GEO ENVIRONMENTAL INDICATORS IN THE POST DISASTER RECONSTRUCTION PROGRAMMES

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Theme: *Any post disaster reconstruction programme needs to blend modern and traditional methods in such a way that vulnerability is reduced and resilience is enhanced.*

Abstract

In order to make sustainable projects of reconstruction in disaster-stricken areas and address the local economy, the environmental and social demands, with the needs and the priorities of the interested communities, it is essential to use the criteria of modern planning.

This requires the use of essential parameters to assess the compatibility of territorial transformation activities. The arrangement of these parameters requires shorter or longer times depending on how the basic cognitive framework is developed.

A preliminary assessment is required in order to guide, limit and control the intervention decisions. The preliminary assessment needs to be put in relation with the geo-environmental impacts and risks and is based on a screening of all the available information on resource vulnerability and the geo-environmental risks.

The screening can be carried out by means of **geo-environmental indicators,** which represent tools giving synthetic information about complex topics.

Suggested indicators are those used in the DPSIR framework, used, in Europe, for environmental reports accomplishment.

With reference to natural phenomena, the DPSIR framework **must** be supported by the **DHVRR framework**. The first is used to verify environmental compatibility, the last to verify the safety of the interested areas.

Keywords: *sustainable projects of reconstruction, modern planning, geological hazard and vulnerability, geo-environmental impacts and risks, geo-environmental indicators*.

Objective: *Maintenance of resiliency of environmental system and improvement of safety condition in post disaster reconstruction programmes.*

1. Rationale and Aims of our proposal.

a) Natural phenomena are frequently the cause of catastrophes that afflict human populations. Natural disasters bring destruction, death, pain and heavy damages to the economy and the environment, causing lasting affects on the development of many countries.

The cultural and scientific pursuit of sustainable development is the basis of any policy which aims to prevent and defend from natural and environmental risks.

b) The revolutionary concept of sustainable development imposes particular attention towards the natural resources. These are essential to the life of human being (see for example the importance of water, soil, energy and animal kind) but, at the same time, they are limited and hardly renewable.

c) However, such natural disasters as earthquakes, tsunami, tornado, landslides, floods, volcanic eruptions, etc. impose improvement of defence capacity, since it is not possible, as to now, to prevent or stop them.

Defence capability is strongly related to both research achievements and enforcement of civil protection measures and services.

Many important proposals follow this direction and among these, we want here to focus on the Program IDNDR (International Decade for Natural Disaster Reduction), which was conducted by the United Nations and aimed at inviting the international community to cooperate for the reduction of natural disasters.

The aims of the Program were:

1. Sound evaluation of the risks related to natural phenomena and its insertion in the development plans;
2. National and/or local mitigation plans, including long term precautionary measures and population awareness;
3. Quick access to global, national, regional or local warning systems.

Risks analysis, which requires a great technical and scientific effort, must be developed taking into account not only the existing situations, but also the possible growth of a given territory.

d) In the scientific community, it is generally acknowledged, that the modern planning is the right tool to pursue sustainable development and for assessing proper natural risks mitigation and prevention.
Modern planning should provide:

- detailed information on natural and cultural resources, as well as territorial hazards and risks related to natural phenomena;
- precise choices on the use and territorial transformation that can increase the safeguard of the natural and environmental value, and to the improvement of the environment and the landscape;
- meaningful contributions not only for risks prevention, avoiding urbanisation of dangerous areas, but also for mitigation, programming protective measures for those areas where risks already exist.

e) In post disaster sustainable reconstruction programmes, addressed to reconcile economic, environmental and social demands with the needs and the priorities of the interested communities, it is essential to use modern planning criteria and procedures.
This requires the use of specific indicator of hazard and risk, that can already be available or not, depending on the state of advancement of basic cognitive framework.

f) The times of definition of the cognitive frameworks can affect the time required for reinstatement and reconstruction. Besides, the evaluation of the time required can influence the choices made for the solution of some resiliency problems of the damaged area and, more important, the problem of temporary recovery of population (the use of light-weight prefabricated houses is conceivable when resiliency and reconstruction times are supposed to be quite long).

g) A screening of the available information, on the resources vulnerability and the geo-environmental risks, can be very useful for the preliminary assessment finalized to guide, limit and control the intervention decisions, in relation to the geo-environmental impacts and risks.

h) The screening can be carried out by means of geo-environmental indicators which are regarded as tools giving synthetic information about complex topics. *(Definition of indicator: a parameter, or a value derived from parameters, which points to, provides information about and describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value).*

i) Suggested indicators are those of the DPSIR framework, used, in Europe, for the accomplishment of environmental reports. They need to be customized to the specific needs, especially with regards to hazards and risks, and simplified, in order to be used in the delicate step that come before reconstruction.

2. Frameworks and indicators to refer to (DPSIR and DHVRR).

The methodologies of analysis for the state of environment evaluation of a given area, make use of several environmental indicators.

The OECD (Organisation for Economic Co – operation and Development) uses three basic criteria to describe “ideal” indicators: policy relevance and utility for users, analytical soundness, measurability.

General criteria for selecting indicators can be simplified as below:

1. Relevance for sustainability and environmental policy activation;
2. Relation with public, international and domestic activities;
3. Scientific soundness;
4. Applicability.

In order to develop State of the Environment Reports, indicator sets were used in such a way fixing existing relationships between human activity and environmental changes was feasible.

The PSR (Pressure, State, Response) model has initially been developed by the OECD to structure its work on environmental policies and reporting. It considers that: human activities exert pressures on the environment and affect its quality and the quantity of natural resources ("state"); society responds to these changes through environmental, general economic and sectorial policies and through changes in awareness and behaviour ("societal response").

The PSR model highlights these **cause-effect relationships**, and helps decision makers and the public see environmental, economic, and other issues as interconnected. It therefore provides a means of selecting and organising indicators (or state of the environment reports) in a way useful for decision-makers and the public, and of ensuring that nothing important has been overlooked.

Depending on the purpose to use the PSR model, it can be easily adjusted to account for greater details or for specific features. One example of adjusted versions is the Driving force-Pressure-State-Impact-Response (DPSIR) model used by the European Environmental Agency (EEA).

Driving forces are the social, demographic and economic developments in societies and the corresponding changes in life styles and overall levels of consumption and production patterns. The major driving forces are population growth and changes in needs and activities of individuals. The driving forces provoke changes in overall levels of production and consumption and thereby exert pressure on the environment. Indicators, provide a representative picture of pressures on the environment.

Indicators of environmental pressures give information on the pressures exerted on the environment. They are closely related to production and consumption patterns; they often reflect emission or resource use intensities, along with related trends and changes over a given period.

Indicators of environmental conditions (state) are designed to give an overview of the quality of the environment and the quality and quantity of natural resource that can be affected by pressures.

Indicators of impact. The Impact component presents data on the impact of the change of the state of the environment on the foregoing factors.

Indicators of response. Societal responses show the extent to which society responds to environmental concerns. They refer to individual and collective actions and reactions, intended to:

- mitigate, adapt to or prevent human-induced negative effects on the environment;
- halt or reverse environmental damage already inflicted;
- preserve and conserve nature and natural resources.

The indicators of the DPSIR framework answer to a logical process that starts from the description of human activities and needs (Driving forces) that exert pressures on the environment (Pressure indicators), which can change the state (State indicators) of natural and environment systems, which then impact (Impact indicators) on human health and eco-systems, causing society to respond (Response indicators) with various policy measures concerning any component of DPSIR model.

With reference to natural phenomena, the DPSIR framework **must** be supported by the **DHVRR framework** (fig. 1). The first is used to verify environmental compatibility, the last to verify the safety of the interested areas.

In this case, sets of indicators must be used such that risk and vulnerability scenarios for populated or to be populated areas are set and related to the dangerousness of natural phenomena.

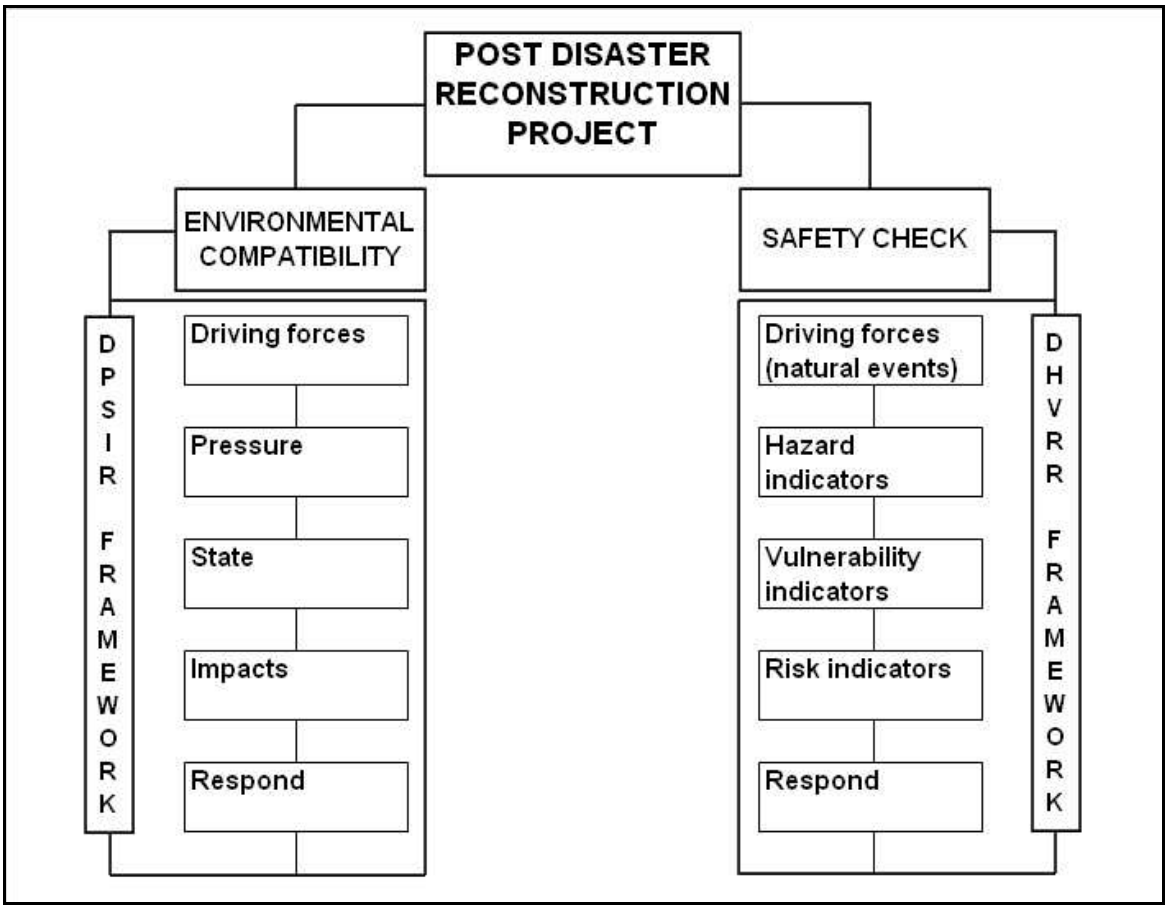

Figure 1. DPSIR and DHVRR flowchart

Descriptive indicators of the DHVRR framework are:

Driving forces: which refer to natural phenomena related to climatic condition or to endogen or exogenous geological processes that may result in change in the state of the territory.

Indicators of hazard: which describe the probability that a certain phenomenon happens in a certain area, in a given lapse of time, with a certain intensity. Indicators have to take into consideration regional dangerousness as well as local dangerousness conditions which can increase the phenomenon.

Indicators of vulnerability of landscape: which are meant as a complex set of population, buildings, economic activities and social organization, like it was configured in reconstruction programs.

Indicators of risks: which provide a quantitative assessment of the risk.

Indicators of response: which indicate measures and actions direct to reduce the risk levels.

The logical path starts from the individuation of that phenomena that can happen in a certain area (driving forces), than can exert higher or lower negative pressures (indicators of hazard) by striking populated areas, that cause risk conditions (indicators of risk or impact), with the probability of negative effects (damages and victims). The weight of these is linked not only to the level of danger but also to the vulnerability and exposure conditions of the elements at risk (indicators of state or indicators of vulnerability and exposure), and with the need then of responses intended to avoid or mitigate the risk .

3. Screening for reconstruction areas.

The sustainable projects of reconstruction of disaster-stricken areas, are addressed to reconcile the economy, the environmental and social demands of the damaged areas, with the needs and the priorities of the interested communities, to whom we need to guarantee security conditions and quality of life.

To this end, the demand to operate with promptness, can not set aside the demand to seek human activities interactions, which will develop after the reinstatement of the population and the territory. This, with the prospect to isolate the principal factors of human activities pressures on the environment or vice versa (environment pressures on human activities), with the purpose to make conscious choices and to find measures and solutions that make the reconstruction operations a sustainable process.

Impacts.

It is recommended that the international scientific community draft a check list of specific driving forces related to a permanent settlement of a human community (that exerts pressures on the essential environmental components), and then

highlight those pressures which are more difficult to address during the post disaster phase, and those for which a response is easier during the preliminary phase of planning assessment.

The environment analysis of reconstruction areas, made using the available cognitive frameworks, should provide the essential “state indicators” with reference to the principals components of the environment.

With relation to the extent of pressures and to the components of the environment vulnerability, typology and importance of the impacts (impact indicators) will be defined; moreover it is important to point out the mitigation and control requirements to response to (response indicators) during the phase of formulation of the reconstruction process, by means of either appropriate plans or protective measures.

Risks

It is recommended that the international scientific community draft a check list of natural phenomena related to climatic condition or to endogen or exogenous geological processes that may cause problems to human settlements.

With reference to these check list it is possible to determine which processes and phenomena are likely to happen in a certain area.

Using the available cognitive frameworks, provided by the international or national scientific community, it is possible to evaluate the hazard of the phenomenon and the local condition that can increase the hazard levels. This to evaluate the economic and technical measures that can be taken to give an acceptable answer to the needs of security.

Where the level of risk is still too high it is necessary to find alternative solutions.

In practical applications the process can be developed step by step. In the first step the definition of different hazard, risks and damage classes (or set of indicator), can already be a very good result. We have here to remember indeed, that many countries, especially underdeveloped countries, lack any cognitive framework.

Conclusion

Maintenance of resiliency of environmental system and improvement of safety condition, are the basic conditions of any project of post disaster reconstruction.

But it is also very important taking into account economic and social demands of interested communities in order to give them the chance to pursuit development after the reconstruction.

Modern planning, oriented to pursue the aim of sustainable development, is the right tool to maintain the resiliency, to make conscious choices and to find measures and solution that make the reconstruction operations a sustainable process.

The DPSIR framework, used by national and international scientific communities to determine existing relationships between human activity and environmental changes, provides a means of selecting and organising indicators (or state of the environment reports) in a way useful for decision-makers and the public.

The final goal of the DPSIR framework is to assess the environmental compatibility of human activities.

On the other hand, in post disaster reconstruction programmes, it is also very important to take into consideration the need of safety of the population, with particular regard to natural events.

The aim of the paper was, then, to introduce a framework that take into account this particular need.

With reference to natural phenomena, the DPSIR framework must be supported by the DHVRR framework. The first is used to verify environmental compatibility, the last to verify the safety of the interested areas.

The DHVRR framework can successfully be used to this end.

This requires the use of specific indicator of hazard and risk, that can already be available or not, depending on the state of advancement of basic cognitive framework.

It is in fact well known that countries differ widely in developing and organizing environment and hazard statistics, so that data availability can be very limited,

especially in underdeveloped countries or in countries that are just embarking on the development of environment statistic.

The paper suggests that, in the preliminary phase of any post disaster reconstruction program, the local/national/international scientific community draft a check list of indicator of driving forces (natural events), hazards and risks existing in that particular area.

This check list make it possible the evaluation of the time required for reinstatement and reconstruction. This can influence the choices made for the solution of some resiliency problems of the damaged area and, more important, the problem of temporary recovery of population.

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