TERRITORIAL RISK AND VULNERABILITY: PLANNING TOOLS AT MUNICIPAL SCALE

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Abstract

The paper focuses on the link between territorial planning and risk management. Starting from the results of an interdisciplinary and international research called Quater-Interreg IIIB, we will underline the importance of territorial knowledge and the role that planning can play to mitigate risks such as floods, landslide and other natural and anthropical hazards. The aim of the research was a kind of certification than can help the municipality to learn and operate on their territory. We worked to elaborate a method that can measure the short term and long term decision that public administration should take to switch a risky land in a secure territory. We worked to understand how the territorial planning can mitigate the effect of hazard especially on the vulnerability components. Toscolano Maderno (Bs) and Seriate (Bg) are the two case studies that we will present here. Furthermore, we will introduce the Emergency Plans that we provided for this municipality and the link that we made with the ordinary tools of planning. In fact we don't think that it is necessary to introduce a new kind of tool, but we believe that the importance of the knowledge of a territory can be integrated in ordinary planning tools, in accordance with the 12/2005 Act of the Lombardy Region, and be helpful in the phases of mitigation, prevention and response. An important role that planner can have is in the recovery phase, especially if we introduce the concept of building a resilience city.

1. Introduction

Every year national and local communities face increasing costs due to the environmental and technological catastrophic events. The impact of these events on the environmental and territorial system is really complex. Due to the increase and the overlapping of the environmental costs, all institutions (public and private) feel the need to change the government system from emergency to prevention and mitigation actions.

Either in ordinary planning or in sectoral planning like the one of emergency, the role that occupies the knowledge of the territory is fundamental. In fact, this analytic phase can become the common base for a planning that takes into

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consideration the intrinsic characteristics of the territory (represented also from the presence of risks), towards a development and a sustainable and harmonious management of the territory.

The goal of the research QUATER – INTERREG IIIB, that will synthetically be illustrated in the first paragraphs of this paper, is the development of a "procedure handbook for the territorial risk management". The different workgroups involved in the research have analysed: territorial vulnerability, flood, landslide, chemical and seismic risk, vulnerability of public buildings. The final goal of the research was to integrate the territorial risk prevention into the ordinary planning system of the public institutions.

The research was applied on a local scale. In the Italian context, the municipal authorities are competent in urban planning and they have a deeper knowledge of the context. The research has been tested on three municipalities with different risks: Seriate (BG), Toscolano Maderno (BS) and Lainate (MI).

On the Municipality of Toscolano Maderno and Seriate the research has not been concluded with the application of the QUATER method, but it has been continued with the predisposition of the Municipality Emergency Plan (PEC). The General objective of the restricted instrument of planning like the PEC, is the predisposition of adequate models of intervention and procedures of emergency to place in action in case of a calamitous event, in order to support the population affected. A description of the innovative elements that characterize these PEC is reported in the 6th paragraphs and followings. The application of the methodologies used for the integration of the prevention of the territorial, anthropic and technological risks, in the ordinary planning and in the daily operating of the Local Agencies is slowly starting to pay off, but there is still lot of work to do because these applications do not result as isolate cases, but enter instead in the daily practise of the planner.

2. The research methodological framework

The methodology framework (analysis and assessment) is based on the evaluation of the potential damages due to the territorial risks that characterise the municipal context. Two aspects can be identified in the general methodology: the risk analysis/assessment and the response system. The risk analysis depends on four interrelated factors:

1. Sensitivity – intrinsic characteristics and resources of the municipal territory/context (natural or human);

2. Exposure – number of goods, people and activities potentially involved during the event;

3. Vulnerability – the tendency of goods, people and activities to get damaged;

4. Hazard – the characteristics (intensity, frequency, areas involved) of the hazardous events.

Risk is the result of all these aspects. The analysis of the hazard and vulnerability can be extended beyond the municipality boundary (local level and territorial level). The aim is to verify the presence of a potential hazard near the municipality boundary that can have some indirect effects on it.

The response system, based on the risk analysis, is characterised by two intervention levels on the territory: the first consider the emergency management measures and risk mitigation interventions (these actions must be implemented in a short period); and the second level regards the territorial risks prevention measures, that must be implemented in a long period (and that must be integrated in the planning and land uses plan instruments). (fig. 1)

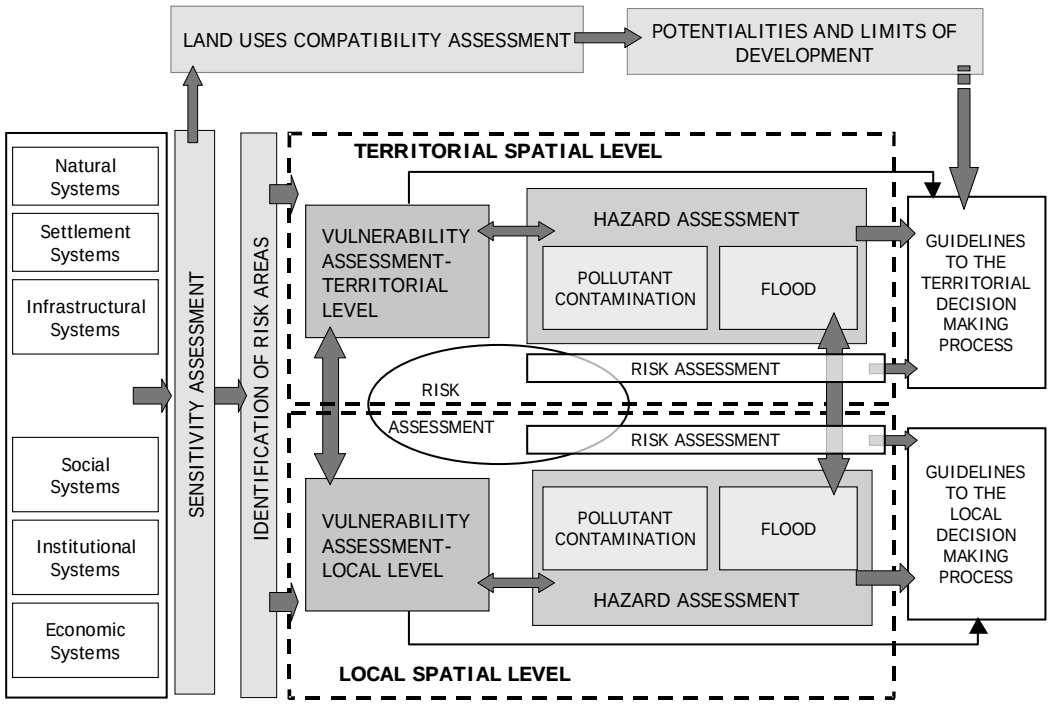

Fig. 1: The research methodological framework

3. The territorial vulnerability analysis and assessment: methodological framework

The method for the territorial vulnerability analysis consists of three steps: a preliminary analysis step (level 1), a detailed analysis step (level 2), and a further detailed analysis step (level 3).

The outcome of the preliminary analysis step (level 1) is the determination of the Basic Knowledge (territorial information/data) concerning the municipality. In particular, this level pinpoints the distribution of the population and the localisation of strategic buildings.

The second step (level 2) outcome is an investigation into the sensitivity by means of specific indicators, varying according to the characteristics of each municipality, and a preliminary exposure and vulnerability assessment of the territorial system for each risk.

The detailed analysis step (level 3) enhances the results of the previous step by means of a specific analysis (of the different hazards and the area of the territory involved).

The outcomes of these three analysis steps help municipal authorities to select an action and intervention system aimed to decrease/reduce territorial vulnerability. Every step uses parameters and indicators that can be used to assess vulnerability and carry out a periodic audit of the certification procedure. (fig. 2)

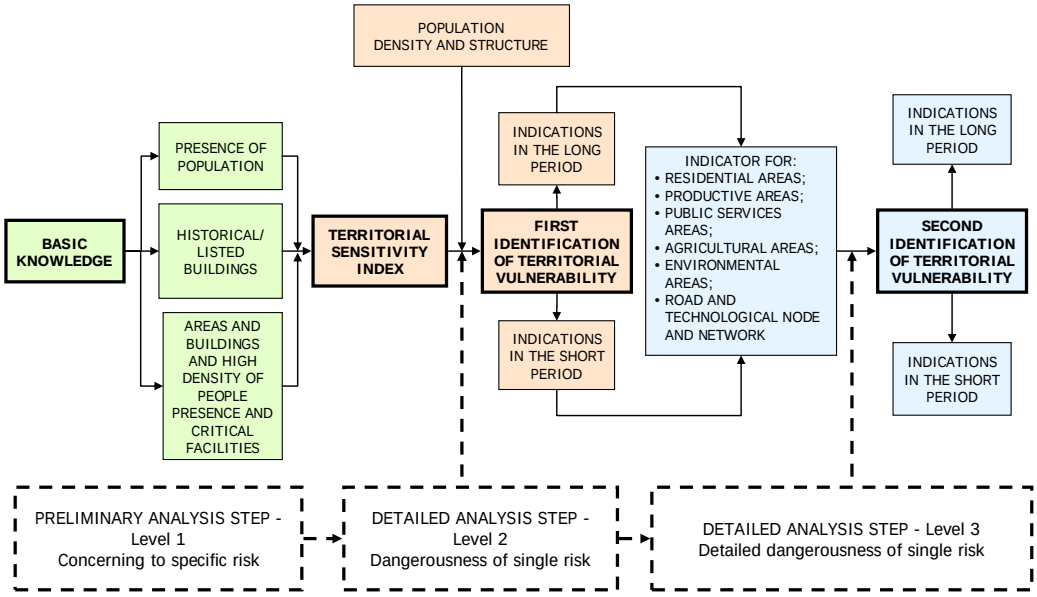

Fig. 2: Steps of territorial vulnerability analysis and assessment method

4. Indications

Like we have already mentioned, after the detailed analysis, the method allows the recognition of some indications in the short period and in the long period. The short period indications are related to emergency management measures and risk mitigation interventions (Municipality Emergency Plan, information campaign for the inhabitants, risk mitigation interventions on strategic buildings). The long period indications are related to territorial risk prevention measures, which have

to be integrated in the planning and land use plans instruments (for example a program for new location of strategic buildings and a land use code).

Table I shows an example of short term and long term indications in the case studies of Toscolano Maderno; the indications are divided in mitigation interventions, Civil Protection actions and planning measures (the red line divides short term indications from long term indications). All the indications are related to the analysis that we have made on the Municipal territory.

In the case studies analyzed, the town/city plan was in use from various years and little or nothing it has been done in order to introduce measures of mitigation which not only refer to the dangerousness, but also to the vulnerability of the territory. The long term indications, in the future phases of updating the plan, would have to be integrated or to be held in consideration in order to create the connection between ordinary and sectoral planning which was foretold, with the support of the procedures of maintenance of the certification.

Table I: Example of short term and long term indications

Indications framework						
	A	Mitigation interventions	B	Civil Protection actions	C	Planning
SHORT TERM	A1	Programming and design of hazard mitigation interventions.	B1	Updating of Municipal Emergency Plan with all risks present on the territory.	C1	Development of internal Municipal office collaboration: development of Territorial Information System.
LONG TERM	A2	Municipal programs finalised to hazard analysis.	B2	Design and development of information campaign for inhabitants.	C2	Verification and comparison with future land use plan and territorial risk.
	A3	Realization of hazard mitigation interventions.	B3	Development of a program to stimulate the intervention to keep the safety of the buildings.	C3	Development of municipality program for new location of strategic buildings.
	A4	Reduction of exposure level for inhabitants and strategic building.	B4	Realization of inhabitants information.	C4	Identification of alternative roads in dangerous areas.
		... ...	B5	Development of municipal Emergency Plan.	C5	Development of new location for public services buildings.
			B6	Arrangement of information about territorial and network vulnerability.	C6	Development of programs and systems for territorial and network monitoring; improvement of Territorial Information System.
				... ...		... ...

An important aspect of the proposed method is the verification of goals and actions. The actions efficacy and the targets gained can be checked in two ways: a continuous enrichment of the Basic Knowledge (which improves the efficacy of the indications) and the monitoring of actions over time.

5. The methodology realized for the redaction of the Municipality Emergency Plans

Like it was suggested in the indication of short term from QUATER methodology, for the Municipality of Toscolano Maderno and of Seriate, we have elaborated the Municipality Emergency Plans (PEC). If we go back to the three parts that compose a PEC, we can then disclose the methodology set in action in the specific cases present in the introduction and highlight some innovative elements and the relations with the planning and the management of the territory.

Firstly, in both cases we have elaborated a multi-risks plans that also takes into consideration those hazards not explicitly cited in the reference norms. The choice that we carried out is the result of the consideration that the hazards are intrinsically part of the territory and all hazards, in the first analysis, must be considered and analyzed with the exact same relevance. Only after a careful assessment it is possible to decide which ones are negligible in the plan.

Regarding the general structure of a PEC, it is composed of three fundamental parts: the Basic Knowledge, the Operative Part and the Part of Verification and Updating.

The Basic Knowledge contains:

- a territorial organization that must be elaborated independently of the presence of risks;

- the analysis of the direct or induced dangerousness, also from a close Municipality;

- the individuation of the vulnerable elements exposed to the risks (es. hospitals, schools, zones at elevated population density, technological infrastructures, etc);

- the individuation of the available resources (es. rapid-reaction force at local and regional levels, areas of reception and/or shelter, vehicles and materials);

- the drawing up of the risk scenes.

The Operative Part identifies the systems of monitoring and premonitoring an event for the expectable risks (es. the alluvial risk) and the drawing up of the aid models (individuation of members of the Local Unit of Crisis, that comprises the rapid-reaction force of the Municipal territory; the localization of over-local useful forces of intervention in the case of particularly serious events or for a particular typology of risks; for every force involved the "who - does - what" of the tasks).

The Part of Verification and Updating comprises:

- the verification of the PEC by drill and, in the case of incidental events, through the former post-analysis of the procedures of emergency action;

- the updating of the PEC through the individuation of protocols of updating of short and long period.

For the realization of the PEC we have used GIS, which allows to share and to update the information arranged systematically in a fast and effective way.

6. The Basic Knowledge of the Municipality Emergency Plans

In the Basic Knowledge, after a general organization of the territory object of planning which comprises of thematics like: climate, geomorphology, hydrography, we have analyzed the urban settlement and the infrastructural system, the distribution and the characteristics of the population, the economic activities, agriculture and public services, the emergency infrastructures and the resources available.

The first phase comprises of the analysis of the population census and the mapping of the strategic and vulnerable buildings; of the emergency areas available (subdivided in waiting areas, reception areas and recovery areas); of the public infrastructures service and of the available resources of Municipal property that we have at disposition in the case of a necessity. Every information obtained in this first part of the Basic Knowledge of a PEC becomes mapped by GIS and in such a way we provide a cartography which is always updated and available for the PEC, but also for the ordinary planning.

The ideal successive step, today still not completed in these two cases, sees this basic information of the territory, at the moment independent from the typology of present risk, contained into a Municipal SIT (Territorial Information System) where all the councillorships can reach and contribute in the given terms of updating. The structuring of the PEC for this purpose has concurred to supply a common working base in which, once the financial resources have been obtained, a Municipality will be able to construct the SIT.

Another important and innovative element in this type of sectoral plan, regards the drawing up and the continuous updating of the file dedicated to the emergency areas; they contain important information on the accessibility, the extension, the equipment of independent infrastructure service, etc. Often neglected inside the norm of writing of the PEC, usually the planner localizes the areas without entering in their specific characteristics.

The second phase of the Basic Knowledge of a Municipality Emergency Plan, regards the analysis of the dangerousness and the risks present in the territory. For the Municipality object of the research, the analyses have already been carried out from the work groups of the project QUATER.

The heart of this phase of surveying the PEC are the risk scenarios, meant from the Regional Directive like verbal and synthetic descriptions, accompanied with an explicative cartography of the possible effects on the population and on the infrastructures, by adverse meteorological events (flooding, also gave away dams), of geologic or natural phenomena (earthquakes, landslides and avalanches), by forest fires, or industrial accidents or of dangerous substances in freight accidents. From the point of view of the risk analysis, it is important to emphasize the presence and the involvement of various disciplines and expertise in this phase. These experts have not only supplied a risk assessment on the present territory, but also a reflection on the relation between these risks and the development of the actual urban area, on the effect of the future forecast urban growth.

The abilities of the planner to represent the territory through a reasoned and synthetic cartography are fundamental in order to give back a general picture of the risks and the complex systems that compose the territory, that a specific scientific sector does not succeed in condensing. In fact, in the phase of knowledge and planning of the territory, we would have to already be notified of the presence of a risk in our area of surveying.

Once again the relation between sector planning, the one of emergency and the ordinary planning emerge. In fact, the new Regional Law of Lombardy 12/2005, considers it obligatory that there is a risk analysis for the plans at different territorial levels, the problem is that all the risks are not taken into consideration and there isn't a directed connection between the ordinary territorial plans with the emergency plans that instead consider, as we have previously said, all the types of risk. Localization of a public structure, for example a school, would have to take into consideration not only the economic reasons, but the planner would have to also take into consideration the degree of dangerousness in the different territorial risks that characterize the area to settle. This information is contained in a PEC.

It is obvious that not always, in our territory, we can refer to new constructions, but we always have to take into consideration public buildings already constructed: in this case, given the impossibility to eliminate the risk, the intervention of mitigation would be opportune and useful in order to diminish the possibility of damage caused on the buildings. In both cases, a deeper knowledge of the territory is necessary, whether in punctual terms (es. localization of the building), or in the analysis of various systems that compose it.

The localization inside the Plan of Government of the Territory of particular services involved in the emergency phase and in accessible areas, is not subordinate to eventual risks (e.g. municipal civil protection, Red Cross, fire brigade, etc.), it allows to supply a ready answer to the emergency and therefore a more effective and efficient management of the event. If we placed side by side these two instruments and a Plan of the Urban Traffic, we could then be sure that

the time of reacting to the event and the dispersion of the forces involved will be limited.

Also regarding the second phase of the Basic Knowledge of a PEC, we have written up a series of explicative cartographies of the dangerousness, the present risks and of the risk scenarios that we have decided to adopts for the drawing up of the intervention models.

Another innovative aspect that deserves further discussion, regards the cartography of the risk scenarios. This cartography has been planned in such a way as to have in an only picture all the reference for the portion of territory interested in the calamitous event, with the indication of the strategic and vulnerable buildings, service infrastructures, that have been involved in the event. Where possible, we specified the civic number of the building involved and consequently we gave a brief description of the characteristic of the single inhabitants. In fact, in the PEC, we have also attempted to distinguish the sensitive population, that is the young people, old people or disabled ones who need particular assistance in the cases of evacuation of the areas at risk.

7. The Operative Part of the Municipality Emergency Plans

As anticipated, the Operative Part of a PEC also characterizes the systems of monitoring an event in the premonitory phase and it drawing up the intervention models. The first aids to the populations are directed and coordinated by the Mayor of the Municipality involved in the event. The Major, in accord to the Italian legislation, is local authority in matter of Civil Protection. In the case of events which cannot cope with local resources, the Mayor could ask for assistance at the Prefect who activates and manages the over-local forces of intervention. Therefore, the first step in the drawing up of the intervention model is the localization of the local forces of intervention, they will then be involved in the Local Crisis Unit (UCL) and the over-local forces will support it.

For every risk scenario contemplated in the Plans, we have identified specific procedures of intervention that, in this methodology are made up of:

- one matrix time/components of UCL; where we identified, subdivided for temporarily and succeeded passages, the activities to place in action part of every member of the UCL (for clarity, the main forces of over-local participation are also comprised in the matrix);

- one matrix activity/responsibility; where, for every identified activity we specify the responsibilities of every member of the UCL (if he is responsible for an action, if he is simply informed or just supporting);

- a job description for every member of the UCL; where the activities placed in the head of every Agency are explained. The job description contains all useful and indispensable elements to know in an emergency

phase (es. telephone numbers of the managers of technological networks, etc.);

- a cartography that summarises all the main information of the intervention procedures.

Where possible, as an example for the alluvial risk, all these procedures of intervention are multiplied for the pre-alarm phase, alarm or emergency phase. For the not expectable risks the procedures are formulated only for the emergency phase.

Particularly innovative and interesting in the contents is the job description and the cartography of the intervention models. Like we had observed for the cartography of the risk scenarios, also in this case we can find in a single cartography the necessary information for the activation of the intervention procedures: one clear map of the area interested in the event with the indication of the interested vulnerable elements, the indication of the ways to escape and the usable emergency areas. This cartography, beyond the graphical part, is physically structured with a series of "pockets" where the main intervention procedures have been collected (matrix time/components UCL, matrix activity/responsibility UCL, job description for every member of the UCL and a list of the population have been involved for typology)

8. The part of Verification and Updating of the Municipality Emergency Plans

All the "architecture of emergency" adjusted with this methodology, introduces to the third fundamental part of a PEC, that Verification and Updating of the data and information are contained in it.

The verification of a PEC generally occurs by drill, in the case of incidental events, through former-post analysis of the procedures of emergency. Closely correlated at the verification of the plan there is the periodic updating, necessary in order to be able to manage the emergency better, because the PEC must be used as a dynamic and modifiable instrument in consequence of the changes of the territorial system to which it belongs. For the review of the PEC we have identified a protocol of updating a short and a long period. The updating of the short period regards the population exposed (with particular regard to the sensitive population) the members of the UCL, the over-local forces of intervention and all the information that changes or could change in a minimal temporal arc. The updating of a long period regards the territory (which changes independently from the presence of risks) and the present dangerousness (that could modify in the light of new studies).

Also in this phase there is a strong relation between the emergency planning and the ordinary planning that can, with its decisions, aggravate or mitigate a present risk.

From the operational point of view the updating of a PEC is therefore also conceived inside a Municipality which adopts a system of certification like that one proposed from the QUATER method , it is useful to emphasize the necessity of a strong collaboration between several operative sectors of the Municipality, from the office of Civil Protection to the Technical Office up to the Registry Office.

9. Conclusion

The QUATER method develops a procedure handbook of the territorial risk management not only with short period actions, but also with some indications for risk mitigation and prevention in a long term vision. The method aims at integrating the risk mitigation aspects in ordinary planning.

The procedure allows the arrangement of information about the territory (Territorial Information System) and develops a public and private collaboration.

The system is managed by the Municipality, in a flexible and incremental way, through a constant process of goals update and verification. Moreover, the support of planning instruments such as a sectorial Emergency Plan, directly connected to the ordinary planning and to the certification process, allows to achieve those goals which were initially set for the mitigation of the risk through the planning instruments.

Table II: The innovative elements inserted Municipality Emergency Plans

	Innovative elements	Relation between ordinary planning
Basic Knowledge	Analysis of dangerousness also outside the municipal boundaries Organization of the information by GIS Interactive cartography	Use of the same information about the territory inside the Municipality SIT Use of the same information about the dangerousness and risk inside the Municipality SIT
Operative	Design of the intervention procedure with matrix, job description and interactive cartography	Coordination of the choice take in the ordinary planning and sectorial planning, in order to avoid a worsening of the situation at risk and to mitigate the effects.
Verification and Updating	Protocol of updating of the information organized by GIS	Continuous updating of the information regarding the territory and the Municipality goods

The task of making the connection between these two typology of plans more effective is still a lot. We do not think that the introduction of new instruments of planning is necessary, but that the correct and sustainable use of the existing instruments is enough. As planners, we think that we can’t stop to think of the single destination of land use, the instruments of mitigation in our "hands" are various (eg. the adoption of particular building regulations, the maintenance and the promotion of the use of particular natural buffer areas, etc.) and it is necessary to enter in the perspective that in order to plan a secure territory, we must think of

different levels of action in space and time and that a synergy between various sectorial expert is necessary.

When we think about "resilience", we often think only for the recovery of a city in the phase post-event, almost as if this stage was a sort of "closure" quantifiable. Instead, for resilience we mean the ability to get out of a stalemate, so do not necessarily equal to the initial pre-event. The ability of a territory to be resilient consists largely from the organization and from the relationships existing prior to the event, more the system will be flexible and more rapid will be the recovery to normal activities with a view to improvement and awareness.

Often, the concept of sustainability is partnered by resilience. Sustainability, in fact, does not necessarily mean that all risks are eliminated, but that a degree of balance between the issues related to risk, the social and economic ones are reached. Certain levels of risk may be necessary and acceptable. Where a community chooses to continue living in a territory, despite the risk, the development should go towards the creation of cities resilient, able to react to the effects of a disaster. This type of approach, namely to know and to work on the nature and not against it, can simultaneously achieve the goals of conservation and enhancement of natural resources without diminishing the chances of developing [Burby, 1998].

The integrated use of appropriate tools for management and planning, as we've tried using in the territories of Seriate and Toscolano, it is necessary for try to plan a resilient city, reducing the intensity of development in hazardous areas, reducing the need to alter and hinder the natural processes, we could reduce the economical and social costs, of vulnerable city.

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