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Territorial intelligence of vulnerability systems - A transitional viewpoint of sustainable development

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Abstract

The use of vulnerability as a main concept, especially as an essential component of risk (De Vanssay, 2003), has been generalized from a decade or so. Together with resilience properties of human structures, it therefore constitutes the principal entry for crossing environmental and social sustainability factors, mostly apprehended from environmental harmfulness and risk perspectives, as shown in the related works in environmental psychology (Moser, 1992). The vulnerability of a system depends on the state of the system itself, on the capacity of a hazard to affect this state taking into account the exposure, the sensitivity and the adaptive capacity of the system to this event and on the undesired consequences the combination of the hazard and the vulnerability will eventually lead to.

The aim of this paper is to propose a truly integrated approach, combining the economic, socio-cultural, and ecological aspects of territorial vulnerability, including its counterclock dynamics, that is to say its resilience. Thus, we attempt to assess the current and future global dynamics by using the concept of transition and capabilities (capacitance), in order to enlighten current and future tensions between social welfare, well-being and environmental quality (Rotmans & al. 1999), in the spot of “new deal” decision-making.

Introduction

If we represent the three interlinked dimensions of territorial vulnerability (socioeconomical, ecological, socioecological), and their dynamic interdependencies within a triangle (see following Figure 1), the first side illustrates the dependence of the vulnerability system on the use of resources that could become scarce as a consequence of the occurrence of hazards and the induced variation of the system. This interaction dimension, formalized as ecological vulnerability, represents failures of the global transition towards sustainable systems through environmental degradation due to the materialist-consumerist paradigm, i.e. economic growth. This degradation is mainly combined with the diminution of social capital.

On a complementary side, socio-ecological vulnerability clearly refers to the fact that natural resources are overused to ensure a basic standard of living, thus placing a great deal of pressure on the ecological capital. To overcome these ecological limits of unsustainable paths of development, the system should rather move towards a transitional perspective in rupture with this current global dynamics. Territorial development would therefore not only depend on vital supplies, but also on education, income levels and amenities access.

At the last side of the following sustainability trade-off interaction triangle, socioeconomic breaking point can be detected where the cost of the system stability exceeds both the value of the property threatened and the financial means of the various local authorities. Thus, socioeconomic vulnerability can be read as a function of territorial needs to be provided to ensure resilience of the sustainability system.

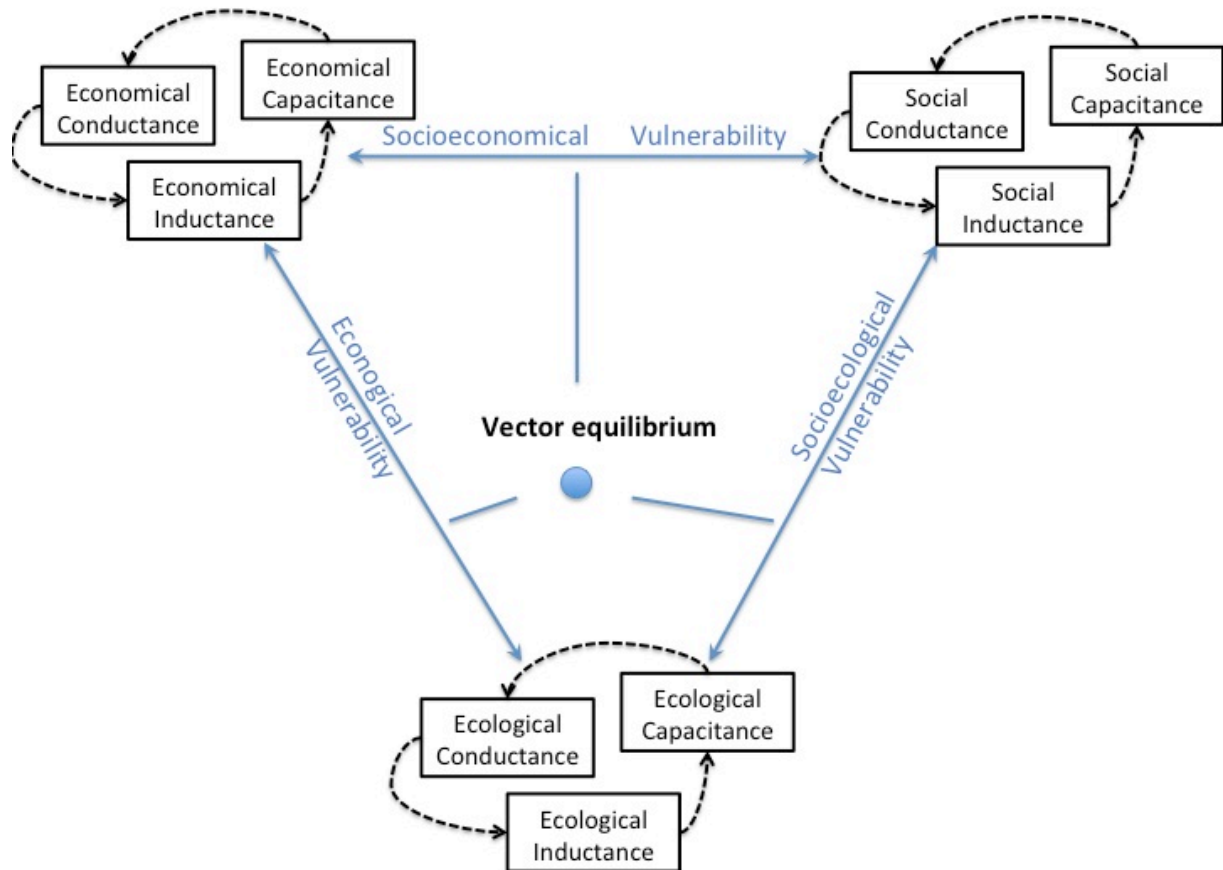


Figure 1: Sustainable-weighted structuration of vulnerability within Territorial Intelligence trade-off.

Moreover, vulnerability studies should simultaneously imply economical trading functions, human societies and ecological systems, through their corresponding (social /economical /environmental-) capitals like socioeconomic pillar, lifestyle preferences, consumption behaviour and policy rules, underlined by biodiversity and cultural diversity similarities.

While adopting a holistic systemic viewpoint, this transitional conception of development may be evaluated by indicators of sustainability 'state', relatively to ecological and socio-economical systems.

In this prospect, corresponding decision and regulation instruments have also to converge, aiming to create adaptive conditions through sustainable development cognitive and socio-political territorial expertise. Here, socio-political dimension of resilience, implying not only public policy, but also others stakeholders behaviors or decisions, has mainly to ensure the capacity to restore the trust of populations. Territorial intelligence of vulnerability systems will therefore depends on local capacities to empower people in order to facilitate their involvement in decision making process linked to socio-ecological transition goals.

Thus, through studying system response or adaptive capacity to answer to the pressure of major effects of the changes in its environment as well as inequalities access to environmental amenities (Faburel, 2007), we could identify the benefits of cooperative structures and decision-making at local levels, and therefore measure the consequent benefits within the sustainability global system (ESO, 2010).

Econological dimension of vulnerability: environmental area in Europe and its economic treatment: environmental economics behavioral laws, the case of ecological monetization (right to pollute)

The adoption of new environmental regulations such as the implementation of tradeable pollution permits which intends to create incentives to pollute less in order to alleviate econological vulnerability can have the mere opposite effect. This type of market-based regulation may be an opportunity for private actors to register new financial gains without having any significant results on the pollution reduction. In the same way, the implementation of dikes to prevent the risks of floods may result in an increased future vulnerability if it should lead to new constructions in areas liable to flooding (Quenault et al., 2011).

Prospect theory asserts two fundamental ways in which people perceive options differently than the rational actor model would predict. First, people value a loss of a certain amount more negatively than the positive value they associate with a gain of the same amount (MiniMax principle, Moles 1977). Second, people tend to overweight low probabilities and to underweight moderate and high probabilities, with the latter effect being more pronounced than the former. (Kahneman and Tversky, 2000). Development of this principle underlines the importance of this environmental economics behavioral laws.

Socio-ecological vulnerability: the example of climate change impacts on cities

Cities, which represent complex socio-ecological systems, are coevolving with the climate of the earth system. Urban areas are approximately responsible globally for 75% of greenhouse gas (GHG) emissions (UN, 2007) as well as being hotspots of vulnerability to climate change impacts, in particular extreme meteorological events such as flooding, drought and heatwaves, heavy rains, storms and hurricanes, leading to catastrophic functional disruptions in the territorial systems.

Thus, cities are both drivers of climate change and foci of climate impacts. In this respect, the city level must be a priority to implement not only mitigation strategies but also adaptation strategies to climate change. In order to reduce vulnerability and to better prevent potential disruptions in case of extreme event by improving the resilience, adaptation strategies to be developed in the urban area have to address simultaneously its various component: exposure, sensibility and adaptive capacity to climate impacts, with analyzing the key interactions and dependencies, linkages and feedbacks between its territorial system components (individuals, institutions, infrastructure) (Quenault et al., 2011).

This example of socio-ecological system interactions illustrates how a multidimensional appraisal of vulnerability can constitute a break with traditional approaches of risk management focused on hazard impacts assessment and technological solutions; instead, it invites to promote an alternative management of territorial vulnerability situations with a greater attention paid on adaptive response, leading to social protection innovations as well as new governance skills (Woloszyn et Faburel, 2010). This paradigmatic change constitutes the basic principle of socio-ecological transition movement.

Socio-economical vulnerability to conjunctural stress: the two dimensions of resilience

Along with the elaboration of sustainable policy sequences, emerging concepts and paradigms about socio-economical dimension of vulnerability mainly underlines the rule of societal resilience. Resilience is a way to account for the adaptive capacity of societies to pursue their development pathways while being under the pressure of the major unavoidable effects of the

changes in their environment. Resilience (from the Latin etymology *resiliare*, to rebound) is literally the act or action of springing back. This notion of resilience has then been elaborated in different domains. In child psychology and psychiatry (Engle et al., 1996), it is referring to living and developing successfully when facing adversity; in ecology (Holling, 1973), referring to moving from a stability domain to another one under the influence of disturbances; in business (Hamel et al., 2003), referring to the capacity to reinvent a business model before circumstances force to; in industrial safety (Hollnagel et al., 2006), referring to anticipating risk changes before damage occurrence.

The environmental concern we aim to develop allows the sustainability trade-off system to retain resilience, with implying a reduction in its self-organization to minimize risk of instability. Resilience theory claims also that entropy evaluates adaptive systems (Bailey 1990) defining to what constraint quality and level the environmental system is able of self-repairing, through multidimensional sustainability converging (Woloszyn 2011).

When resilience theory claims that perturbed systems soon returns to their dominant stable equilibrium, it describes both economic and social systems: as economic system resilience is defined by the ability to allocate resources efficiently in the face of major shocks, social systems resilience traduces the capacity of human societies to face conjunctural stress (Munasinghe, 1994, Costanza and alii. 1997).

Moreover, socio-economical systems vulnerability impacts interaction processes between human facts and economic environment can lead, for example, to crime (Hillier & Xu, 2004); social segregation (Vaughan et al, 2005; Legeby & Marcus 2011), or accessibility differentials (Stähle 2008). In that frame, resilience studies investigate the influence of socioeconomics in environmental protection, as well as territorial well-being.

Territorial resilience as a response to vulnerability: the role of politics (r)evolution and public involvement

So, human and society resilience has to converge, thanks to their corresponding decision and regulation instruments, aiming to create both cultural and technological adaptative conditions through sustainable development cognitive and socio-political territorial expertise.

Here, social dimension of resilience, implying both state and public policy, but also stakeholders, ensures the capacity to restore the social system well-functioning through the trust of populations. Thus, state securisation, as a necessary condition of resilience processing, could not constitute the only response to socio-economical vulnerability. In this way, resilience could constitute an objective (i.e. for state administration), but is mainly attended as a state (in the systemic point of view), i. e. a guarantee of the social system structural stability.

Hence, following the new goal of territorial resilience as a response to vulnerability, local or metrolitan governances has also newly (mainly?) to deal differently with population's attempts and demands, so to deal with involvements wishes, participation appraisal, even with inhabitants empowerments. That is a remarked fact throughout the world: decisions making processes and regulation tools have been progressively adapted to environmental and urban planning risks of disputes. Stakeholder's scenes have nowadays to facilitate the participation informal actors, for instance community groups, but also power coalition (Sabatier, 1988) gathering other types of expertises (and experts too).

That is also a former condition in order to negotiate new balances between needs, resources

and territorial development, so to find vector equilibrium between ecological, socio-ecological and socioeconomical vulnerabilities, pursuing. In a tension context, requiring new bargaining between economic, ecological and socio-cultural capital, places attachments, lifestyles, wellbeing appear as new resources and knowledge's themes. For instance, local habits of production could feed new economical model for transition cities.

Here, admittedly, the required adaptive capacity of societies for territorial resilience passes by new political roles, regulation tools efficiency, and other democratic processes (participative ones). Mainly, it deals with recognition people capabilities (Sen, 2001), and democratic innovations (for instance controversies methods, in Callon, Lascoumes and Barthe, 2001). That the reason why capitals should recover people capacities to directly cooperate to transition model, and the vector equilibrium should also put capabilities and governance processes of empowerment at cornerstone.

In that way, nevertheless, vulnerability could become differently economical (i.e. participation inequalities, environmental iniquities and injustice... Faburel, 2012) and, at least, differently politic, being vigilant to unequal capacities to participate at strategic scale and step in decision-making processes for socio-ecological transition of large territories. According to us, that is a new essential stake for sustainable planning in resilience necessity paradigm: how to differently manage with local singularities in a general perspective of transition model of development. Therefore, convergence of adaptive actions could strengthen the resilience of the territories and most disadvantaged groups as parts of a coherent strategy for social cohesion, with both introducing political priorities for local action and adapt public action goals to the socio-ecological new i-deal.

Improving the visibility of the resilience of territories and populations: sustainability indicators

To achieve this goal, vulnerability, and therefore, resilience evaluation should qualify interaction laws between economical system, human societies and ecological systems through transverse dimensions, involving non-commensurable variables and objectives for multi-criteria analysis.

With adopting a holistic systemic viewpoint, indicators of system 'state' relatively to the durability of ecological and socio-economic dimensions, may help to realize this interactional measurement. Therefore, the self-organizing and internal structure map of ecological and socioeconomical system can proceed to cooperative structures and decision-making processes identification.

Here, according to the necessity of empowerment, undoubtedly, well being and quality of life should have to be put at political assessment agenda, as "new" sustainable indicators. For instance, on well-being, the New Economics Foundation develops the SWEMWBS » scale (ShortWarwick-EdinburghMental-WellbeingScale) at european level (Michaelson, 2011). Or the European Council (Palatin, 2011) developps the Societal Progress Indicators and Responsibilities for ALL methods by focus groups, deling with well-being and on social cohésion,

Conclusion

Improving our understanding of the interactions among social, economic and ecological systems should allow a better appreciation of vulnerability management. To achieve this goal, associated risk and uncertainty (entropy) will also be parametered by the use of decision

analysis tools, with using specified indicators which have to answer the following questions:

What kind of territorial indicators to valuate well-being and quality of life within sustainable development pillar convergence ?

What articulation between new acknowledgement fields and stakeholders practice for those convergence indicators ?

To what territorial action objects shall they refer ?

What new governance practices shall they imply to improve territorial resilience ?

Answering those questions will constitute a major key for trans-actional analysis of the sustainable development objectives, in order to define the cognitive frames, the policico-cultural coding as well as the scientific expertise performativity for territorial action evaluation.

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