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ENSURE E-LERNING TOOL

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Indicators for a vulnerability and resilience assessment: an introduction

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1 Working with vulnerability and resilience indicators

As already mentioned, few studies have attempted insofar to clarify how different types of vulnerabilities should be accommodated in one integrated study and what process should lead to the identification of suitable indicators. Studies in this regard can be found regarding sustainability indicators and reports for countries or urban areas (see in particular MacLaren1996; Winograd and Farrow, n.d.). Those studies discuss the criteria that should drive any effort to develop sustainability indicators. The latter are rather useful for the present project, as the concept of sustainability is as difficult to measure as is vulnerability. Both require to capture the complex interrelationship among different systems which interact at various spatio-temporal scales, in a parallel and even in a cross cutting fashion.

One important difference seems to distinguish vulnerability from sustainability: while in the latter the verification process is extremely difficult, as it requires to confront the state and the process toward sustainability with impacts that cannot be fully envisaged, in the case of vulnerability indicators, the latter can be confronted once an extreme event occurs with actual damages. This is perhaps more true for physical, some kind of systemic, social and economic vulnerabilities than for others, in particular resilience parameters. At least in principle, though, it is possible to compare the vulnerability assessed before the event and the damage occurring afterwards as well as to compare the expected response capacity with the way an actual event has been managed. In the meantime the establishment of good vulnerability indicators permits to enlighten aspects and types of losses that should be considered and checked in any event aftermath, so as to gain a reference value against which the validity of vulnerability indicators and of key measures can be evaluated.

This means that the distinction between different kinds of vulnerability should encourage to estimate coherently damages, distinguished among physical damage to buildings and infrastructures, damage to economic assets and activities, losses to human and social capital, secondary consequences in terms of functional failure of fundamental services an activities.

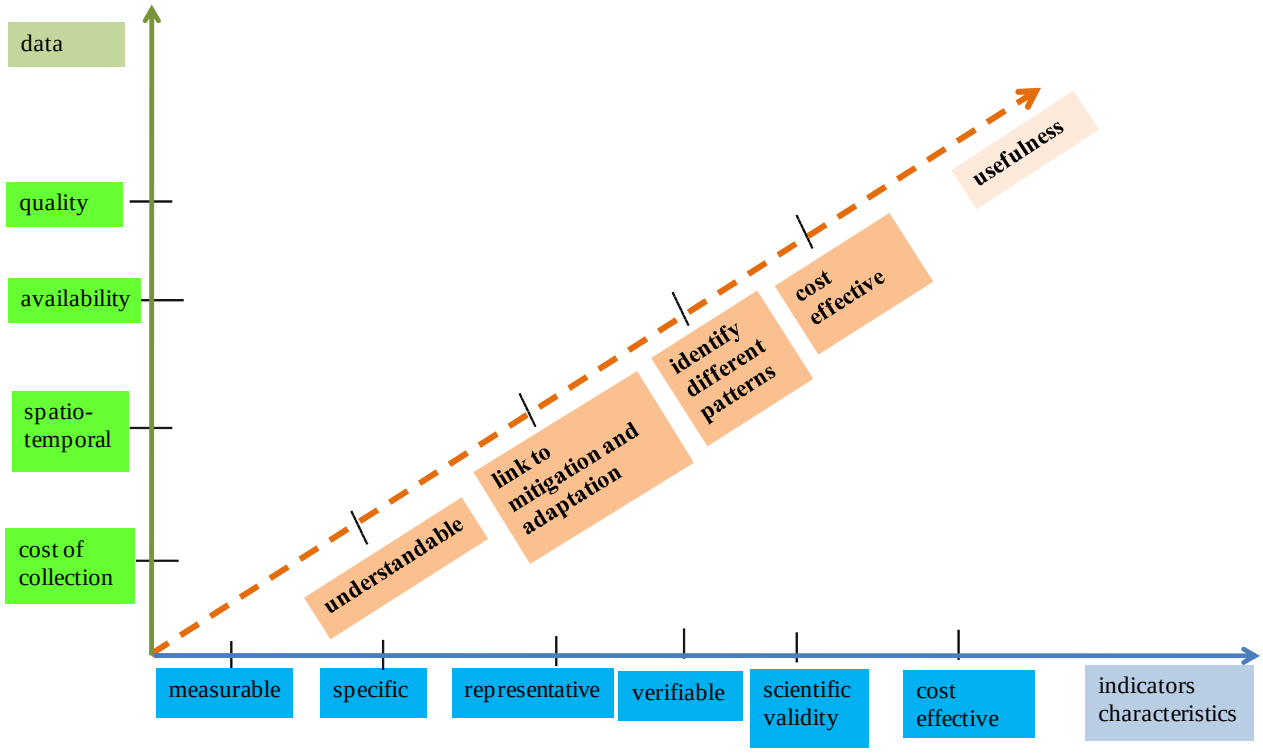
On the other end, studies which are currently addressing the issue of how to find the best fit vulnerability indicators are being developed in the climate change community (see for example Eriksen and Kelly, 2007, Adger et al., 2004). Those studies are particularly enlightening in that they drive our attention to the need to capture complex processes and relations among indicators, and not just provide a state diagnostic, which may be limited in relevance as far as potential usefulness by end users and decision makers.

Therefore, before entering into the discussion of the validity of each individual parameter that has been selected, the criteria that have driven the same choice should be discussed.

The latter can be synthesized according to the diagram shown in figure 1. Criteria are grouped along three main axes:

- On the x axe, the inherent characteristics of indicators are addressed;
- On the y axe, the characteristics of the data to be used to assess the indicators value in a given place are shown;
- On the z axe, the usefulness of indicators is appraised.

Figure 1 Criteria to identify and select vulnerability indicators



a. With respect to the inherent indicators characteristics, the following have been granted importance in the literature.

- **Measurability**. We are aware from the work that has been carried out in previous WPs that the complexity of phenomena and societal response to natural calamities cannot be fully grasped just using indicators. In the meantime we believe the latter should be intended as proxies of complex aspects and systems characteristics, so as to be able achieve some important goals. The first is comparability among places and communities, to establish priorities and identify key specificities as well as constant features; the second is the possibility to assess, though with large uncertainties, to what extent given policies and strategies are able to move the system towards increasing or decreasing vulnerability levels. By measurability we do not intend only quantitative measures, but also qualitative, which allow to construct some sort of qualitative grouping of values referring to a benchmark or value established by previous research and findings.
- **Specificity.** Indicators should address as much as possible specific vulnerability aspects rather than generic features that do not help in understanding what makes a given area or a given society more or less prone to suffer the consequences of an external stress. As mentioned in a previous deliverable, for example, economic disadvantage is not per se a measure of vulnerability: it becomes such when we are able to demonstrate how a poor response and low coping capacity is linked to limited access to financial resources and to services.

- **Representativeness**. Indicators should represent a wide set of cases and situations rather than being constructed after each individual case. This requires that indicators are chosen after they have been recognised as constant elements in several similar cases or across scales and regions or across different risks. Indicators cannot be too tailored to the specific case at stake, even though calibration procedures must be carried out; on the other hand, they must guarantee a minimal level of generalization, to be supported by statistical analysis. While this requirement can be met for physical vulnerability, it is far more complicated and thus constitutes more an aim than an established feature, for the less investigated aspects, like social, systemic, and economic.
- As for **verifiability**, as mentioned at the beginning of this paragraph, there is the need to tune the search of correlations between indicators and surveyed damages after disasters, so as to be able to improve the capacity of indicators to elicit those systems characteristics that seem to be the root causes of poor or mediocre response.
- The features mentioned above can be all mentioned as part of **scientific validity**, particularly when we talk about measurability and verifiability. In the meantime, to be scientific, indicators should meet the agreement of a large scientific community, should strive toward objectivity, even though we are all aware about the large room for subjective and even arbitrary judgement that is inevitably involved in any complex environmental assessment requiring to bridge among natural and human systems. Nevertheless, what can be required is that indicators be chosen as rigorously as possible, be framed in a transparent conceptual framework linking the selected indicators to the notion that must be evaluated (in our case vulnerabilities).

b. With respect to data characteristics, the following criteria should be met, while looking for vulnerability indicators:

- **Data quality** is an important requirement, even though many times only poor quality data are available, particularly for indicators that are not part of a long and well established tradition. In this case, perhaps it can be recommended that at least the quality of data will be made explicit so that assessors can judge to what extent the related indicator can be considered reliable. In fact, in designing a general framework, it is rather hard to dismiss all indictors for which data are not available in a given country or region good: this would be too limiting, also considering the fact that data quality differ enormously from one region to another and sometimes even from one municipality to another. Therefore eliminate indicators on this basis would diminish the relevance of assessments also in areas where data quality is high and the information that can be obtained may be very valuable for mitigation purposes.
- Indicators of vulnerability are required to cover different spatio-temporal scales, when this is relevant for the final assessment. In this regard, we should make sure that data are available accordingly at the needed **spatio-temporal scales**. Similarly to what has been said for data quality, this requirement, while valid in principle, can prove to be too limitative in some situations and particularly currently, as many data

are not available because they have never or poorly been considered until now for risk mitigation purposes. As said above, the framework and the proposed indicators should set a sort of pathway for future damage assessment, to capture the attention of analysts on aspects that have been neglected insofar.

- **Availability** should be considered also **over time**, particularly when processes must be captured: data that are available only at a given time spot do not permit to follow processes or to monitor whether or not a given system is becoming less or more vulnerable over time.

c. The entire method is being designed to guide and orient amidst mitigation strategies. In this respect, how useful proposed indicators are in enhancing the latter must be asked as well. Usefulness in this regard does constitute an important criteria for indicators selection.

   - The first requirement is that indicators be **understandable** by users, not only as far as terminology is concerned, but also in the way they are measured, reference values selected and actually used in the assessment. This is a fundamental requirement should indicators be discussed with concerned stakeholders and be used by them as part of their ordinary planning an programming activities (of land use and spatial planning, granting permissions, deciding about infrastructures modernization etc.).
   - Indicators should provide directly or indirectly a door towards a set of strategies aimed at mitigating present levels of risk. In this regard they should not be only "descriptive" of a given situation, but also be **linked to potential intervention policies**, both as goals to be achieved and as factors against which achievements can be monitored and appraised.
   - Perhaps the most important requirement with respect to all those defined insofar, relates to what extent proposed indicators permit to **distinguish different patterns** in a given areas, eliciting so called "pockets" or hotspots of vulnerability. In general, it is an important requirement that using the indicators, differences among conditions, individual areas, zones, parts of community, and communities are sorted out, so that priorities can be decided and tailored measures designed.

The "**cost effectiveness**" requirement has been left at the end to be considered collectively across all axes.

Talking about data collection, cost effective means that a reasonable cost is associated to the operations needed to gather the required data. In this respect it is commonly known that census data, data derived from national and international databases are often preferred, not only because they are cheaper, but also because they guarantee coverage over time and across scales, and can be used for comparative purposes. A balance must be obtained between the requirement of good quality data, optimised for the needed level of detail, and cost of collection.

Talking about usefulness, indicators that require too complex mechanisms to obtain data, or data that are privately hold or covered by secrecy are of limited use.

Finally cost effectiveness can be measures also from a cognitive viewpoint: indicators that are too complex to construct, that require sophisticated and opaque operations to be assessed should be carefully considered, given the large uncertainties they may entail. In the meantime, also the total number of indicators must be the object of reflection: endless lists of indicators are not only difficult to use, but also raise questions about the actual possibility to guarantee the other requirements of quality and usefulness that have been described until now. From a cognitive point of view, sustainability studies warn against the excessive number of parameters that nobody is able to handle nor master.