interference of the associated components, the bigger is natural hazard. For example, the higher is the vulnerability of the exposed elements (by value, provision, quantity, etc.), in relation to the characteristics associated with the natural phenomenon itself, the bigger natural hazard.

Disasters of various kinds, but particularly natural ones, had a severe impact on economy on a relatively global scale. In the last quarter century, has decreased the number of human victims, but increased damage to property, and the trend is to increasing (Abramovitz 2001 and Mileti 1999 in Pine 2009). The prevention of natural hazards are usually made by the government authorities, which however, are under a process of reorganization of its structures and skills (Amaro 2008). The response to disasters is now the result of a joint effort between a diverse group of domains, especially the land use planning, who are recognized by skills in planning, and civil protection, who are associated with the actions of response level. In Portugal, the emergency plans of civil protection consists, according to the Resolution of the National Civil Protection n. ° 25/2008 of 18 July, in "*formal documents in which the civil protection authorities, at different levels, define the guidelines for the types of action of the various agencies, services and facilities to engage in civil protection operations*" (ANPC 2009, p.351). The municipalities are responsible for the preparation of municipal plans. The method of hazard analysis is included in such plans in order to know the relevant aspects for emergency planning, such as the territory characterization (general, physical, socio-economic, infrastructure and hazards) and historic major events, vulnerabilities or negative consequences in case of disasters.

Hazard analysis is, according to Barros (2010), a process that involves multiple disciplines, such as Sociology and Economics, Geography, Geology, Meteorology and Biology, Statistics, or the Architecture and various areas of Engineering. The same author, quoting Ayala-Carcedo (2002 Barros in 2010, p.4) says that "risk analysis can be defined as a process that aims to identify and analyze risks in order to reduce them in a rational way, having always present the preventive action ". In Portugal, according to the specifications of the ANCP (ANPC 2008), the big issues that must have answers from the application of hazard analysis are:

- *The identified hazard can affect the territory?*
- *If so, are they a significant threat?*
- *What consequences result from these hazards?*
- *How much is estimated that the population would be severely affected by the hazard?*

When the procedure of hazard analysis is completed, are reunited the conditions to advance to the next phase, with is the development of cartography for support of emergency planning and risk assessment, where measures are proposed to mitigate the risks.

The need for revision of territorial management tools created room for a new thematic intervention, such as hazard prevention. According to Pereira (2009), before choosing the location of an human settlement or economic activities, a risk assessment of should be a policy priority in land use planning.

The PNPOT was the first plan that took into account the hazards and vulnerabilities in order to support the definition of development policies. As a strategic objective, the PNPOT defines: *"Conserve and enhance biodiversity, natural resources and heritage, landscape and culture, sustainable use of energy geological resources, and monitor, **prevent and minimize risks.**"* The PNPOT also defines *"assessing and preventing factors and risk situations, and develop devices and measures to minimize their effects"* as a specific objective. Recently, the establishment of the Sectorial Plan for Prevention and Risk Reduction (PSPRR) by Direccção Geral do Território (DGT) and the National Authority for Civil Protection (ANPC), was a big step forward in the strategy of hazards prevention under PNPOT.

According to Pereira (2009), the review of MMP currently underway, will produce practical results in terms of hazard prevention, as the municipality is the territory where occur licensing processes of urbanization and edification. The integration of hazard analysis in the preparation/review of these instruments is defended by Queiroz (2008 Barros in 2010), so that they can determine future hazards, the same time it acts to prevent and mitigate them.

In terms of legislation, the risk concept is spread out, in the absence till this date of a legal document that addresses this issue comprehensively. Within the field of natural hazards, risks to public health, pollution and the environment, or other, the factor "dispersion" is something that, according to Teles (2010), brings difficulties to the efficiency in the work of prevention and hazard management. In terms of legislation there are three levels, the european, the national and the regional levels (for the autonomous regions). As an example of legislation with authority in the prevention of natural hazards in Portugal, there is the Lei do Solo⁵, Lei de Bases do Ambiente⁶, the European Directive 2007/60/EC of 23 October for the assessment and management of flood risks, or, Reserva Ecológica Nacional⁷ (REN), this last one still needing to adaptation to the context of the Portuguese archipelagos. The activity of civil protection is guaranteed by legislation, which provides the basis for the establishment of their authorities and agencies, emergency operations, and preparation of emergency plans, as the Decreto-Lei n.º 203/2006 de 27 Outubro (establishing the ANPC), Lei n.º 27/2006 de 3 de Julho, approving the main Law on Civil Protection, or, Resolution no. 25/2008 of CNPC (Comissão Nacional de Protecção Civil), which sets standards for the preparation of emergency plans.

STAKEHOLDER PERSPECTIVES ON THE INTEGRATION OF STRATEGIES

In order to realize the articulation between the land use planning and the emergency planning, some interviews were made to public administration professionals that operate at the planning and field levels. The interview, composed by 10 open-ended questions, was developed in order to try to understand what are the limitations of the current articulation between the MMP and the MEP, in terms of prevention and analysis of natural hazards, and what their future expectations are. The analysis of the interviews showed that, for guidelines to orientate the preparation of the MEP, the main ideas are that these are good, being used almost at 100%. However, they can be improved in order to update the scientific concepts and the scientific components enhance to the characterization of the territory

⁵ Decreto-Lei n.º 794/76 de 5 de Novembro

⁶ Lei n.º 11/87 de 7 de Abril

⁷ Decreto-Lei n.º 93/90 de 19 de Março

when the plans are up for approval. Public participation is one of the major gaps, according to them. It was noted that the membership levels are low, so as hypotheses for this, there is the fact that the population is not well informed and for them the work of emergency planning is not familiar, or they may think that their contribution makes no difference. It was admitted by these professionals that the authorities can do more and better to get near the public, such as organizing sessions in wish they can actually expose relevant and understandable content to the public.

In terms of articulation between MMP and MEP, the majority of respondents indicated that it does not exist. For them, work strategies and coordination between urban planning and civil protection activities are not the best, and that currently, may still is a bigger interest in urban development, instead of the consideration for natural hazards (Figure 1). The time that mediates the development of each of these plans was not considered a problem, but, mainly, the problem is not using the data that was get for the previous plan, on the other. Another problem related to this, is the fact that none one of them is the baseline.

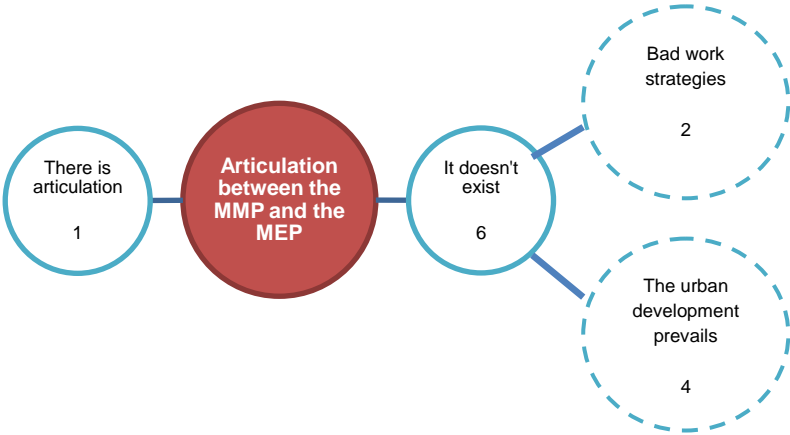


Figure 1 – Evaluative responses to the current articulation between the MMP and the MEP (10 respondents)

One of the biggest problems, in the opinion of the respondents, is the lack of technical and human resources. The lack of specific software and *know-how* mean, that there is less preparation by part of municipalities, so the technical teams are not so prepared for drafting these plans. In many cases, external technical teams are hired, exclusively for such work. As for the future, respondents indicated that there is room for improvement in the articulation between the MMP and the MEP, especially using the mapping of hazards. The work between different departments also need to be better coordinated, and new laws for land use regulation, may also have an important role (Figure 2). Resorting to external teams for the development of hazard analysis, was not a well shared idea. The cooperation between the municipalities and the scientific community was highly valued, allowing the exchange of techniques and experiences, for the development of better strategies for the prevention of natural hazards.

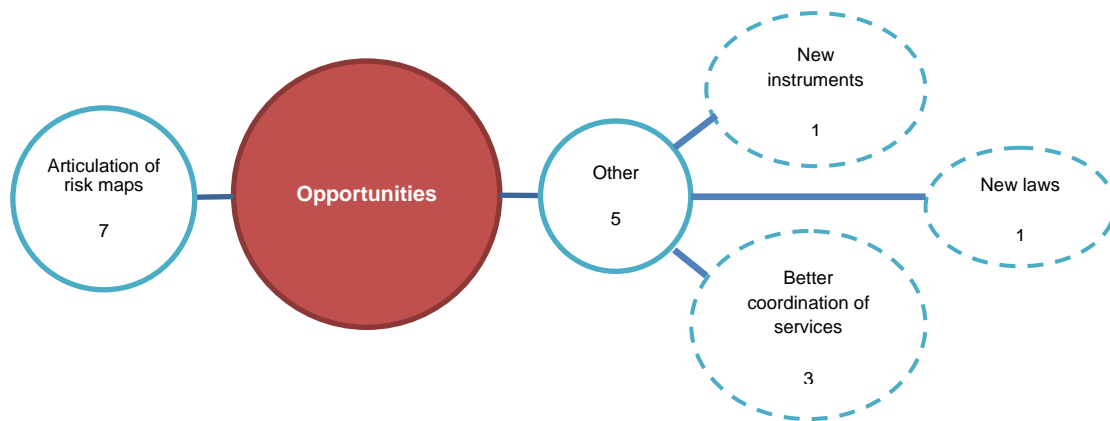


Figure 2 – Opportunities for the articulation of hazard analysis between the MMP and the MEP (10 respondents)

As results of the interviews, five parameters were defined for a smooth articulation between the MMP and the MEP, in terms of prevention and analysis of natural hazards. These were integrated into a reading frame for subsequent comparative analysis of the case study plans:

- A. Application of standards and guidelines laid down in legislation and proposals in the technical books;
- B. Articulation between the MMP and the MEP in terms of studies for territorial and risk characterization;
- C. Involvement of the public in the preparation of the MMP and the MEP;
- D. Articulation with other instruments and the use of new tools;
- E. Conformity between the proposed planning land use planning and the strategy for prevention of natural hazards;

INSIGHTS FROM THE CASE STUDY OF LAGOA MUNICIPALITY (AZORES)

With the current development of the MMP (44 made so far) and the MEP (70 to date) across the country, the case study chosen to apply the analysis of the parameters previously defined, in its MMP and MEP, had to comply with three conditions: the preparation of the MMP must be completed; the development of new MEP must be finalized; and the easiness accessing to content from both plans. From a total of 308 municipalities nationwide, only 11 met the first two conditions. The municipality of Lagoa (Azores) was the only one where it was possible to access to its plans in full content, so it was the chosen one.

The municipality of Lagoa, located on the São Miguel island, recorded, between 1840 and 1998, twenty five incidents of coastal flooding, floods by heavy rainfall and/or overflow of streams, and also cases of landslides. The urban areas along the coast are more exposed to sea waves. The major storms caused coastal flooding in coastal areas, damaging buildings, roads, farmland, harbors and fishing vessels (Borges and Andrade 1999). The intense precipitation, originated from extreme storms, usually caused landslides, and floods and overflows of rivers. The winter months are the wettest, and

rainfall is greater in the mountain areas, where there are steep slopes and soils loops, characteristic of volcanic archipelagos (Figure 3). These conditions combined, with changes to land use, increased the level of hydrological hazards. In 2011 the population was 14 430 people, while the number of buildings and houses was 9713 (INE 2011). The housing also notes a considerable number of buildings without earthquake resistance, so earthquakes are also a risk to consider, given the location of the archipelago at the junction of the american, african, and eurasian tectonic plates. In this case study the combination of all natural and anthropogenic factors described above, contribute to increase natural hazards, such as landslides, floods, volcanic eruptions, earthquakes, or soil erosion.

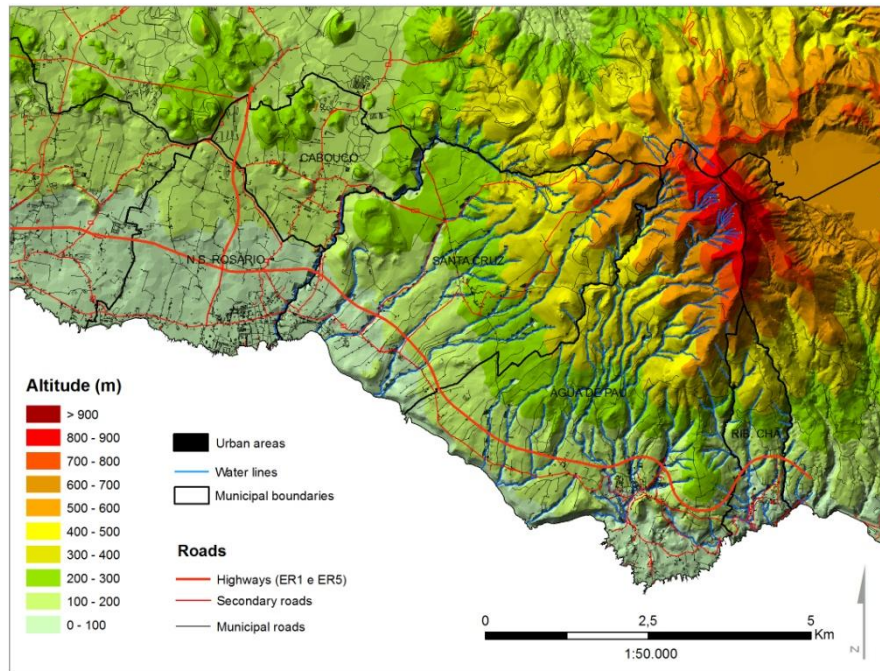


Figure 3 – Altitude map of the Municipality of Lagoa (Azores) (CAOP 2012.1, IGP)

DISCUSSION OF RESULTS

In the analyzes of the parameter A, from the reading frame, it was clear that the elements of each plan are different, because of the different nature and objectives of each one. While the MMP contains the regulations, reports and land use cartography, focused on structuring the municipal land use, the MEP is composed of a report, also with pictures for characterization of the territory, but always with a focus on emergency response operations. It does not comply in full with the index model proposed by the legislation. It also identifies natural hazards using the hazards analysis and vulnerability analysis, while the MMP does so in its maps and in the SEA (Strategic Environmental Assessment).

As for the parameter B, it was clear that, in addition to the fact that hazard analysis and hazard vulnerability are not made in the MMP, the listed ones in the MEP do not have the events log, the methodologies adopted, or the scenarios. The identification of vulnerable people and structures are inaccurate. The characterization of the territory is done differently. In the MMP it is more complete

including the different components, and in MEP is more focused on inventorying and organizing the resources and strategies for emergency situations. Although they are conforming to the legislation that rules them individually, the different practices of characterization can arise as the result of a lack of uniformity of rules for the preparation of plans.

For the parameter C, it was not possible to analyze people's involvement in the development of the MEP, as data from this phase were not available. Concerning to the MMP, there were only 13 participations, and none of them said anything about the issues or delimited areas of natural hazards, or about strategies for hazard prevention. The public consultation was made as required under the applicable law. However, there are no references to the occurrence of public information sessions. Without any confirmation, due to absence of contact with the population, probably this type of exposure is not as simple and attractive for the general public.

For the parameter D, in terms of the use of new tools, the MEP uses, although incomplete, hazard analysis and vulnerability analysis, while the MMP uses the SEA. With this tool, it identifies risks, as well as plans and programs of different scales, which can be linked with the MMP, highlighting those which have common objectives for hazard prevention. The MEP identifies mainly the regional plans for its articulation. In this context, it is noted that, it is linked with the old version of the regional emergency plan, because the new one is not yet complete.

Finally, for the parameter E, the analyses between the conformity of strategies for hazard prevention and the proposed land use shows that, they are placed differently. The MMP acts primarily in the regulation of land use and uses various programs and laws, for this task. As a negative aspect, it does not specify the areas allocated to the tasks of civil protection. The MEP, due to its more reactive side, makes suggestions for the public awareness, and to actions that do not profoundly change the landscape of the territory, but takes into account the immediate response to emergencies.

CONCLUSIONS

The way that natural hazards have been treated in the land use planning activity has been changing, making them a key factor in the implementation of new policies for development and regulation of land use. Meanwhile, civil protection holds up mostly the response strategies for hazards. Although that fact, there is a rapprochement between the two domains. The language differences between technicians of municipal services, the scientific community, decision makers and people in general, seem to be barrier to a simple and comprehensive communication, so the actual levels of public participation may have here a reason for low levels of adherence. The legislation regulating natural hazard is scattered in several pieces, which complicates their treatment and the cooperation between different authorities. It is expected however, that the new PSPRR can solve this problem, as an improvement for the articulation between plans of different domains and scales. The difficulties in the development and operation of the MMP and the MEP come up today, too, due the current economic conjuncture, depriving the different public authorities to invest on new resources.

By analyzing the MMP and the MEP of Lagoa, we can conclude that, there is a need to intervene and explore new strategies for the dissemination of plans, and new ways to attract people to participate, without depriving any content from the plans. The scale of work should be reviewed, and also the cooperation between different municipalities, in order to articulate their strategies for land use planning and civil protection, leading to supra-municipal plans, considering natural hazards as something broader than just one municipality concern. In the case of islands, it is suggested that plans could be island scale, due to its small size and low number of municipalities. To the characterization of the territory and hazards analysis, given the differences between the two plans, it is suggested that they would be uniquely made and included in the plans according to two different hypotheses, the “horizontal integration” model, or the “vertical integration” model. In the horizontal model, base territorial studies and hazard analysis are integrated equally in the MMP and the MEP, being constantly update with no differences between them. In the vertical model, the MMP assumes the preventive side, integrating the characterization studies and hazard analysis. The MEP boils down to the reactive strategies and emergency operations, using all the information it needs about the territory, directly from the MMP (Figure 4).

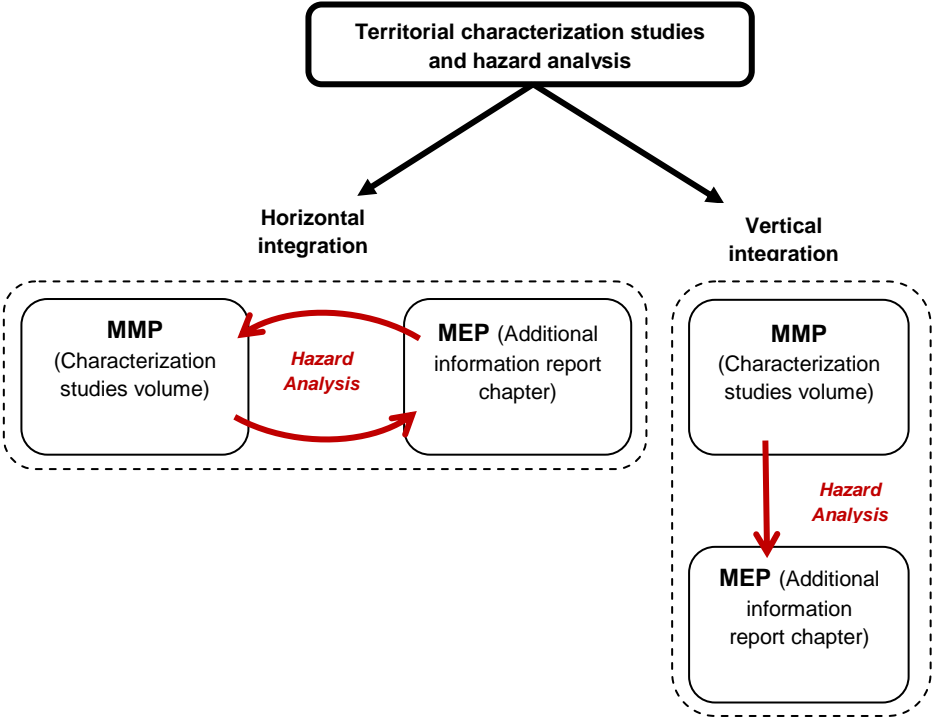


Figure 4 – Proposed models for territorial characterization and hazard analysis in the MMP and MEP

The preparation of territory characterization studies, hazard identification, hazard analysis and vulnerabilities analysis, if assumed as a starting point, taking into account the future evolution of scientific knowledge and review of land use policies and emergency planning, may allow the adoption of integration models and their articulation between instruments for planning. This should also include the contribution and role of all intervenient, such as public administration professionals, scientific community, decision makers and the general public.

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