Security and Resilience in Small Centres of Inland Areas

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Abstract. Starting from a theoretical reflection on current planning tools and on the concept of urban resilience, the paper supports a new methodological approach that attempts to offer a more structural and not only operational characterization to the Emergency Plans. The analysis of the physical and functional relationships between the various strategic elements of the territory shifts the focus of the emergency from a punctual approach to a more integrated one, capable of directing future decisions relating to the urban planning of the territory in a more appropriate way specific to spatial planning. In fact, although over the years the issues of risk and safety have contributed to orienting the methods of governing the territories, still today, when an adverse event occurs, clear unresolved critical issues emerge that push urban planning to question the new challenges to be faced undertake, especially in terms of emergency management. The focus of the municipality of Moliterno, in the Alta Val d'Agri district (Basilicata, Italy), is shown as a practical example of improvement in seismic emergency management, despite the presence of critical issues, such as the historic centre and the accentuated orography.

Keywords: Security · Emergency management · Inland areas

1 Introduction

Urban planning plays an important role in emergency management and can pursue regeneration and sustainability criteria [1–7], placing them in a resilient perspective of the iland areas, taking into account above all that the dynamic nature of territorial systems leads to awareness that there are risks that cannot be avoided, rather, they must be accepted and managed in the different time phases (ex-ante, in itinere and ex-post) [8, 9]. It is understood that, in order to appropriately address the risks present in the territory, it is first of all necessary to reduce the vulnerability of the reference urban system, and to do so it is also necessary to identify an effective and efficient instrumentation system capable of planning, planning and designing regeneration activities sustainable urban areas, also in terms of emergency management [10–12].

The urban seismic risk assessment is prepared to carry out prevention and mitigation actions for the two main phases following the seismic event: the emergency phase, immediately following the seismic event, and the phase of resumption of activities and reconstruction, in the short-medium term following the event [13, 14].

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In order to ensure the operation of the system itself after the earthquake, the analysis of the Limit Condition for Emergency (CLE) is introduced in the OPCM 4007/12, which has the purpose of verifying the main physical elements of the management system emergencies defined in the civil protection plan (coordination places, emergency areas and connecting infrastructures).

The study on the Minim urban structure (SUM), on the other hand, represents the modality through which systems of routes, spaces, urban functions and strategic buildings are organized in advance for the response of the settlement to the earthquake, in order to allow a rapid resumption of urban activities after the occurrence of the calamitous event. The SUM rapresents a tool to assess urban resilience, that is the ability of a system to restore its functionality after having suffered an external impact [15].

The main difference is that the SUM overcomes the objective of simple emergency management to also aim at the possibility of ensuring the resumption of the main urban functions [16].

The CLE Analysis and the SUM study come from two different institutional referents, because theoretically they refer to two different moments of post-earthquake intervention; the first comes from the work of the Civil Protection, the second, on the other hand, is a method strictly linked to regional and local planning, therefore possibly provided for in the regional urban planning laws [17].

The innovative contribution that is intended to be illustrated in the following paragraphs, and in particular in the case of experimentation by the municipality of Moliterno, relates to a possible integration between CLE and SUM. To carry out this operation, it is necessary to organize phases that are strictly dependent on each other. It was a question of understanding which elements of CLE and SUM can integrate and allow the achievement of the common goal for the mitigation of seismic risk.

2 The Urban Layout of Moliterno Municipality

To introduce a new methodological approach for emergency management, it is essential to implement a phase of knowledge of the housing fabric, because each inhabited area is unique and therefore reacts subjectively to adverse events, such as an earthquake. The available urban planning tools are analyzed, both in terms of planning and civil protection plans, compared with urban fabric growth [18–20].

The municipalities of the inland areas, such as Moliterno, have a small extension of the housing fabric, since in general the population is less than 5 thousand inhabitants. In the case of the municipality of Moliterno, the main settlement stands on a promontory at an altitude of 880 m above sea level, overlooking the bed of the Sciaura stream. The building fabric is extremely compact in the medieval part, forming a walled curtain, and less so in the more recent area. Access to the town is from the north and west, through the main road axes, and from the south through a road that develops consistently with the main elevations. The State Road 103 connecting the Fondovalle dell'Agri and the A3 Salerno - Reggio Calabria motorway, constitutes the main road network [21].

The historic centre (see Fig. 1) stands in a prominent position with respect to the rest of the town, dominated by the presence of the castle. The edges are compact, consisting of steep ridges on three sides (north, east and south) while to the west the historic

centre has no clear physical edges; the historic centre is accessed through paths that are partly accessible to vehicles and partly pedestrian. Due to the presence of buildings of historical architectural value and significant elements, the historic centre, in a good state of conservation, can be considered significant from the point of view of value and quality.

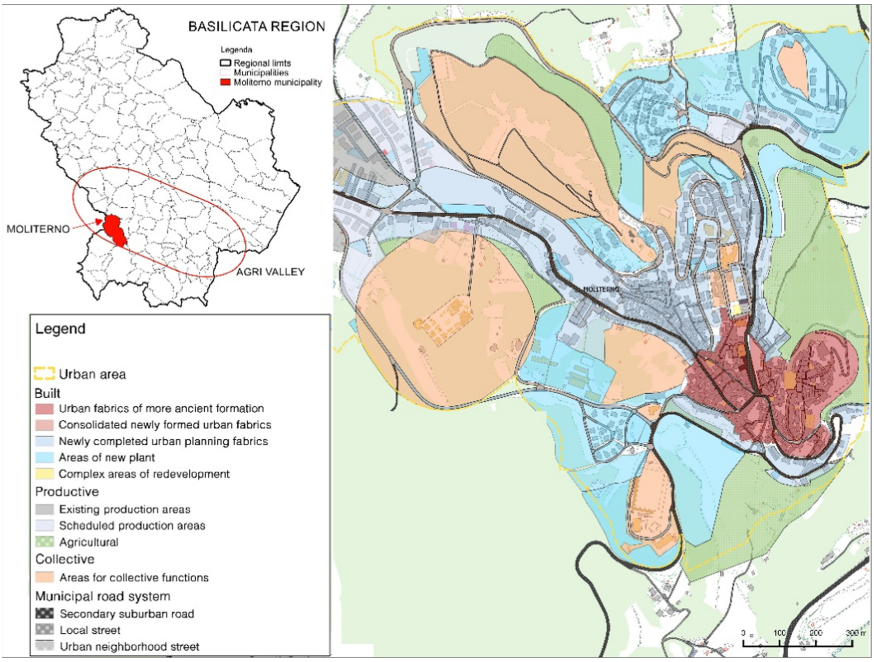


Fig. 1. Framing of the municipality of Moliterno in the Basilicata region *(left)* and identification of the main fabric of the settlement indicated in the urban planning tool *(right)*.

There are no hamlets in the open area and there is a moderate trend towards Parsee settlement. As for the functional characteristics of the settlement system, Moliterno winds between the inhabited centre and the two industrial/artisan areas located one in the terminal part of the town in the western direction (almost completely implemented), the other in the flat area in the north-est direction (only partially implemented). All services and equipment are located outside the historic centre, in the external area to the north, in a hinged area between the historic centre and the more recent expansions. The functions present are located in a compact fabric characterized by an irregular road network in which the original typological and architectural characteristics are recognizable, while the more recent part is characterized by a less regular medium-density fabric developed along the main access road to the inhabited centre. The settlement under construction, on the other hand, stands on the secondary viability in the western direction adjacent to the saturated production/artisan area, has a low-density linear development urbanistic-building fabric which includes areas not implemented in the current PRG intended mainly to the residence.

The periurban and extra-urban area of Moliterno has important elements of morphological-landscape relevance due to the presence of areas intended for the conservation of biodiversity and the production of eco-compatible resources due to the presence of natural and semi-natural ecosystems, as well as for the elements of the network hydrographic.

3 Methodology

3.1 Limit Condition of the Emergency (CLE)

The organizational question of the rescue action is pertinent to the Civil Protection Plan, while the analysis of the Emergency Limit Condition (CLE) aims to identify suitable physical structures and infrastructures within which it is possible to carry out the action of rescue.

The CLE analysis involves:

- the identification of buildings and areas that guarantee strategic functions for the emergency;
- the identification of accessibility and connection infrastructures with the territorial context, buildings and areas and any critical elements;
- the identification of structural aggregates and individual structural units that may interfere with the accessibility and connection infrastructures with the territorial context.

The analysis of the CLE of the urban settlement is carried out using archiving standards and cartographic representation of the data, collected through a specific form prepared by the Technical Commission for Seismic Micro-zoning studies, established by OPCM 3907/2010 (art. 5 paragraphs 7 and 8), and issued with a specific decree of the Head of the Civil Protection Department [22].

In particular, the analysis involves the compilation of 5 forms:

i. the ES Strategic Building,
ii. AE Emergency Area,
iii. AC Infrastructure Accessibility/Connection,
iv. AS Structural Aggregate,
v. US Structural Unit.

The main task of the CLE check is to ensure that each settlement has a system of elements capable of supporting the immediate action of the Civil Protection, whose fundamental principles are linked to the speed, efficiency and effectiveness of the intervention.

The CLE verification can represent an element of interest within the preparation of the SUM; the CLE, in fact, although based on the principles of the organization of the emergency, may be able to provide both useful indications for the rescue action and give indications to ordinary planning and specific risk reduction interventions contents.

It therefore emerges that the SUM cannot be reduced to the contents of a civil protection plan, rather it is the way to translate the objectives and contents of a civil protection plan into urban planning terms.

The Moliterno CLE system (see Fig. 2) includes n. 6 Strategic buildings (ES) and n. 7 Emergency Areas (AE). The ES who participate in emergency management are:

1) the Town Hall (headquarters of the COC) - Police Command; 2) the Barracks of the Ca-rabinieri; 3) the Barracks C.F.S.; 4) the 118 station; 5) the alternative headquarters of the COC (ITCG - High School); 6) the Traffic Police Station (Pol-strada). The AE, including Hospitalization areas and Storage areas, which participate in emergency management are: 1) municipal sports field (Hospitalization); 2) square in front of the municipal sports field (Shelter); 3) area adjacent to the municipal sports field (Stacking); 4) area behind the municipal sports field (Stacking); 5) area behind the municipal sports field (Stacking); 6) area behind the municipal sports field (Stacking - covered); 7) area behind the municipal sports field/in front of the gym (Stacking).

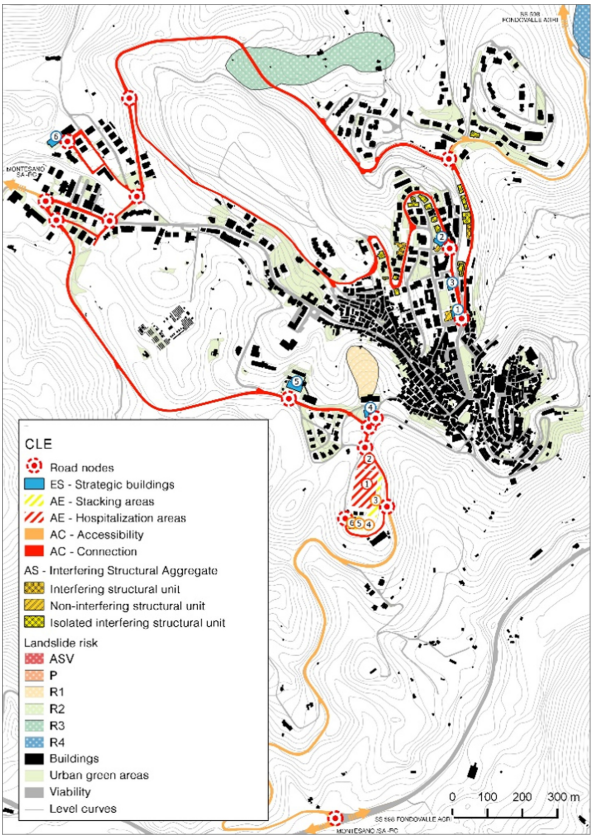


Fig. 2. Map illustrating the configuration of the Limit Condition for the Emergency for the municipality of Moliterno.

In addition to the ES and AE, the accessibility and connection infrastructures (AC) and any critical elements interfering with them belong to the emergency management system, in particular phenomena of landslides/landslides affecting road infrastructures.

Have been identified n. 24 BC. Finally, there are the Structural Aggregates (AS), n. 3, and the Structural Units (US), n. 29, interfering with the connection and accessibility infrastructures.

3.2 Minim Urban Structure (SUM) and Urban Resilience

The strategic elements of the SUM are not only those necessary for the seismic emergency phase - that is, those that respond to the purposes of the Civil Protection Plan - but all those essential for the functioning of the urban structure and for the resumption of ordinary urban activities after the seismic event.

The identification of the SUM is the necessary urban framework for priority interventions and, more generally, to direct public action in the field of seismic prevention [23, 24].

The contents and stages of identifying the SUM can be linked to three points:

- the identification of the strategic components of the urban structure for the urban response to the earthquake;
- the identification of criticalities and system weaknesses of the strategic components of the urban structure;
- the definition of the actions and interventions for the SUM.

All that is strategic from a functional point of view is part of the SUM: the structuring routes, the main road and railway communication routes and related functional nodes, escape routes and safe open spaces are always part of the SUM.

The main economic functions and elements of high symbolic value can also be part of the SUM - as a reason for being rooted in the place - which are a symbol of the social fabric and local culture, the loss of which could compromise the ability to react settlement and recovery following the seismic event.

The criticality of the SUM can be defined as its susceptibility to damage or loss of functionality that can derive from the physical damage of individual elements and/or systems, and which can lead to a loss of systemic functionality, even greater than the sum of the individual damages physical. The criticality assessments useful from an urban planning perspective consist in a quick consideration of the potential criticalities, in qualitative and system terms, of the single elements or component systems; existing specialist assessments, such as building vulnerability, can be incorporated or summarized, if available [25].

The increase in the functionality of the SUM consists of a series of actions and interventions to be implemented both to reduce the criticality of elements and structures, single or system, and to improve the overall behaviour in the event of a seismic event. The reduction or elimination of the criticalities of the SUM is a priority in the provision of interventions to mitigate the urban effects of the earthquake. Such issues may became objectives for the new territorial development policies funded by EU Structural Funds [26–30]. It can consist of interventions for eliminating or reducing specific criticalities but also in interventions for the definition of alternatives, i.e. the creation of elements of redundancy. The overall improvement, as well as through the elimination of specific criticalities or the definition of alternatives, can also derive from new plan forecasts (new strategic buildings, safe spaces and escape routes).

The SUM articulated in its components must be an integral part of the municipal urban planning instrument; therefore, it is necessary that there is a close relationship between the process of defining the SUM and the planning process.

In preparing the cognitive framework, the systemic components of the urban structure for the response to the earthquake must also be identified, i.e. the components of the SUM, they are:

i. the mobility and accessibility system,
ii. the system of safe open spaces,
iii. the system of buildings and strategic structures,
iv. the system of the main technological networks.

Depending on the specific context conditions, they can also be part of the SUM:

i. the system of cultural heritage and places of relationship,
ii. the system of economic-productive activities and main urban functions.

In the cognitive phase, the civil protection documents, the relative forecasts and any studies on building vulnerability are taken into consideration.

In the absence of a validated study of the SUM, at this stage they will be at least identify the components of the structure strategic urban areas for recovery (see. Fig. 3), in what has already been assessed the efficiency of those that belong to the system of emergency.

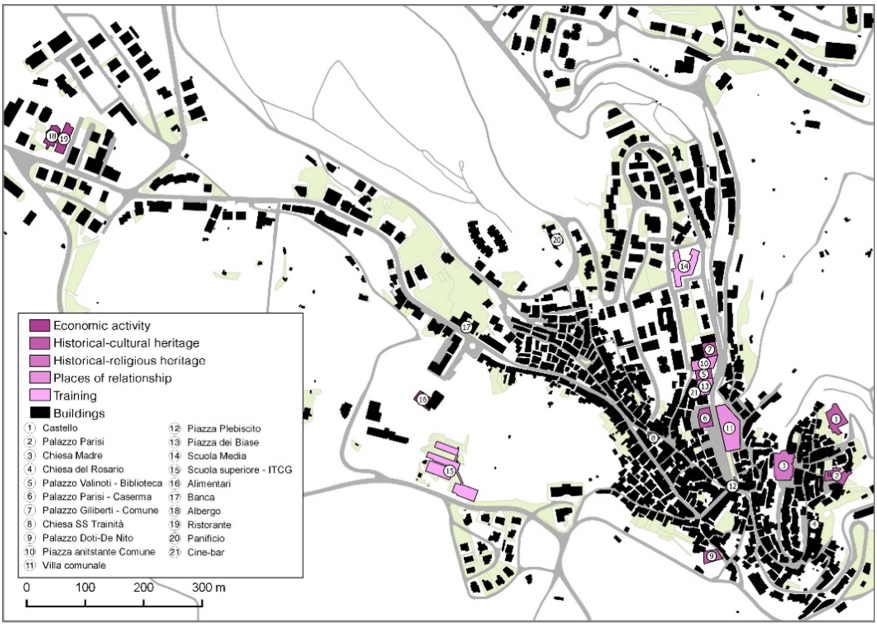


Fig. 3. Identification of the Strategic Components of the structure urban area for recovery for Moliterno municipality.

By doing so, you can have it a well-defined idea of the critical issues of the CLE Analysis and lay the foundations for integrate CLE studies with those for the definition of the SUM.

3.3 Evaluation of the CLE to Supplement the SUM

The CLE analysis serves to identify, in a given settlement or territory, the elements necessary for emergency management, what they are, where they are and what characteristics they possess. In fact, if the Limit Condition for Emergency is reached in a settlement hit by the earthquake, it means that all urban functions are compromised except for most of those necessary for the management of the emergency and its subsequent overcoming.

The evaluation of the CLE is a process that aims to verify whether the emergency management system - in the conditions given at the time of the evaluation - is adequate to ensure that the CLE is verified for that settlement. That is, given the existing elements recognized in the analysis phase, the evaluation serves to verify whether those elements are sufficient to ensure the urban performance necessary for emergency management.

In order to assess the system's resistance in an emergency phase, it is advisable to verify the relationship of this system with the characteristics of the urban structure and the recovery objectives of the settlement following the earthquake. Basically, two objectives must be taken into account in the assessment: one strictly functional and one consistent with the characteristics of the settlement.

To meet the two objectives mentioned, we intend to refer to three criteria for the evaluation of the emergency management system; they are: completeness, efficiency and urban compatibility. The three criteria define increasing urban performance. In fact, an emergency management system can be complete but not efficient, as some elements may not withstand the earthquake or may not be well connected to each other. Similarly, a system can be complete and efficient but not compatible from an urban point of view.

In detail, the completeness criterion is used to verify whether all the essential elements for emergency management are present within the settlement; the efficiency criterion is used to assess whether the set of elements allows to provide an efficient urban response in the emergency phase; finally, the urban compatibility criterion serves to assess whether, in addition to operation in the emergency phase, the system is able to guarantee the maintenance and resumption of strategic urban activities for recovery.

The evaluation of the elements of the CLE must possess such requisites as to meet the objectives described, structured according to the criteria of completeness, efficiency and urban compatibility, and with characteristics that allow its use in ordinary urban planning processes.

For the purposes of the assessment, two objectives were taken into account: one strictly functional and one consistent with the characteristics of the settlement. To address the two objectives mentioned, reference was made to three criteria for the evaluation of the emergency management system: the criterion of completeness, efficiency and urban compatibility.

Following the results obtained for the town of Moliterno, an overall assessment was established on the current CLE analysis. In fact, the verifications and evaluations carried out were put into the system - in a summary table.

3.4 The Improvement of the Urban System for the Management of the Seismic Emergency

A different location of the elements of the emergency management system can generate an overall evaluation of the CLE that is better than the current one.

Basically, for the municipalities of Moliterno and Tramutola - which have insufficient performance - the intention is to improve the criterion of urban compatibility and this is only possible by introducing new elements within the system. The relationship between settlement and components for recovery with the new emergency system leads to the improvement of the assessment of urban compatibility, that is, to a sufficient overall assessment.

The municipality of Moliterno, compared to the CLE configuration, had some criticalities due to the concentration of the AEs in a single area, i.e. near the sports field (AE 1, 2, 3, 4, 5, 6, 7), and to the little consideration of the relationship between the emergency management system and the strategic components for recovery.

To improve the assessment of urban compatibility (see Fig. 4), it was intended to act precisely on a greater distribution of the AEs; in this way it was possible to involve more parts of the settlement and components for the recovery.

In particular, the new AEs are:

8) area in front of the municipal villa;
9) Piazza Immacolata;
10) Area in Via Madonna del Vetere, at the ES 6 Traffic Police Barracks;
11) Piazza Kennedy (in Via Parco del Seggio), at the ES 2 Carabinieri Barracks.

For new AEs, it is necessary to identify the AC Connections that can allow accessibility.

In this regard, the road system that is added to that of the emergency management system includes three road sections: Corso Umberto I, Via Amendola and Via Istria. Corso Umberto I retraces part of the Provincial Road which rejoins the AE at the sports field; moreover, this road section is essential because it is the only one that crosses the ancient building fabrics (Zone A identified in the PRG), generating a strong criticality due to the presence of numerous US interfering structural aggregates. These criticalities and interferences will be duly taken into consideration in the subsequent phases of the SUM. Following the identification of new components within the CLE emergency management system, it was possible to carry out a new urban compatibility assessment, in order to verify that the overall assessment is sufficient for the basis of the study on the SUM.

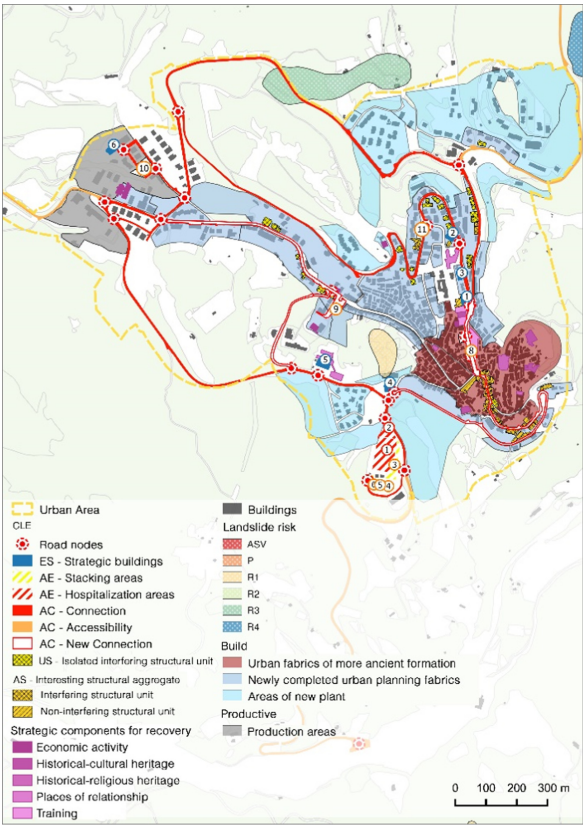


Fig. 4. The map shows the improvement of the urban system for the management of the seismic emergency in Moliterno municipality.

In conclusion, the new elements of the emergency system led to a Medium-high urban compatibility assessment, starting from the partial results (medium-high, high). By comparing this result with the efficiency evaluation, an overall Average (4) evaluation is obtained, which in this case is sufficient to represent the first phase for the identification of the SUM.

4 Conclusion

The improvement of the management system of the emergency was made possible by taking action on the assessment of urban compatibility. The added Stacking Areas (AE) have been located in in order to respond to further needs, related to the resumption of the settlement after the earthquake, which go beyond the initial state of emergency.

Its localization has also considered the presence of areas subjected to hydrogeological risk; however, for an effective definition, it would be useful to fill in the appropriate CLE maps also for these items. In fact, this is mainly a attempt to affirm what - by posing more attention to all fabrics of the residential type settlement and the strategic

components for the recovery - it is possible to create a system emergency management that has a significant contribution to the recovery. Following the changes made, the emergency management system for the three municipalities is organized in a manner to have an overall evaluation sufficient; in thus, the CLE can represent the first phase of identification of the Minim Urban Structure (SUM). Generally, in the first phase they are identified precisely the components of the structure strategic urban areas for the response urban to the earthquake. The integration of CLE with SUM, following improvement changes in the organization of the elements of CLE, is only possible when it also meets urban compatibility criteria connect also with smart and sustainable urban development [31–33]. The SUM, therefore, can help the CLE Analysis and bring together the results of this study in the first phase of its global structure. Basically, it comes down to two orders of results; the first is an increase in efficiency of the resources made available for achieve the mitigation objective seismic risk on the urban scale; the second result, is the predisposition of apparently a contact between two realities distant, which come from needs different, where it is however possible establish convergences.

An intersting development perspetive of this research also is to inlcude in the territorial assessment the dimension of ecosystem services as a territorial value under risks [34–36].

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