



ENSURE PROJECT

Contract n° 212045

WP 1:

State-of-the-art on vulnerability types

Del. 1.1.2-3:

Lessons learned and research windows opened by the State-of-the-art on territorial vulnerability

Reference code: ENSURE – Del. 1.1.2-3



The project is financed by the European
Commission by the Seventh Framework
Programme
Area "Environment"
Activity 6.1 "Climate Change, Pollution and Risks"



Project Acronym: ENSURE

Project Title: Enhancing resilience of communities and territories facing natural and natural-tech hazards

Contract Number: 212045

Title of report: Del. 1.1.2-3: Lessons learned and research windows opened by the State-of-the-art on territorial vulnerability

Reference code: ENSURE – Del. 1.1.2-3

Short Description:

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Partners owning:

Contributions: HUA, UNINA, MDX, POLIMI.

Made available to: All project partners, European Commission


Versioning		
Version	Date	Name, organization
0.1	13/03/2009	HUA
0.2	04/09/2009	HUA
0.3		

Quality check

Internal Reviewers:



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1 Lessons learned and research windows opened with respect to territorial vulnerability in case of hydro-geological hazards

Approaches to Territorial Vulnerability: Advancements and future challenges

After the brief review of the most recent approaches to territorial vulnerability it is worth referring to the similarities and differences among them as well as their achievements on one hand and insufficiencies on the other:

1. To the scientific and research communities of Hydro-Geological Risks/Hazards on the one hand and Climate Change on the other, the meaning of Territorial Vulnerability reflects propensity to losses of complex geographical entities (to the Climate Change community this propensity includes the generation of exposures and new hazards by these entities) due to a stressor. These complex entities incorporate physical, social, economic, cultural, organizational, institutional micro-units and macro-structures. Territorial vulnerability denotes susceptibility to losses of all above units and structures contained in a territorial entity as well as of their interconnections and linkages. Kindred terms are “geographical vulnerability”, “urban vulnerability”, vulnerability of an area, region etc. Some researchers emphasize the “exposure” dimension of territorial vulnerability, others consider equally the “exposure” and “coping capacity” dimensions and there is a third group advocating a three dimensional essence of vulnerability (i.e. one comprising “exposure”, “sensitivity” and “adaptive capacity” or “exposure”, “resistance” and “resilience”). As to the locus and origin of Territorial Vulnerability the exposure component is considered an external factor while other components (i.e. coping capacity, sensitivity and adaptive capacity, resistance and resilience) are considered internal or inherent to the territory / community factors of vulnerability.
2. According to the above various conceptual interpretations, different procedures of assessment of territorial vulnerability exist. Some methodologies start from consideration of vulnerability of the micro-units included in a territory (without ignoring the influence of the wider structures) and proceed then step by step to larger and larger scale units. Other methodologies follow the reverse path; these start from macro-structures and macro-indicators and attempt subsequently indicator specializations and division of the territory to lower scale units.
3. Most approaches do not deal with the root causes of vulnerability, the mechanisms and processes that make a spatial entity (a geographical or territorial unit) vulnerable; they deal instead with the end results, the observable symptoms of vulnerability. They elaborate quantitative and space variable parameters and manage to arrive at mapping results showing the spatial distribution of vulnerability at various scales. In the few cases of approaches and models searching for the mechanisms of vulnerability generation, expansion and transference, no rating of locations / spatial units according to their vulnerability level or mapping results have been achieved.

4. Some of the approaches – which have been reviewed in Del. 1.1.2-1 / chapter 1.2 – are hazard specific, such as the cases of approaches to vulnerability to floods, the CIPE-MURST methodology and the methodology referring to seismic vulnerability of micro-territories in Athens; others refer to groups of hazards (such as the Munich Re and DRI approaches) and a third group of methodologies are hazard-independent or applicable to all hazard cases (e.g. ESPON Hazard methodology, ARMONIA etc). The researchers dealing with single hazard situations consider the determination of vulnerability to multi-hazards as the major challenge of the future. On the contrary, researchers pre-occupied with the general aspects of vulnerability applicable to all hazard cases presume hazard-specific vulnerability as the major issue of the future.
5. While most approaches acknowledge that vulnerability of spatial units is multidimensional as it incorporates social, economic, functional, systemic and physical aspects, this rule is not followed in most of the specific methodologies. Often, although claims are made that multiple aspects of vulnerability are taken into account, the end-result is almost exclusively “physically-oriented” and dependent on land-use parameters, for practical reasons. Some approaches are concerned with social and economic indicators alone (DRI and ESPON), some are pre-occupied with building damages (Munich Re approach) and others focus exclusively on functional and systemic vulnerability (e.g. CIPE-MURST methodology and the methodology for the Italian historic city-centres). In other words each individual approach is not but a partial view of the problem of vulnerability. When for instance “coping capacity” of a district is estimated in terms of availability of emergency equipment and road accessibility indices alone, other aspects (physical, social, economic) are missing (e.g. personal and household mobility issues, education and training aspects, accessible economic and social assets etc.). This means that trade-offs between the several aspects of vulnerability and resilience are not captured. An indicative example is the case of a hospital or a productive firm that activates an emergency electric generator when electricity supply is interrupted due to damages in the electricity distribution network. In practical terms, physical vulnerability may be traded off by organizational resilience and the result as regards overall response may surpass the expectations inferred by estimations of physical vulnerability alone.
6. The relationship between exposure and vulnerability is proved to be the most intricate and disputable issue. At one end we have the DRI methodology considering exposure as an independent, exogenous factor, out of and irrelevant to the intrinsic and endogenous property of vulnerability. At the other end the ESPON Hazards methodology identifies exposure with the damage potential component of vulnerability, where the aggregate of this potential and the coping capacity represents the respective vulnerability level. In between the two extreme cases other methodologies (such as ARMONIA and the methodology for mudflows by DIPIST) avoid mathematical operations to extract composite vulnerability indices. These latter methodologies acknowledge that exposure and coping capacity often have completely different locus and scale of reference and different periods or moments of occurrence. For instance, population’s exposure within a neighbourhood unit might be estimated on the basis of population size and density parameters at the neighbourhood level but coping capacity of the area and its population may depend on road network accessibility at entry points far away from the spatial unit under consideration. Besides, urban factors that aggravate exposure might enhance coping capacity or the other way around. Furthermore, initial exposure in the event of actual disaster may alter the urban landscape (and not alone) in unpredictable ways that undermine the assumptions

made for coping capacities in normal periods and hence estimations and projections of the overall vulnerability potential.

7. As mentioned, almost all methodologies, except those focusing on causal origins and the transference mechanisms of vulnerability are based on procedures and parameters that yield mappable results. In a way the methodologies have been built to serve the need for maps that depict spatial distribution of vulnerability to support spatially differentiated measures and policies. However, this rationale presupposes that vulnerability fluctuates solely in terms of space, which is not the case. The immaterial aspects of vulnerability, e.g. institutional vulnerability, are certainly not mappable and these immaterial aspects might affect the material ones or be affected by them. These interchanges are lost altogether by the “snapshots” of single faces of vulnerability. Therefore the efforts to arrive at results that can be represented on maps lead to dangerous simplifications that neutralize the dynamic and non-spatial properties of vulnerability. As we emphasized earlier it is the absence of adequate coverage of institutional vulnerability which is particularly to be deplored.
8. The sociologists’ point of view that vulnerability is the composite result of exposure, resistance and resilience (Kasperson et al. 1996; Pelling 2003) is very close to the perception of vulnerability by the Climate Change Community as a synthesis of exposure, sensitivity and adaptive capacity. On the other hand when vulnerability is taken as the product of exposure and coping capacity the latter component is not clearly defined. Does it concern pro-active counter-disaster properties alone? Does it refer exclusively to post-disaster remedies and rehabilitation action or both of the above? Some researchers would like coping capacity to encompass both pre- and post-disaster ability for action; however co-assessment is problematic since it necessitates time compression and equalization of diverse and distant agencies / domains (for instance the population groups living in a district may be exposed to specific hazards to which they respond with their own coping capacity; at the same time they are dependent on the coping capacity of the institutions that assume the emergency operations should a crisis come up).
9. The methodologies differ in terms of their stance as regards the type(s) of losses to which vulnerability refers. In some cases the referred type of loss is explicitly quoted (for instance in the case of DRI); in others it is implicitly derived (e.g. in the case of manufacturing firms in Athens where survival / continuity / closure is at stake); finally there is a third group of methodologies where reference to the loss type is not made at all, implying that the suggested methodology covers all forms of impacts and losses (direct and indirect, primary and secondary, loss of lives, physical damages, economic losses, property losses, disruption of services, operations and processes, bankruptcy or dislocation of firms, business closures and so on). Indeed, once the losses under consideration are not stated one is allowed, if not encouraged, to include everything. The underlying assumption is that if capacities and strengths are missing anything can happen; the type of impact is irrelevant to vulnerability. However, this is debatable. For instance, dismissals of firms’ employees might result or might not result from structural vulnerability of the premises housing the firms; on the other hand it might be the outcome of medium term secondary impacts such as business interruption for a couple of weeks due to lifeline failures or even due to decrease of the annual turnover of the firm as a consequence of disturbances to the wider economic activity in the urban area destroyed. Hence, vulnerability to physical damages and direct loss of immovable assets is something completely different from

vulnerability to long term impacts and incapability of survival in the long run. Besides this latter, long term vulnerability is an undesirable property that one can get rid off because it can be externalized to other interconnected agencies. Long term vulnerability is an unwelcome evil that may be easily removed.

10. As already mentioned in most methodologies vulnerability is not assessed as a time variant parameter. It is approached either as an instantaneous property of a spatial entity (e.g. the Munich Re approach at Mega city scale considering vulnerability at a distinct moment) or as if vulnerability repercussions that extend actually over long periods could be piled up at a specific post-disaster moment (e.g. the points of view of DRI and ESPON Hazards project). Time compression here is a problem because needs, capacities and action at the emergency and recovery periods are consequential to first instance, direct losses after the disaster and they cannot be anticipated before disasters but only as probabilities dependent on prior stage eventualities. However, in the real disaster conditions first instant losses (due to pre-disaster vulnerabilities) are followed by waves of coping efforts which may manage short term recovery but lead the temporarily recovered entities into deteriorated vulnerability conditions in the long term. Coping capacity is not always a factor relieving vulnerability and in any case the latter is a time variant parameter.
11. In most approaches, the fact is neglected that vulnerability is closely connected to a locus of reference, i.e. the agency or the system carrying it; in some cases this agency / system is capable of self-regulation and adaptation through learning in some other cases it is not. Anyhow the various agencies in the context of territories interact and some succeed in “unloading” their vulnerabilities (either consciously or unconsciously) to the disadvantage of others. Hence, aggregation of vulnerabilities of the components of a territorial unit (or the subsystems of a system) does not reflect its overall vulnerability. Socio-economic and physical vulnerabilities are not properties of the same entity; they are not independent quantities measurable on the basis of a common measure that can be added up to reflect the vulnerability of a totality.
12. It has been obvious from the above that mapping vulnerability values raises questions. Maps are representations of parameters that are spatially determined and more or less settled and steady in temporal terms. However, vulnerability is nothing of the sort at least in post-disaster periods; it has to do with dynamic action and movement and undergoes changes from month to month even from one day to another. Surely pre-disaster exposure (in some respects a basic component of vulnerability) is a mappable condition though exposure in our days has become a rapidly changing situation too; but resilience (if we consider it as another component of vulnerability) has to do with inventiveness, it comes up as a product of human knowledge, intuitiveness, innovation, cleverness; it is the creature of the moment. Resilience is a matter of immaterial assets and intimately connected with organizational issues and in this sense it is a non-spatial property therefore non-mappable.

Finally, our review of approaches to territorial vulnerability has shown that they are not only by and large limited, but also that there is a lack of adequate links with the wider study of territoriality and territorial structures, as a separate spatial concern and field of analysis. At this point therefore it is essential to return back to the introduction of the chapter and initiate a deliberation on possible relationships between territorial vulnerability and territorial capital. We do not claim of course that what follows is derived as a conclusion from our review of territorial vulnerability research, policy making and methodologies.

2 Lessons learned and research windows opened with respect to territorial vulnerability in case of forest fire and drought

The territorial aspect of vulnerability in both cases of drought and forest fires is critical and essential. However “territory” in the above cases may connote either a purely ecological territory or a human-ecological system. Hence territorial vulnerability (to droughts and forest fires) is split to ecological vulnerability and vulnerability of complex human-ecological systems.

Ecological vulnerability to forest fires denotes susceptibility of the ecosystem to change as a consequence to fire, the rather in an irreversible fashion. Ecological vulnerability changes with respect to the phases of the forest fire disastrous event. Short term ecological vulnerability refers to the soil degradation risk (hence its locus is on topsoil) and it is determined by pre-event parameters as well as exposure to the same the fire event. Medium term ecological vulnerability refers to probable changes in plant composition and structure that are not curable. Exposure to the fire event and resilience of the plant community are the basic components of this second type of ecological vulnerability. It is noteworthy that unlike hydro-geological hazards the meaning of exposure in ecological vulnerability is connected to the span of time during which the ecosystem suffers the damaging influence of the fire event.

The researchers dealing with territorial vulnerability of human-ecological systems to forest fires consider exposure and vulnerability from a different point of view. At a pre-event stage exposed and vulnerable territories are those suffering a high probability of fire ignition, i.e. those that are stressed and pressed by mass presence and expansionary trends of human population and socio-economic activities. At the stage of event manifestation (i.e. once fire starts) vulnerability is determined by climatic conditions, land use characteristics, vegetation patterns, species flammability and terrain slope. In this second stage population presence may decrease vulnerability. Hence exposure may carry two meanings, either a socioeconomic / institutional / ecological system that produces fire ignition incidences or a system that is exposed rarely or often, for short or for long to fire episodes.

In the case of droughts vulnerability of a human-ecological system is perceived as opposite to system's robustness. More specifically a system is vulnerable to a drought when its structure, parameters and way of functioning qualitatively change under the effect of drought and cannot be restored afterwards. It is interesting to note that vulnerability is related to a threshold of losses after which damage is irreversible. As in the case of forest fires vulnerability is tightly connected to exposure to the hazard of drought. According to aforementioned definition “vulnerability of a system depends on the strength and duration of the drought”, meaning exposure. As regards vulnerability assessment this is based on the damage potential and the coping capacity potential of the system under drought pressure. It ensues then that the approach of territorial vulnerability to droughts does not differ much from the cases of hydro-geological hazards. The difference lies in that in the latter cases damage and coping capacity refers to principally pure manmade systems. Besides the capacity to cope with hydro-geological risks originates basically from the threatened (possibly vulnerable) human-territorial system while the capacity to cope with droughts is a function of both the dynamics of the drought (i.e. hazard) and the capabilities of the exposed human-ecological system (its past, present and future).

3 Territorial Vulnerability in connection with territorial capital

In the introduction and in the section on objectives () we introduced the concept of territorial capital and we stated our intention to explore its potential use in the analysis of territorial vulnerability. We shall present here very briefly the relevant (and very limited so far) literature on territorial capital. We consider this of great interest for the study of territorial vulnerability. Although the writings on territorial capital consider it as a concept which is useful for the study of regional development, we are of the view that the territorial capital of an area is a critical factor for determining territorial vulnerability as well. The concept of territorial capital is a novel introduction into the "territorial" literature. In the few contributions to the subject the claim is made that it was first introduced in a 2001 OECD publication, which we mentioned already (OECD 2001), but the first reference to it, to the best of our knowledge, can be found in a paper by Josef Konvitz, who claims that "the economic future [of nations and regions] is shaped in part by how well territories can exploit and enhance their endowments and assets, what can be called *territorial capital*" (Konvitz 2000, 657) (*Italics added*).

In the introduction (see 1st section in Del 1.1.2-1) we quoted a frequently mentioned paragraph from OECD's report *Territorial Outlook* of 2001. We draw attention to the fact that in the definition of territorial capital included there we find a reference to both tangible and intangible factors, including e.g. customs, informal rules, solidarity and other concepts of great relevance for territorial vulnerability.

Important references to territorial capital can be found later in European Commission documents. In the EU *Third Report on Economic and Social Cohesion* of 2004 the term is not being used and there is only indirect reference to it, but there is reference to territorial cohesion: "The concept of territorial cohesion extends beyond the notion of economic and social cohesion by both adding to this and reinforcing it. In policy terms, the objective is to help achieve a more balanced development by reducing existing disparities, preventing territorial imbalances and by making both sectoral policies which have a spatial impact and regional policy more coherent. The concern is also to improve territorial integration and encourage cooperation between regions" (CEC 2004, 53).

Direct references to the concept of territorial capital are included in a series of documents drafted in the process of preparation of a policy document on the Territorial State and Perspectives of the European Union which ultimately led to the "Territorial Agenda of the European Union", agreed at an Informal Ministerial Meeting in Leipzig in May 2007. In discussing the reasons of a territorial approach to development, the authors of a 2005 Scoping Document insist that "each region has a specific territorial capital that is distinct from that of other areas and generates a higher return for certain kinds of investments than for others, since these are better suited to the area and use its assets and potential more effectively. Many of the components of territorial capital, including their integration and connectivity to other areas, can lead to productivity gains and generate growth" (EU Informal Ministerial Meeting 2005, 3). A definition of territorial capital is also provided in a short 2008 document of the Assembly of European Regions: "Territorial capital: What makes an area distinct from the others in terms of development potential. It is determined by a wide range of factors, such as geographical characteristics, size, climate, history ... This territorial capital gives a region some strengths and weaknesses, generally

called 'development potential' or 'structural difficulties'. The aim of a balanced territorial development is to give each region the opportunity to make the best out of its territorial capital" (Assembly of European Regions, 2008a). From a slightly different perspective, reminiscent of the OECD definition, Skjerpen considers that territorial capital is determined by "geographical location (size, production endowment, climate, agglomeration economies etc.), untraded interdependencies (understandings, customs, informal rules, mutual assistance, social capital) and intangible factors (institutions, rules, practices, research and policy-makers that make a certain creativity or innovation possible)" (Skjerpen 2008).

The importance of a territorial approach as an integrating framework of policy-making is stressed repeatedly in European Commission reports and territorial development policies are in fact viewed as "an important instrument for strengthening regional territorial capital" (EU Editorial Group 2006, 3). A document issued by the EU German Presidency of 2007 and entitled *The Territorial State and Perspectives of the European Union* formed the basis for the Territorial Agenda of the EU, which was eventually agreed in Leipzig in May 2007. Here we find, once again, both the OECD positions regarding territorial capital and the arguments outlined in previous EU preparatory documents. It is interesting that in this document there is reference to some of the components of territorial capital, i.e. to resources (economic and non-economic, social, environmental, cultural, and the '*genius loci*'), as well as to integration and connectivity (German Presidency 2007, 5).

In Lisbon, in October 2007, the heads of government of the EU Member States approved the final text of the EU Reform Treaty. In it, the aim of territorial cohesion is placed alongside the already established goals of economic and social cohesion. The European Commission is due to produce a Green Paper on Territorial Cohesion, which is expected to be released very soon. In a discussion document of the Assembly of European Regions (2008b) it is stated that "territorial cohesion means exploiting as much as possible the so-called 'territorial capital' of a given geographical area" and that it should "enable territories to identify and take advantage of their territorial capital". It must be noted that, as Peter Schön remarks, the notion of territorial capital had been already implicitly referred to in article III-116 of the EU Amsterdam Treaty of 1997 (Schön 2005, 394).

Following the attempts to define territorial capital in OECD and EU documents and reports, the concept was addressed in the final report of the ESPON project 2.3.2 in 2006, already mentioned in our introduction (see Del 1.1.2-1). The following extract is taken from the section "Territory as territorial capital: territorial governance as territorialized collective action" of the report:

- "The concept of territorial capital ... is a relational and functional concept at the same time ... whose elements are different but with common characteristics ...
- they are a localised set of common goods, producing non divisible collective assets that cannot be privately owned;
 - they are immovable goods, that is constantly part of specific places;
 - they are place-specific, that is almost impossible to find elsewhere with the same features;
 - they are heritage goods, that is they are stocked and sediment in a long period and cannot be produced easily in a short time.

Factors that compose territorial capital are, for instance, geographical location, the size of the region, natural resources, quality of life, local and regional traditions, mutual trust and informal rules, etc. These factors can be grouped as:

- natural features;
- material and immaterial heritage;
- fixed assets ... as infrastructures and facilities;
- relational goods ... as cognitive, social, cultural and institutional capital

...

Synthesizing, the notion of territorial capital allows to sum up the different forms of capital (intellectual, social, political and material capital) ..." (ESPON project 2.3.2, 2006).

These views were reiterated by Governa and Santangelo (2006) and then by Davoudi, Evans, Governa and Santangelo (2008), where the point is made in addition that "applied particularly to the local or regional level the concept of territorial capital is similar to that of 'endogenous potential'". Camagni (2005) discussed the components of territorial capital (see introduction) and later provided the most comprehensive analysis of the concept of territorial capital which has come to our attention (Camagni 2007).

Camagni explored the concept of territorial capital through a taxonomic process by placing it in a 3 by 3 matrix, along a vertical axis labelled "rivalry" and a horizontal one labelled "materiality", as shown below. The three rivalry categories refer to the private – public continuum of goods, while the three materiality categories refer to the tangible – intangible continuum (Fig. 1).

In Camagni's view, "the four extreme classes – high and low rivalry, tangible and intangible goods – represent by and large the classes of sources of territorial capital usually cited by regional policy schemes. They can be called the 'traditional square'". In the above figure, they are marked by trellis shading and by the letters c, f, a and d. "On the other hand", continues Camagni, "the four intermediate classes represent more interesting and innovative elements on which new attention should be focused; they can be called the 'innovative cross'" (Camagni 2007, p. 5). They are marked in the figure below by solid grey shading and by the letters i, b, e, g and h. The components of territorial capital included in the shaded squares are extensively explained by Camagni and can be compared with the elements of vulnerability identified in the relevant vulnerability literature, e.g. in the analysis of Wisner *et al.* (2004). Camagni concludes that "territorial capital is a new and fruitful concept which enables direct consideration to be made of a wide variety of territorial assets, both tangible and intangible, and of a private, public or mixed nature. These assets may be physically produced (public and private goods), supplied by history or God (cultural and natural resources, both implying maintenance and control costs), intentionally produced despite their immaterial nature (coordination or governance networks) or unintentionally produced by social interaction undertaken for goals wider than direct production" (Camagni 2007, 13).

Rivalry			
Private goods (high rivalry)	c	i	f
Club goods and impure public goods	b	h	e
Public goods (low rivalry)	a	g	d
	Tangible goods (hard)	Mixed goods (hard + soft)	Intangible goods (soft)
	Materiality		

Figure 1: Sources of territorial capital according to Camagni (2007)

There is a clear cross-fertilization between a number of scientific fields concerned with vulnerability, territorial development and poverty, to name but a few. This is in fact acknowledged as far as vulnerability, livelihood and poverty are concerned by Wisner, Blaikie, Cannon and Davis (2004, p. 95), in a section in which they explain the changes made in their book in comparison to its previous 1994 edition (Blaikie *et al.* 1994). The definition of vulnerability given by Wisner *et al.* has been quoted in our introduction.

Wisner *et al.* put forward an analytical model which is illustrated in a diagram. The diagram includes a presentation of “the progression of vulnerability” from “root causes”, to “dynamic pressures” and then to “unsafe conditions” (op.cit., p. 51). In a second diagram they present “the progression of safety” through successive actions called “address root causes”, then “reduce pressures” and, finally, “achieve safe conditions” (op.cit., p. 344). As we show later, we have retained the parameters used under the heading “the progression of vulnerability” and produced a table in which we attempt a comparison with Camagni’s components of territorial capital. Worth mentioning is that Wisner *et al.* also discuss the notion of livelihood. Although this is a subject which we are not touching here, we note that in their view “livelihood analysis seeks to explain how a person obtains a livelihood by drawing upon and combining five types of ‘capital’”, which the authors consider similar to the assets that are involved in one of their vulnerability models:

1. Human capital (skills, knowledge, health and energy);
2. Social capital (networks, groups, institutions);
3. Physical capital (infrastructure, technology and equipment);
4. Financial capital (savings, credit);
5. Natural capital (natural resources, land, water, fauna and flora)” (Wisner *et al.* 2004, p. 96).

Once again, if we look at the parameters listed in brackets we find a clear and most interesting similarity with the components of territorial capital. What emerges from our

review of the literature is that there are interesting (and promising) bridges between concepts and the literature which has dealt with them, in spite of the diverse origins and initial premises. E.g. we speak of “economic, social and territorial” cohesion and / or capital and we do the same thing with respect to vulnerability, although the “territorial” attribute of the latter has not so far been explored and researched, except in a narrow material sense related to buildings, solid infrastructures and land uses, i.e. elements that can be mapped and recorded in Geographical Information Systems¹. As we pointed out in the introduction there is a missing link between vulnerability and territory, which is underlined in the writings of Susan Cutter:

“Vulnerability science requires an integrative approach to explain the complex interactions among social, natural and engineered systems. It requires a new way of viewing the world, one that integrates perspectives from the sciences, social sciences, and humanities. Since vulnerability can refer to individuals (person, housing structure), groups, systems, or places, scalar differences and the ability to articulate between geographic scales are important components. Vulnerability manifests itself geographically in the form of hazardous places (floodplains, remnant waste sites); thus, spatial solutions are required, especially when comparing the relative levels of vulnerability between places or between different groups of people who live or work in those places” (Cutter 2003, p. 6).

Territorial vulnerability (but also vulnerability in general) and territorial capital (but also other types of “capital”) share a common characteristic: they are multidimensional and complex concepts. As to territorial capital, we have repeatedly seen, especially in Roberto Camagni’s analysis, its multidimensional character. Both territorial vulnerability and territorial capital essentially describe an areal unit’s potential or lack of it to face a challenge, either the area’s future development and sustainability or its capacity to withstand shocks and stresses. If we view them in this perspective we can easily see the potential of bringing these concepts closer together in order to better understand vulnerability. Territorial capital analysis can offer a tool for explaining the workings of vulnerability, although it is certainly not the only one.

The literature on vulnerability is full of references to the elements of vulnerability of communities and to make a comprehensive list is in itself a major task. However, we can take the features which Wisner *et al.* have listed under “the progression of vulnerability”, to which we have referred already, and use them as an adequate list which we can compare to the elements of territorial capital. For the latter we can use Camagni’s matrix. We should not forget of course that he uses the concept of territorial capital for a totally different purpose, i.e. to determine the development prospects of a region. Therefore the present comparison is a first and perhaps crude approximation which will require further refinement.

¹ See e.g. the papers presented by a research team of the Politecnico di Milano, derived from the European research project QUATER (Treu, M.C., A. Colucci and S. Lodrini, Territorial vulnerability analysis: The methodological framework, in C.A. Brebbia, ed., *Risk Analysis IV*, WIT Press, 2004; Treu, M.C, M. Samakovlija and M. Magoni, Territorial vulnerability analysis: The case studies, in C.A. Brebbia, ed., *Risk Analysis IV*, WIT Press, 2004; Baldi, C., M. Martelli and M.C. Treu, Territorial vulnerability analysis: The Environmental Risk Managemens Systems, in C.A. Brebbia, ed., *Risk Analysis IV*, WIT Press, 2004; Treu, M.C, A. Colucci and M. Samakovlija, Territorial vulnerability and local risks, in *WIT Transactions on Ecology and the Environment*, Vol. 84, 2005). These papers are accessible through the website www.witpress.com.

In constructing the table that follows (Table 1) we decided to group the elements of vulnerability and territorial capital in 5 categories: Economic, social, natural, manmade - physical and institutional. We have included all elements found in Camagni's matrix of territorial capital and in the diagrams of vulnerability progression by Wisner *et al.*, without exception. We did however change the terminology in some cases.

Table 1. Correlations between elements of vulnerability and elements of territorial capital.

Categories	Territorial capital (after Camagni)	Vulnerability (after Wisner <i>et al.</i>)
Economic	Fixed capital Economic externalities Limited access goods Networking and linkages of firms Inputs of R&D and technology	Economic system Local investments Local markets Debt and repayment schedules Non-development expenditures Low incomes Livelihoods at risk
Social	Social capital Entrepreneurship Creativity Know-how Proprietary networks Cooperation capability Collective action Behavioural models and values Trust relationships Associative habits	Power structures Social resources Education Appropriate skills Population change Urbanization Social groups at risk Endemic diseases
Natural	Landscape Natural resources	Deforestation Soil productivity Dangerous locations
Manmade physical	Cultural heritage Manmade heritage Social overhead capital Infrastructures Urbanization / agglomeration	Unprotected building and infrastructures
Institutional	University research Partnerships with private and social entities Land governance and planning Collective competencies Dissemination of R&D Encouragement of receptivity	Political system Local institutions (or lack of) Press freedom Lack of disaster preparedness Ethical standards in public life

This first approach can be enriched and further developed with additional material. E.g. we have already mentioned, following Wisner *et al.*, the five forms of capital, which they use in one of their models (human, social, physical, financial and natural). The elements which make up these "capitals" (skills, knowledge, health, human energy, networks, groups, institutions, infrastructure, technology, equipment, savings, credit, natural resources, land, water, fauna and flora) are all typical features of territorial capital. But even as it stands, the above table already shows interesting conceptual bridges, which promise that the analysis of territorial capital can become a useful tool for territorial vulnerability assessment.

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