ABRUZZO AS A TWO-FACED REGION: BETWEEN VULNERABILITY AND ENVIRONMENTAL SAFEGUARD

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Abstract. Since its establishment, safeguarding and enhancing the landscape and the environmental heritage represent two key-elements in Abruzzo's regional planning. Several implemented plans, regulations and official documents over the years have been underlying the creation of an integrated regional development programme, increasing the image of Abruzzo as a "Green Region of Europe" (one-third of the protected surface so as to have three National Parks and a Regional Park). By contrast, recent national and regional reports show that Abruzzo – in all its four provinces – ranks among top positions in Italy as regards vulnerability risk in terms of surface, population, enterprises and cultural heritage, with percentages well above the national average in each category. These data present a jarring framework compared to the initially envisaged image of regional environmental rebalancing. The recentmost natural catastrophic events (abundant snowfalls within in a few days and continuous earthquakes) suggest the need for studying the actual resilience of the region. In view of it, it is important to assess the real control of the territory, the spending capacity of the local authorities and the broader coordination of the involved institutional actors, in order to avoid – or at least to restrict – situations that have been recognized to severely damage real estate assets, and incur especially heavy human losses.

1. INTRODUCTION

The complex relationship between human beings and the environment, if viewed in an anthropocentric perspective, recognizes the natural elements as resources, neutral features, or hazards for humanity (Pelling, 2001). In this sense, natural events and conditions are not *prima facie* classifiable; they can be, according to the territorial, temporal and socio-economic context, favourable, neutral or harmful to human beings.

When considering potential environmental disasters, one must consider natural risk on the one hand, and human vulnerability on the other: as regards natural risk, it is necessary to examine the magnitude and frequency of events; as for human vulnerability, exposure, resistance and resilience must be taken into account.

The process of hazard assessment can be conducted on three levels of analysis: hazard identification, vulnerability assessment and the risk analysis (Deyle *et al.*, 1998).

The first essential phase concerns the process of estimating the geographical extent of the hazard, its intensity and probability of occurrence. It is important to underline that not every natural hazard leads to *catastrophic* disasters (earthquakes, floods, etc.), but there are also more common hazards, less visible at first, which include everyday risks to human health and wealth, the so-called

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chronic disasters; in the latter case, an extended definition could include fragile and unstable lands, subject to landslide risks.

The second element to consider is vulnerability; according to a broad definition of this concept, it means: *the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard* (Wisner *et al.*, 2004, p. 11). This definition has a proactive inflection that focuses on the ability to build over time a system able to reduce permanently the impact on the population caused by a risk exposure. About vulnerability, the focus is on people's adaptive capacity: in a physical location, with a given exposure to risks due to some characteristics of built and natural environment, it is important to define the resistance and resilience of a socio-ecological system (Gallopin, 2006).

Resistance to a disaster means the capacity of an individual or a group to withstand the impact of a hazard; in order to strengthen the resistance of a group to natural hazards, it is crucial to improve the goals of economic, social and political inclusion, to ameliorate infrastructures, the health system and so on.

The degree of resistance of a community is based on two concepts: exposure, meaning the gradation, duration and extent to which the system is in contact with, or subject to, perturbation and sensitivity, namely, the extent to which a system can absorb impacts without suffering long-term harm or other significant state change (Adger, 2006).

Close to the concept of resistance is resilience: resilience to natural hazards is the ability of an individual or collective actor to cope with or adapt to the hazard stress.

According to the prominent literature, the concept of adaptive capacity should be incorporated into resilience: adaptive capacity *is the set of potential actions that contribute to the potential minimum vulnerability but not to the existing vulnerability* (Luers, 2005, p. 218). Speaking of hazards, some authors consider that it is better to use the concept of mitigation instead of adaptive capacity, understood as *any action taken to reduce or avoid risk or damage from hazard events* (Cutter *et al.*, 2008, p. 600).

The third level of analysis concerns the risk analysis, which stimulates reflections on the concept of acceptability; the extent to which risks are identified, and the ways in which they are managed, will depend on a range of individual, social and situational factors (Brown, Damery, 2009). Usually, there are two weak points in risk analysis: first, institutions approach the topic of acceptable risk only from an economic point of view rather than considering the overall impact of the natural hazard; second, many structures and procedures employed by government agencies are built on determinism (collected data, models of predictions, communication often top-down rather than deliberative).

The hazard assessment framework is particularly interesting as a topic of discussion in the context of protected areas.

The first idea behind the conception of protected areas is strictly focused on conservation, where nature itself dominates a landscape, conceived deterministic, by the beauty of its landscape and by its biological and aesthetic values, so as to require protection.

In time, the idea of protected areas and the consequent concept of safeguard has become more complex, including the identities of inhabitants, with their cultural background. Thus, protected areas turn into instruments to protect and, at the same time, enhance both natural and human resources that are part of them; consequently, there must be a harmonization between conservation and development within the park.

Protected areas allow for the monitoring of human interventions on their territory, not only to preserve, but also to promote those activities capable to induce a development process also in marginal areas, maybe recovering some practices that are fading away, or creating original patterns of actions compatible with the environment, so as to build new economic outlets.

Therefore, the institution of natural protected areas is one of the most demanding aspects in the ecological subject considered like a process of global planning. It passes over the easy protectionist or preventive aim to lead to territorial forms of management able to respond to concrete economic, social and cultural needs.

By recognizing that natural systems are often resilient is not the same as assuming that these natural ecosystems represent a buffer for human societies against disasters. Therefore, it is essential to make natural ecosystems within protected areas able to mitigate disasters in ways that are convenient for human beings; this function will need to be reflected in the management plans and budgets of protected areas.

Where properly planned and budgeted, protected areas can play three direct roles in preventing or mitigating disasters arising out of natural hazards: maintaining natural ecosystems (...); maintaining traditional cultural ecosystems that have an important role in mitigating extreme weather events (...); providing an opportunity for active or passive restoration of such systems where they have been degraded or lost (Randall, Stolton, Dolcemascolo, 2010, p. 101).

The effectiveness of the role of protected areas in preventing, or mitigating, disasters must be assessed in the light of the governance model chosen for them. According to Eagles (2008), there are several models of protected areas governance; substantially, there are four basic models of governance: fully public management (National Park Model); parastatal model; non-profit organization model; private model (ecolodgical model).

All these models, and their combinations, have advantages and disadvantages. Public agencies are able to carry out in-depth analyses and potentially manage large and reliable sources of incomes coming from societal taxes, but they must face a certain bureaucratic and procedural rigidity. Parastatal agencies are more flexible, have a better knowledge of local issues and could have different kinds of revenues (user fees and so on), but they risk to fragment land protection actions, which need to be designed in a comprehensive and unified way, even on a large scale. The contribution of private companies is difficult to establish; usually non-profit activities are very interested in protecting the environment, but they often lack adequate professional skills and economic resources; for profit corporations, despite having large economic means, they often try to maximize revenues and turn the protected area into a product suitable for service users.

The current study is aimed at applying such theoretical premises in order to assess the effectiveness of territorial policies in a context where, on the one hand, there is a marked exposure to natural risks, while on the other, there is a strong propensity to environmental protection. The objective of this work is to produce new synthetic cartographic representations in which the distribution of some environmental hazards can be superimposed on protected areas, by using the capability of geography to hypothesize relations that normally escape different analytical points of view.

2. STUDY-AREA

The Abruzzo region is located on the eastern slope of the Central Apennine Chain, with a complex geological and structural framework. The region has been affected by extensional tectonics, uplift processes and morphostructural processes; these events have shaped the three major morphological domains in the Abruzzo area: the Apennine Chain, the Adriatic Piedmont, and the Adriatic Coastal Plain (D'Alessandro *et al.*, 2003).

The Apennine Chain in Abruzzo consists of duplex geometries made up mostly of carbonate: an outer Apennine fold-and-thrust belt divided into two systems, the Lazio-Abruzzi Unit (comprising the Simbruini Ridge) and the Abruzzi Unit (comprising the Gran Sasso-Monte Genzana Unit, 2,912 m. altitude); a series of tectonic windows emerging from the Apulia-Adriatic platform (comprising the Maiella, 2,792 m. altitude, Mount Morrone, 2,061 m. altitude, Mount Sirente, 2,349 m. altitude, and other related forms of relief of relevant altitude) (Vezzani *et al.*, 2010).

Consequently, the morphology of the Central Apennine Chain is asymmetric, with its highest peaks rising eastwards of the main Tyrrhenian–Adriatic drainage divide.

Local extensional tectonics affected the Apennine Chain, producing the formation of intermediate topography undulations along the main NW–SE-directed extensional fault systems. This

caused the uplifting of the chain system, the formation of the intermontane basins, the ensuing widening of the chain area and the emersion of the Adriatic Piedmont (Miccadei *et al.*, 2017).

The present-day tectonic setting is characterized by extensional tectonics still active in the axial part of the chain, with intense seismicity and strong historical earthquakes (Di Bucci, Angeloni, 2013), like those of Fucino in 1915 and L'Aquila in 2009.

The morphostructural elements in Abruzzo are affected by the main surface processes (mostly fluvial, slope, lacustrine, karst and glacial) induced and controlled by climate fluctuations, local and regional tectonics and related base level variations.

The main transversal valleys define the connection of the drainage system of the Apennine Chain with the one in the Piedmont area. Along the front of the chain, a sequence of alluvial fans and terraced fluvial deposits provides evidence that the incision occurred because of uplifting and the drainage network deepening, with the development of intense erosion processes.

The Adriatic Piedmont started developing during the emersion phase that occurred in the Pleistocene. Its morphostructural setting is the result of the late evolution of the Adriatic foredeep domain of the Apennine orogenic system, with a coarsening-up sequence of marine clayey-sandy-conglomerate rocks. There are slopes incised by approximately SW–NE-oriented consequent valleys and covered by landslide and colluvial deposits. Therefore, the piedmont area is mainly characterized by selective erosion processes (Buccolini *et al.*, 2010).

The Abruzzo Coastal Belt is a narrow, elongated plain bounded by palaeocliffs in the northern part and a rock coast with cliffs of variable height and small beaches in the southern part. Coastal plains are characterized by Holocene continental, transitional and marine deposits, with mainly silty and sandy lithotypes. The coastal plain continuity is interrupted by urban areas and coastal hydrographical arrangement, mainly characterized by valleys directly flowing towards the Adriatic Sea (Parlagreco *et al.*, 2011).

According to this morphostructural partition, Abruzzo has been divided, for statistical purposes, in three main zones: the inland mountains, the inland hills and the coastal hills.

The inland mountains, with 7,050 km^2 (65% of regional surface) and 166 municipalities, correspond to the Apennine Chain, with the entire province of L'Aquila (5,048 km^2) and some parts of the other provinces; this area, despite its large surface, has a low population density, with only 366,813 inhabitants at the beginning of the year 2017 (52 inhabitants per km^2). Among the most relevant cities are the regional chief town L'Aquila (69,605 residents), Avezzano and Sulmona, all three placed in the flattest areas of intermontane basins.

The inland hills broadly match the inner areas of the Adriatic Piedmont in Abruzzo, covering 1,681 km^2 and having 199,840 inhabitants. This is an area of transition with few relevant municipalities, including the provincial chief town of Teramo (54,775 residents).

The coastal hills fall into the outer portion of the Adriatic Piedmont and the Coastal Plain with a surface-area of 2,100 km^2 and high population densities – 755,594 people (360 inhab./km^2). Among the 73 municipalities falling into the coastal hills, 19 are effectively in front of the seaside, mostly characterized by a significant urbanization rate, due to a multitude of advantages and consequently to an internal migration process. The seaside municipalities have 443,473 inhabitants, living in a very narrow area (639 km^2), accounting for 34% of the total regional population; among them, the most populated city in Abruzzo, is Pescara with 120,420 residents. These main characteristics are summarized in Fig. 1.

Along the coastal areas, the rapid growth of population has consolidated a very important phenomenon of urbanization, with the development of dual settlements in most of the coastal municipalities. Historically, the first settlements, usually positioned on the hills immediately overlooking the sea; the latter in the lower flattest areas, after the draining of marshes and the improvement of accessibility by means of relevant communication arteries (railroad and, subsequently, high slip roads and motorway). Nowadays, the population growth is concentrated almost on the narrow coastal strip, while the settlements on the hills have lost much of their historical relevance.

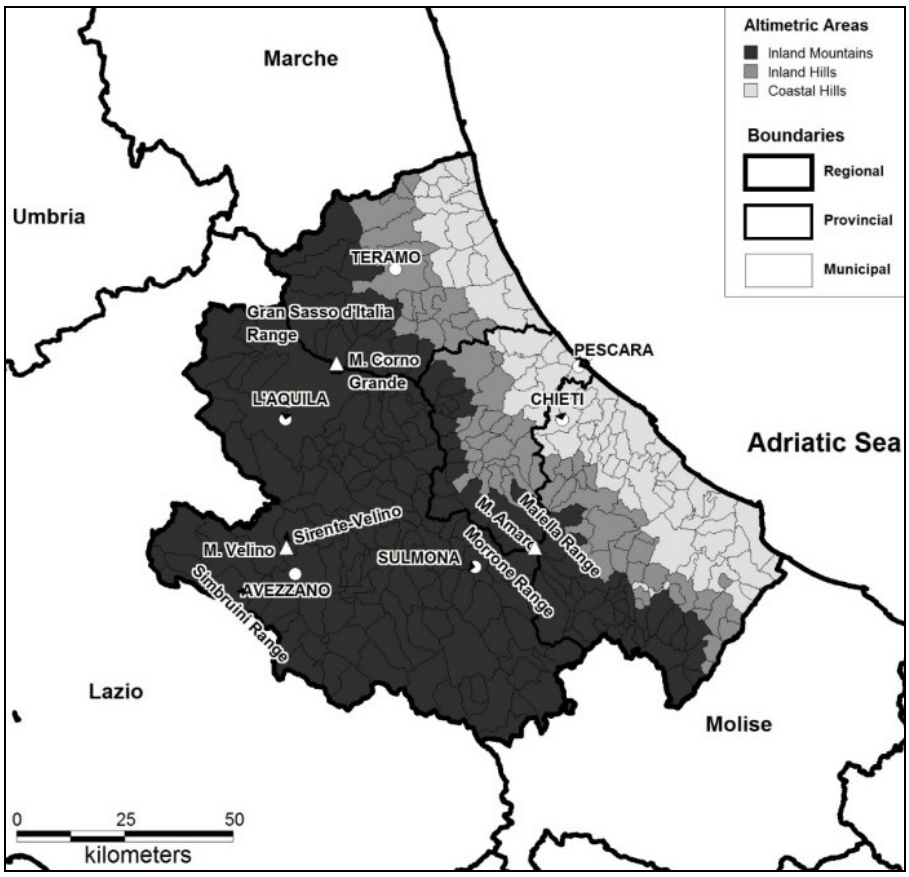

Fig. 1 – Study-area of the Abruzzo Region (Italy).

From the point of view of the urban layout, the region contains a metropolitan area, collocated at the edge of the urban and functional regional hierarchy, formed around the axis constituted by the two chief provincial towns of Pescara and Chieti, presenting phenomena of diffusion of suburbanization and periurbanization, which have allowed the strengthening of a network of intermediate centres, functionally relevant.

Therefore, at first sight, the land consumption phenomenon (Fig. 2), meaning the degree of land artificialization and subjected to human pressure, is obviously increasing, moving from the inside to the coastal areas. In the mountain area, only some municipalities use its territory, to the best, most relevant in this respect being in L'Aquila; however, in this case, the percentage of land made use of is only 6% of the whole surface, due to the high territorial extension of the municipality. In the coastal areas, in particular from Martinsicuro, at the northern regional borders, to Ortona, immediately south to the main regional conurbation area of Pescara-Chieti, there is a real continuum of urbanization, due to vast processes of territorial artificialization (industrialization, tourism, commerce, etc.). The most relevant percentages of land consumption in the coastline municipalities have Pescara (51% of the municipality surface-area), Montesilvano (33%), Martinsicuro (33%) and San Salvo (32%).

Conversely, in the inner areas, there is a historical and now consolidated process of depopulation, there is a high rate of uninhabited dwellings. This is mostly the consequence of the abandonment of inland mountain areas, causing the degradation of heritage building; however, in some cases, there is a growing phenomenon of second houses for winter tourism areas, with a noticeable presence of recently made buildings, used mainly for seasonal holidays.

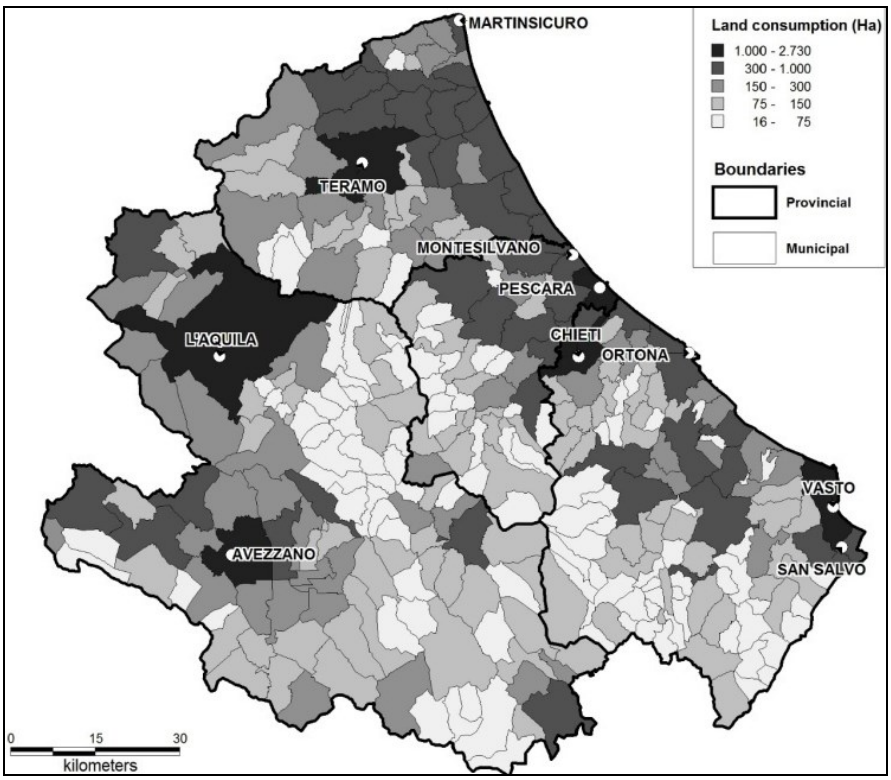

Fig. 2 – Land consumption (ha) in Abruzzo (based on ISPRA, 2016 data).

3. METHODS AND DATA

Given the broad heterogeneity of available data and of the regional plan documents, we have agreed to make use of mixed methods in order to offer a qualitative interpretation of existing information. In a first phase, through a synthetic cartographic approach, we will be able to recognize – graphically – what the vulnerabilities of the Abruzzo region are, and, by contrast, which is the level of environmental safeguard, in terms of protected territorial surface, deriving from the institution of five Parks, between National and Regional ones. A single cartography will be provided in greater detail concerning the territorial extent of all the Regional and National Parks currently instituted, or in the phase of being approved, in Abruzzo region; then, for each of the vulnerabilities deriving from the Regional data and Regional plan documents, one specific cartography will be provided. The second phase of the study concerns a qualitative description of the current issues of Abruzzo region, on the basis of the evidence deriving from the cartographic support. In this way, although not exhaustive for understanding what measures of interventions are needed for achieving a regional equilibrium, it will be possible to outline some preliminarly suggestions and trajectories to be pursued for accomplishing a balanced management between the natural protected environment and all the related territorial vulnerabilities.

In particular, after having discussed – in the previous paragraph – the main demographic and orographic characteristics of the Abruzzo region, with the support of a series of datasets concerning environmental risks and protected areas (elaborated on ISTAT data, the Italian statistical authority), we are going to outline the human and social landscape of the Region, especially in inland areas, where the issues of depopulation and aging are of particular importance.

In what concerns environmental protection, the respective cartography will show the spatial extent of all the National and Regional Parks currently active in the Abruzzo region (§4.1), while for environmental vulnerabilities the choice is to describe the sequence of landslide risk (§4.2), avalanche risk (§4.3), the risk of hydrogeological instability (§4.4) and the seismic risk (§4.5). For each of the aforementioned subparagraphs, a synthetic cartography and a related qualitative interpretation will be provided in Section 4 (Results and Discussion), with general considerations and preliminarily intervention hypotheses being included in Section 5 (Conclusions).

Data concerning the protected areas of the National and Regional Parks in the Abruzzo Region are available in "Natura 2000", a source depending on the national Ministry of Environment, which is a network based on the European Directive 92/43/CEE, aimed at providing instruments to guarantee the long-term maintenance of natural habitats. Data regarding these risk phenomena can be obtained by consulting the databases provided by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale), a national government agency, which published in 2015 an accurate report about hydrogeological instability in Italy. Furthermore, the PAI (*Piano per l'Assetto Idrogeologico*, that is Plan for the Hydrogeological Asset), elaborated by the regional government, has been used. The definition of the earthquake risk, is based on evidence from the Civil Protection Department and from the agencies created to manage post-earthquake emergencies in 2009 and 2016 (USRA, *Ufficio Speciale per la Ricostruzione dell'Aquila*, USRC, *Ufficio Speciale per la Ricostruzione dei Comuni del cratere*, COR, *Centro Operativo Regionale Abruzzo sisma 2016*).

An important passage which is present in all vulnerability cartographies, is overlapping risk maps, as collected, to those of the perimeters of Parks (identified in subparagraph 4.1), intended as the most extensive areas of environmental protection management. This phase will allow to individualise visually what the convergence areas between protection and vulnerabilities are, and to elaborate some initial considerations, surely to be explored further, regarding the opportunity and appropriateness of some political issues.

4. RESULTS AND DISCUSSION

As previously outlined, the Abruzzo Region has highly vulnerable morphogenetic structures, including: landslide risk, due mostly to the porosity of the sandy and silty rocks of the Adriatic Piedmont, and related hydrogeological instability; avalanche risk due to the steep slope of some mountains; the continuous seismic movements triggered by the orogenic activity of the Apennines. All these vulnerabilities will be discussed after having identified the perimeters and the main characteristics of the five protected areas currently active in Abruzzo.

4.1. The environmental framework: protected areas in Abruzzo

The great variety of landscapes in Abruzzo, over a relatively small distance from sandy beaches to mountain karst rocks, induced government bodies to institute many protected areas, so to coin a slogan as "Green Region of Europe", due to its high concentration of protected areas (Cavuta; 1995; Massimi, Cardinale, 1995; Cardinale, Fuschi, 1998).

Currently, this propensity to environmental protection has led Abruzzo to be the most relevant region in Italy in terms of protected areas included in the European Natura 2000 Network (Fig. 3); more than a third of the regional land surface represents sites of natural interest (35.74%), well above the national average, and one of the highest in Europe.

Among the most important environmental protection sites, Abruzzo has three National Parks, one Regional Park, one planned National Park in the coastal area (Fig. 2) and, also other minor areas.

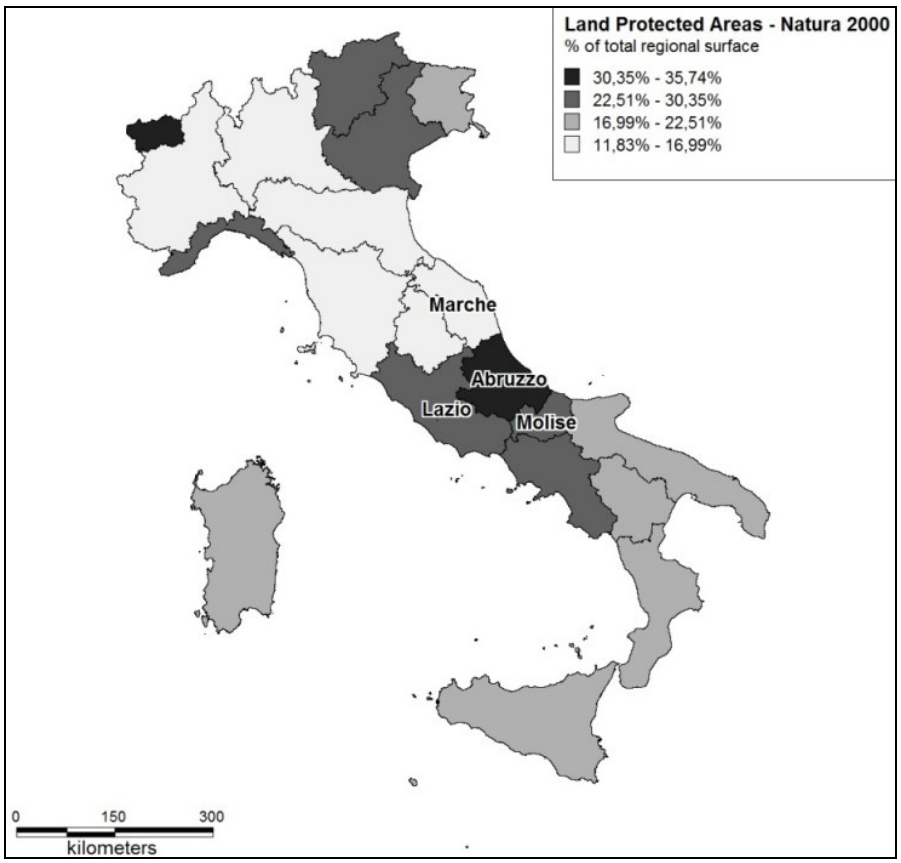

Fig. 3 – Natura 2000 sites in Italy in 2017 (Based on Ministero dell'Ambiente data).

The Abruzzo, Lazio and Molise National Park (PNALM) is the most ancient protected area in the Apennine Chain; originally founded at the beginning of the 20th century only in the south-west portion of the Abruzzo territory, it has in time been enlarged to Lazio and Molise regions. The Park area is characterized by a relief arranged as a series of ranges, separated by deep fluvial valleys (River Sangro is the most remarkable one); the landscape is dominated by the Meta Range (Mount Petroso, 2,247 m. altitude, Mount La Meta, 2,242 m. altitude), but there are still other peaks higher than 2,000 m. altitude (for instance Mount Marsicano and Mount Greco in the external protected Park area). The Abruzzo portion of the Park actually occurs in 12 municipalities of low demographic relevance (with an overall population in this area of 12,143 residents; the most important town, Pescasseroli, has only 2,208 inhabitants).

The Gran Sasso e Monti della Laga Park is also an interregional environmental park, which extends for the most part in Abruzzo, but involves some municipalities of Lazio and Marche. The landscape of the Park is predominantly mountainous, marked by the presence of three mountain groups, with the highest peaks in the Apennine Chain: the Monti della Laga Chain, a siliceous lithology, consisting of sandstones, the Gemelli Mountains and the Gran Sasso d'Italia Chain, with a carbonatic, calcareous and dolomitic lithology. The Park covers a large surface-area in Abruzzo, including 40 municipalities with a total population of 128,983 residents, mostly in the chief regional-town of L'Aquila (69,605 residents).

The Maiella Park is geographically made up of four great orographic individualities – the Maiella itself, a large and compact limestone massif, the Morrone, the Porrara and the Monti Pizzi. The Park is founded on 39the territory of municipalities, with an overall population of 87,598

inhabitants; the most important town is Sulmona with 24,454 residents; other relevant settlements are Guardiagrele, Pratola Peligna, Manoppello and Popoli.

It is important to remark that the three established National Parks coincide with relevant portions of the three main geological units of the Apennine range in Abruzzo: the Lazio-Abruzzi Unit, the Abruzzi Unit and the Apulia-Adriatic Unit.

Another protected area in Abruzzo, instituted by the regional government, is the Sirente-Velino Regional Park, consisting of two massifs, the Sirente (2,348 m. altitude) and the Velino (precisely, whose orography serves as a bond between the massifs of the geological unit of Lazio-Abruzzo and of the Abruzzo unit). The Park is spread over the territory of 22 municipalities, with 34,650 inhabitant (the most relevant town, Celano, has 10,982 residents).

The National Park of the Costa Teatina, established by a national law in 2001, but still not concretized, should be added to the current panorama of national and regional parks. It will be located in the southern seaside, consisting largely of rocky coasts. It should involve 10 municipalities in a densely populated area (111,108 residents, with cities such as Vasto, 41,283 inhabitants, Ortona and San Salvo).

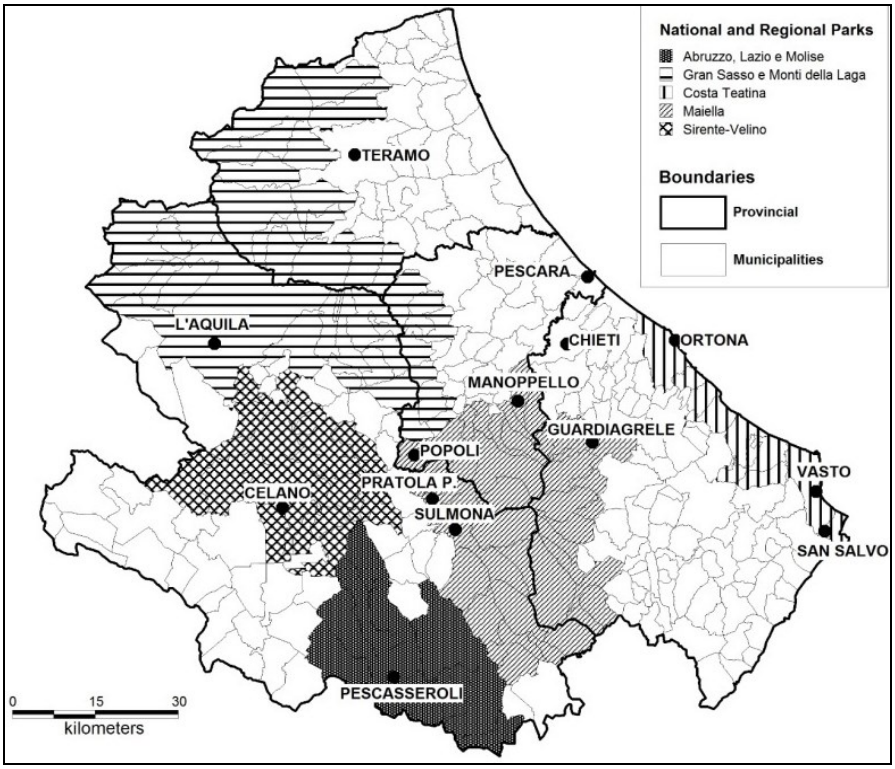

Fig. 4 – National and Regional Parks in Abruzzo.

4.2. Vulnerabilities – Landslide risk

Landslide risk could be understood as one of the most important *chronic* disasters, especially in Italy, with hilly and mountainous terrains exposed to seasonal rainfalls. The most relevant problem in evaluating landslides is to make the difference between hazards and risks: the landslide risk is affected not only by morphological settings, suck as hazards, but also, and above all, by population density and human settlements in landslide-prone areas (Guzzetti, 2000; Salbego *et al.*, 2015).

Abruzzo is marked by intense exposure to landslide hazards, the typologies regarding rotational/translational shifts and slow mudslides prevailing mostly in the Adriatic Piedmont, where soils consist of shales, conglomerates and sandstones. Such lithological characteristics condition the hydrogeological structure with the presence of aquifers confined in clayey lithotypes, towards which punctual and widespread water emergencies favour landsliding (D'Alessandro *et al.*, 2007).

The ISPRA national report on landslide risks (ISPRA, 2015) proposes a classification largely based on the concept of population at risk from landslides, divided in 4 categories: P1 – low; P2 – average; P3 – high; P4 – very high.

According to this classification, the ISPRA survey in Abruzzo estimated that 19.25% of the regional territory is exposed to landslide risk; more precisely, the P3 high risk affects 9.13%, the P4 very high risk 5.76%, the P1 and P2 risks together, 4.36%.

In particular, the hills in Teramo and Chieti provinces (due mostly to their proximity to river basins) and Valle Roveto at the southwestern border with Lazio, are the most exposed areas to landslide risk.

The Piedmont Adriatic hills are the more exposed to this risk; in small municipalities like Castelguidone (368 residents) and Colledimacine (191 residents), the percentage of high risk rises to over 55%, and many others (108 municipalities overall) show values over 22% (Fig. 3).

This situation of constant danger in very small territorial communities, consisting mainly of an elderly population, must be included in a management organized by several actors at various government levels, since the resources, economic and human, of these small municipalities are certainly not able to cope with situations of prevention, constant monitoring and rapid response to any risk events.

The landslide risk does not involve too much the Parks' protected areas, but there are some cases of municipalities with considerable propensity to it, especially in the Maiella National Park (Palombaro, Montenerodomo, Ateleta) and in the Gran Sasso-Monti della Laga National Park (Corvara, Pescosansonesco, Villa Celiera, Brittoli); these areas represent borders of transition between mountainous and hilly territories, with the superposition of different soils.

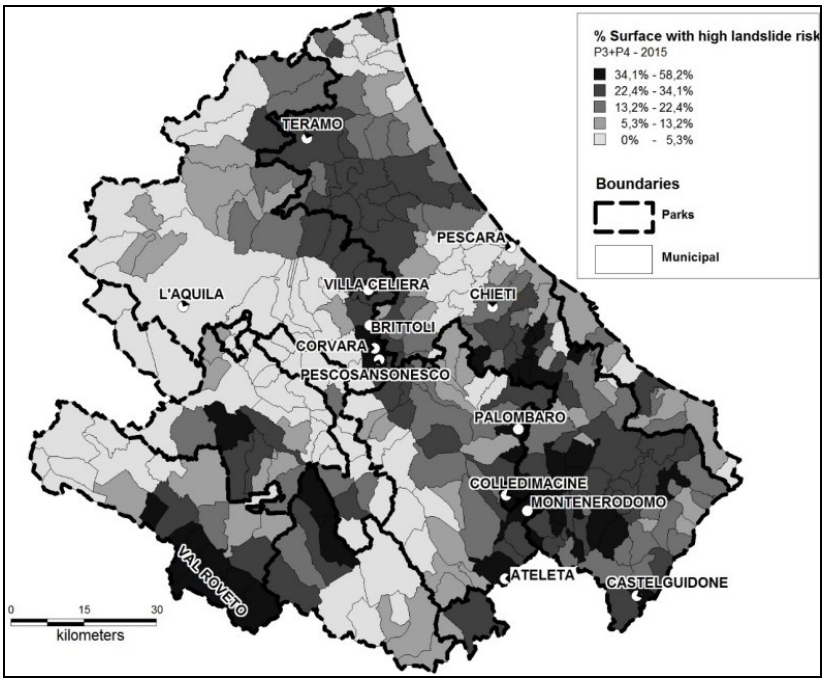

Fig. 5 – High landslide risk and National and Regional Parks in Abruzzo (based on ISPRA data, 2015).

4.3. Vulnerabilities – Hydrogeological instability

By enlarging the discussion to the whole issue about hydrogeological instability in Abruzzo, it should be noted that the regional government has drawn up a specific plan called the PAI (*Piano per l'Assetto Idrogeologico*, that is "Plan for the Hydrogeological Asset", hence forward called PAI), in order to classify the hazards (based on the systematic periodic review of a database containing the recorded events), and then elaborating a process of assessing specific risks (considering their potential impact on the population).

The first step for the regional government was to create a database and the subsequent classification of the events occurred, building up a map of dangerous sites from the hydrogeological point of view, based on objective evidence. According to the PAI classification, the region has 1,561 km^2 of potentially dangerous surface-areas, divided as follows: P1 – Average, 402 km^2; P2 – High, 882 km^2; P3 – Very High, 278 km^2.

In a second phase, this classification has been intersected with data from different types of human settlements. In accordance with the national legislation, the regional government has finally built a risk matrix, in which the most dangerous risks are considered in areas with higher hydrogeological and landslide dangers and more concentrated population densities, so evaluating the vulnerability of each different place.

The result of this classification process shows that the most relevant risks (R4) are only those in scattered settlements and in larger urban centres at higher danger (P3).

Table 1

Classification of hydrogeological risks in Abruzzi, according to PAI

Valuable elements	**Dangers**		
	P1	**P2**	**P3**
Agricultural and forestry areas	R1	R1	R1
Areas with environmental constraints	R1	R1	R1
Public and private service areas	R1	R1	R2
Infrastructures of local relevance	R1	R1	R2
Railroads	R2	R2	R3
Production and technological plants	R2	R2	R3
Infrastructures of national or regional relevance	R2	R2	R3
Settlements with scattered buildings	R2	R3	R4
Urban areas	R2	R3	R4
Dangers: P1=Average; P2=High; P3=Very High **Risks: R1=Low; R2=Average; R3=High; R4=Very High**			

Source: Regione Abruzzo, 2008 and subsequent amendments.

On the contrary, protected and agricultural areas obviously do not have significant demographic burdens, even if they occupy a large part of the regional territory; so, they are classified as low-risk territories (R1), despite the relevance of potential dangers.

As a result, areas actually recognized in the region have been divided as follows: R1 – Low, 1.528 km^2; R2 – Average, 22 km^2; R3 – High, 8 km^2; R4 – Very High, 3 km^2. Therefore, such a classification could lead the regional government to neglect dangerous situations, when they occur outside the densely populated areas; even the compilation of the inventory of events, often based on direct observation, may favour an imbalance towards human settlements in the future.

These choices are justified by limited access to economic resources to counteract the hydrogeological hazard, thus focusing efforts only on areas where human well-being can be improved.

It is necessary to rethink the entire architecture of the Plan in this sense, so as to safeguard also the areas of environmental and agricultural protection, even if the interventions are of low impact on the population, but this means a necessary increase of economic and human resources to provide for land care.

4.4. Vulnerabilities – Avalanche risk

Forecasting avalanches has a major fundamental physical uncertainty in the usually unknown temporal and spatial variations of instability in the snow cover, including their links to the terrain; one of the most relevant problems is connected with human perception of the avalanche risk (McClung, 2002).

In the 1957–2013 period, according to the database built by the regional government and Meteomont, 799 avalanche events were recorded; most of them took place in the Park areas.

Among the Parks with major avalanche events, the Gran Sasso and Monti della Laga National Park (471) are worth mentioning, especially in the towns of Pietracamela, Fano Adriano and L'Aquila.

These movements usually take place rapidly, with erratic frequencies and, as a rule, in areas of very low population density, so the avalanche phenomenon is often considered irrelevant in the perception of natural hazards in Abruzzo.

Yet, on 18 January 2017, at about 17.00 p.m., from a ridge about 1,900 m. of Mount Siella (Gran Sasso Massif), a snow avalanche triggered by a seismic event destroyed a forest along the way, reaching finally the locality of Rigopiano in the municipality of Farindola (PE), with catastrophic consequences. The avalanche in fact fell on Hotel Rigopiano, currently occupied by 40 people, guests and service personnel: 29 people died and the impact destroyed the structure (Regione Abruzzo, USR, 2017).

Only after this tragic event, the regional government, under pressure from the negative impact on public opinion, is trying to produce a specific plan to improve the techniques of observation, control and response to avalanche phenomena.

4.5. Vulnerabilities – Seismic risk

Since the Quaternary, the region of the Central Apennines has been deformed by active extensional tectonics following the eastward migration of the Apennine compressional front. A broad and complex pattern of normal faults is the result of superposition of extensional systems in areas previously affected by compression. Today, an almost continuous, but segmented, NW-trending active normal fault belt runs along the Northern-Central Apennines between the Adria and the Tyrrhenian plates (Chiaraluce, 2012).

Due to Abruzzo's high exposure to the seismic risk, the national classification of the region includes it, apart from a strip of land close to the coast and the nearest coastal hills, in the higher risk categories (Fig. 6).

In addition, interventions were planned for the reconstruction of private buildings in the area of the earthquake after the completion of a specific damage-assessment investigation. In this case, in addition to the earthquake area established by national law, reconstruction works could be reimbursed also in other municipalities, if earthquake-incurred damages were recognized.

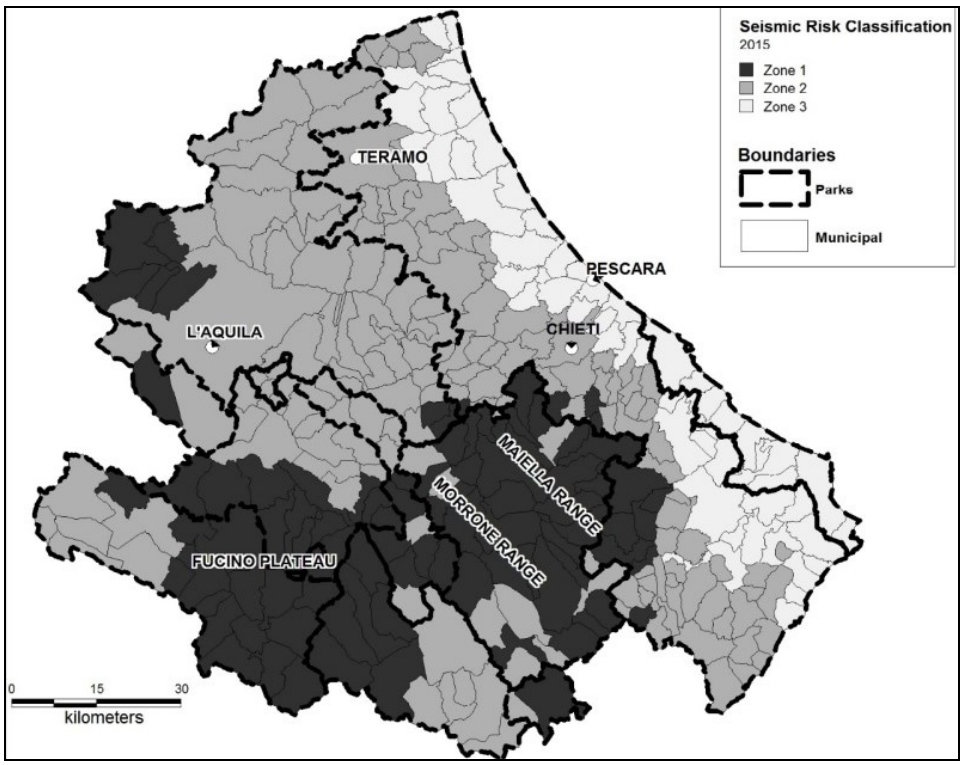

Fig. 6 – Seismic Risk in Abruzzo (based on Protezione Civile data, 2015).

Due to these provisions, the area of post-earthquake reconstruction works has greatly expanded, including also some municipalities lying at a great distance from the epicenter (Fig. 7).

The amount granted for private reconstruction was actually of 6.5 billion euros, out of which 4.8 were disbursed in the city of L'Aquila, 1.4 in the other municipalities of the earthquake area, while over 300 million euro were distributed to municipalities outside the earthquake perimeter (Regione Abruzzo, USR, 2017).

More recently, between August 24, 2016 and January 18, 2017, a new earthquake struck Amatrice and other areas on the border with Abruzzo, causing damages also in some municipalities of the Abruzzo region (involving a large area in the province of Teramo and some municipalities in the north of L'Aquila province), included in some national laws (Fig. 8). The original area of intervention planned after the earthquake of August 2016 (with 8 municipalities) was extended for the first time after the new earthquakes of October 2016 (to additional 6 municipalities) and, finally, another time in January 2017 (to other 9 municipalities, including Farindola, where the tragedy of Hotel Rigopiano had occurred).

The economic impact of this new seismic event is not yet quantifiable, but 20 million euro were planned for public buildings and 24 million for the reconstruction and consolidation of schools (Regione Abruzzo, USR, 2017).

The latest earthquakes involved mainly the Gran Sasso Massif area, in communes with territories falling mostly in the protected National Park perimeter.

The high number of deaths and injuries and the heavy reconstruction costs, available only through national funding and exceeding the national community's investment capacity, reiterate the need for prevention and protection against the seismic risk.

Although it is very difficult to foresee such sudden and catastrophic events, yet national and regional policies have never been very proactive in Abruzzo in preventing accurately this type of hazard and its consequent vulnerability, though a historical memory of seismic risk did exist.

Above all, it is the build-in heritage that needs a deep-going restructuring, especially in mountain areas; paradoxically, the progressive abandonment of villages and their continous exposure to negligence and temporal degradation have almost made decision-makers forget the urgency of preserving the buildings.

As previously anticipated, Figures 7 and 8 represent the two areas subjected to the two main seismic events which affected Abruzzo region, in 2009 and 2016, respectively. As a consequence of these two different catastrophes, the overlapping of levels of governance in the processes of reconstruction *ex post facto* has resulted in several management problems, which have generated mainly phenomena of parochialism among the interested municipalities, due to the large amount of resources needed for reconstruction. In this way, in order to have access to the funds destined to reconstruction, some local entities have in many cases tried to prevaricate on others, sometimes ignoring the real priorities of those municipalities which had suffered more from the earthquakes, and generating confusion and visible mistakes in the process of allocating the resources.

However, vulnerabilities do not respect administrative boundaries; a good model of territorial governance should therefore overcome the short-range logic and organize, in a systemic and perspective way, a global and supportive response to meet the needs for the seismic protection of the territory. A deep reflection on the resilience capacity of Abruzzo (Ferrari, Fuschi, 2014) could mitigate the effects in cases of catastrophic events.

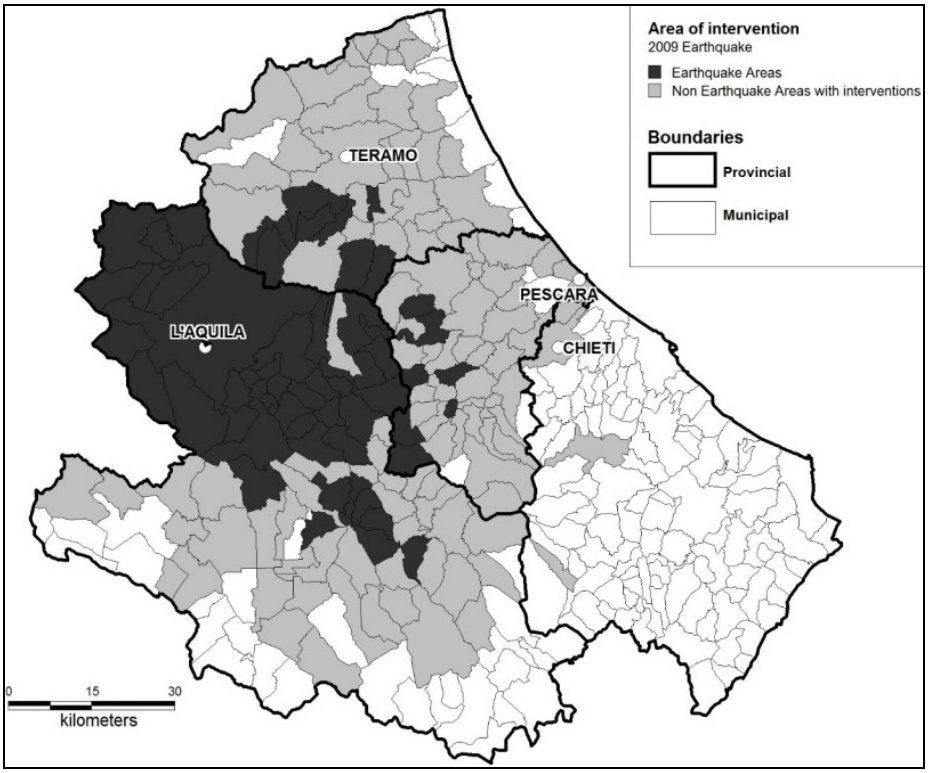

Fig. 7 – Area of intervention for the provision of funds for reconstruction following the "L'Aquila 2009" earthquake (based on Regione Abruzzo data, 2017).

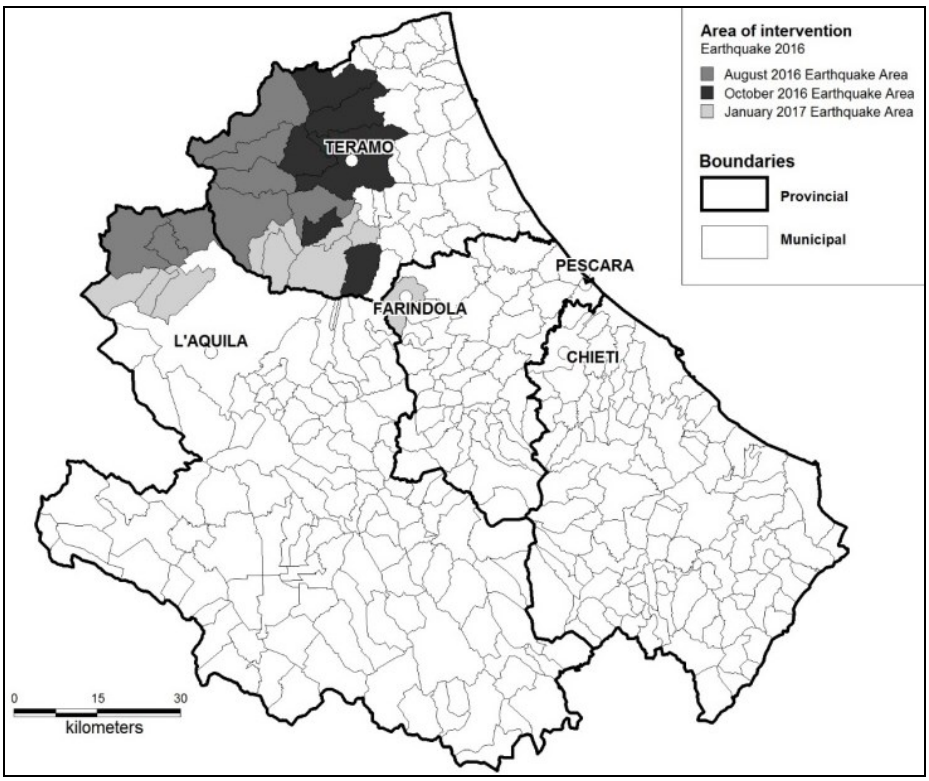

Fig. 8 – Perimeter in Abruzzo of the "Amatrice 2016" earthquake
(based on Regione Abruzzo data, 2017).

5. CONCLUSIONS

Based on various dichotomies, Abruzzo can be considered a two-faced region: it is a mountain-based region on one side, but it is also a coastal-based region on the other; it is a Region exposed to multiple vulnerabilities, due to geo-morphological processes amplified by human processes (the emptying of inner areas and excessive settlement pressure on the inland hills and coastal areas), but, at the same time, a great percentage of its own territory is under protection; it is a highly-populated Region on its coastal area, but a sparsely-populated Region in its inner areas; it is a highly-urbanized Region in its coastal and inland area, but it is a low-urbanized Region in its mountain areas. If, on the one hand, there is a progressive abandonment of the territories of mountain areas, especially those with high environmental constraints, on the other hand, the coastal areas suffer environmental problems of overpopulation, which, in some cases, exceed their carrying capacity.

National and regional environmental policies are also substantially two-sided: the policy of environmental protection, implemented by the Abruzzo Region and built mainly through the foundation of Parks, must deal with the environmental vulnerability that affects the territory for a long time, endangering the image and, even more so, the very sense of environmental protection, if not tackled (Cardinale, Fuschi, 2015).

Starting from the late eighties, we have assisted to a transition from an integral protectionist policy to a policy based on the valorization of natural and human resources. In this way, the Park becomes a territorial management instrument, potentially capable of combining different human and environmental needs.

The important process of urbanization and the consequent settlement pressure on coastal and mid-hill areas have contributed to increasing the problem of the risk-exposed land; otherwise, the abandonment of some inland areas has made the absence of territorial safeguard into empty areas.

For these reasons, one of the most important regional policies has focused on rebalancing the disequilibrium between inner mountain areas and coastal hills.

Among the most significant choices regarding development policies, Abruzzo Region opted for the institution of a significant number of National and Regional Parks (based on the national law No. 394 of 1991). This choice points to a "functional rebalancing" (with some territorial specification, such as tourism valorization, promotion of food and wine products, local crafts, traditions, etc.) implying a non-conservative and non-restrictive policy, but a proactive policy, which considers the Park as an instrument of valorization and territorial planning.

The main idea was to alleviate the strong contrast between coastal and inland areas through an environmental vision able to better express the greater authenticity of the places lying within the internal areas.

Therefore, the Abruzzo environmental policy, through the government of protected areas, has adhered so much to the principle of socio-economic valorization (even if not achieving successful results in all cases), but overshadowing the strict sense of environmental protection, which is related to the real environmental safeguard.

A full knowledge of the territory implies an in-depth study of places, allowing for a careful and participatory management of hazards and vulnerabilities and looking for the best environmental practices. Municipalities are vulnerable because the maintenance of natural assets through projects of requalification, valorization and promotion have not been developed together with territorial knowledge, by counteracting problems of environmental hazards and vulnerabilities.

This paper has highlighted the main vulnerabilities of protected areas, especially such as the large Park territories.

Thus, by having a profound knowledge of what the territory means and having the full consciousness of its peculiar characteristics and dynamism, one must reach a substantial point of view in which the territory is not neutral and nor static either. It must always be remembered that the territory embodies the concepts of space and time. Therefore, the territory is a patrimonial value and a public asset of collective relevance; its safeguard demands primarily significant social involvement.

For these reasons, an integrated approach to the different subjects of interest is needed (policy-makers, civil society, entrepreneurs), for a governance able to focus on the real territorial safeguard, in order to restore and increase the value of the territory. Surely, we also need a more punctual reconstruction of the hazards and correlated vulnerabilities of the Abruzzo Region socio-economic system (Regione Abruzzo, ENEA, 2010).

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