2014 3rd International Conference on Geological and Environmental Sciences
IPCBEE vol. 73 (2014) © (2014) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2014. V73. 13

Introducing a New logical Model Based on the Holistic Approach to Risk Assessment for Environmental Disaster

Brenda Bravo-Díaz [1] and Pedro Joaquín Gutiérrez-Yurrita [1, 2 +]

[1] National Polytechnic Institute

[1, 2] Interdisciplinary Center for Research and Studies on Environment and Development

Abstract. A natural hazard (anthropogenic or combined) can produce different effects in natural or artificial landscapes, ranging from barely perceptible damage to catastrophic damage. To reduce its consequences is necessary to reduce the risk by reducing the vulnerability of the exposed elements. To do this we must identify the threat conditions, recognizing the vulnerability factors and determining the ability of the society to prevent or respond to disasters. The diagnostic aspects of an environmental system including threats are fairly well developed, even the same diagnosis can estimate the probability of a catastrophic event occurs, but what cannot be done with the diagnosed and poorly developed, is the holistic disaster risk management. Some management systems base their operation on warning systems and early action; but after the disaster happened. The prevention of environmental disasters can be performed partially. While it is true that may not be predicted long in advance when a particular catastrophic event occur, they can be logical prediction models, so that disaster risk is managed before, during and after natural event occurred. In this paper the integrated approach to disaster risk management, the holistic assessment and aspects that are necessary to achieve compliance with proper disaster risk management is described.

Keywords: Environmental hazard, socio-ecosystems, risk management, economic losses, environmental damage.

1. Introduction

Annually environmental disasters kill thousands of people worldwide. And millions of dollars in economic losses. An element of nature alone could go unnoticed by the human population, but when it becomes affected disaster. Earthquakes, floods, hurricanes and volcanic eruptions are natural phenomena that have always been present in the history of mankind, but only remembered when they have caused misery in the population [1]. The crux of the problem is that sedentary human societies have been built in areas where their subsistence resources were located at hand. Initially, these settlements did not contemplate catastrophic natural events. And when one happened, they associated to the wrath of a god and they had two options, either whole village moved or curried with their god. Currently have grown considerably villages that are already occupied most of the territory, is not so easy to locate a city or town anywhere else, and few communities still believe that a great disaster happened by God's wrath. The result is that disasters by elements of nature still occur due to the exposure of human communities to different threats, but with a high degree of vulnerability. Vulnerability includes different factors depending on the exposure and physical susceptibility, social, economic and ecological fragility or lack of resilience of the socio-ecosystem, i.e., the ability to recover from disaster and return to previous conditions system to event.

The Disaster Risk Management (DRM) is to reduce the social, economic and environmental consequences of a disaster, so it is necessary to know that a disaster follows its spiral near a cycle in terms of prediction with a measurable uncertainty, but with human or non-interference. This randomness of when and

+ Corresponding author. Tel.: +52 5729 6000 ext. 52701; fax: +52 5729 6000 ext. 52710
E-mail address: pgutierrezy@ipn.mx

where a disaster will happen is the reason why it is necessary to develop a logic model to help manage the risk of disaster.

1.1. The Concept of Disaster

The development of humanity is becoming faster and more widespread, the result is that there has been a considerable increase in natural disasters that adversely affect human societies [2]. Since the disaster depends on intrinsic natural events (threat), but also the place where the community is (vulnerability), as it is increasingly difficult to predict a catastrophe [3].

We must take into account also the combination of all human activities with unpredictable weather conditions and changing constituents of ecosystem functionality, make insufficient measures which until then taken to alert of a disaster and repair damage to occur [4], even, has not been possible to establish specific regulations to govern settlements and human activities in order to counter the risks of disasters [5]. There are environmental laws at the national level and international directives, but they center on the evaluation of specific environmental impacts. The most advanced is in the European landscape protection, but is not yet completed and therefore not currently applies [6]. Overall, a catastrophic situation or disaster is a disruption of the functioning of a community or society, negatively life altering and exceeds the normal capacity for action of any organization and government, often causing permanent changes in the socio-ecosystems. Synthetic disaster management terms, historically speaking, has two parts (before and after the disaster):

1.1.1. Before the disaster

- *Prevention*. It can be defined as the set of measures and advance actions to avoid or prevent a dangerous phenomenon is present or to reduce their impact on the population, goods, services and the environment.
- *Mitigation*. The effects of disaster require information relevant to real dangers. These actions can be defined as the means, which aims at organizing, and facilitate preparations for the effective and timely warning, rescue and rehabilitation of population disaster.
- *Preparation*. Refers to take action to reduce the impact of the disaster or when it is predicted as imminent. These actions can be defined as measures that aim to organize and facilitate preparations for the effective and timely warning, rescue and rehabilitation of the population in case of disaster.
- *Alert*. It is a state that is declared prior to the manifestation of a dangerous phenomenon, so that operational emergency agencies activate procedures preset action for people to take specific precautions because of the imminent occurrence of the expected event.

1.1.2. After the disaster

- *Response*. The answer relates to the emergency measures taken during the impact of a disaster and its consequences in the short term. The main emphasis is to save and protect lives. The victims are rescued and their needs are met. In general, at this stage the actions of search, rescue, relief and assistance aimed at saving lives, diminishing suffering and shun the loss of property running.
- *Rehabilitation*. Rehabilitation is the process of repairing the ecological damage, restore services and rebuild facilities after the disaster. It is the process of restoring normal living conditions through repair of interrupted or damaged by the disaster indispensable vital services.
- *Reconstruction*. The process of recovery of the community affected by a disaster by restoring the social tissue and their relationships, and repair the physical damage suffered in his buildings, infrastructure and productive activities.

2. Methodology

Holistic approach to assessment risk management described by Cardona [7] is the methodology proposed to construct our logic model. This approach considers three elements: i) Exposure (environmental susceptibility); ii) Vulnerability (socio-economic fragility) and, iii) Resilience. These factors try to prove de hypothesis that there are a huge relationship between society development and vulnerability, in addition of considering other issues like low resilience society to confront risks of disaster, disaster recovery and

adaptation to a post-disaster situation. These are the characteristics of the factors considered for the development the model:

- *Exposure* (E): This is a "hard" risk related to the potential damage to the physical structure of human constructions and the environment.
- *Vulnerability* (V): Contribute to a "soft" risk related to the potential impact on the social context.
- *Resilience* (R): Also contributes to the "soft" risk or impact factor of the second order on communities and organizations.

To carry the construction of the model to a more practical level, not just the theoretical, we consider the average conditions of vulnerability and threats in Mexico because it is one of the countries most exposed to natural hazards in the world. In Table 1 are the four major risks, the territorial area exposed and the number of people affected [8].

Table 1: Major natural hazards that increase the vulnerability of the population in Mexico.

Natural Risks	Exposed Area		Population exposed	
	Km^2	National Territory (%)	Inhabitants (Millions)	Percentage of the total population
Storms, hurricanes, floods	815,353	41.0	31.3	27.0
Earthquakes	540,067	27.0	31.0	27.0
Drought	573,300	29.0	21.2	19.0
Fire (in natural forest)	747,574	37.0	28.4	25.0

3. Results

The current framework for disaster risk management has gone through changes due to the importance that has been given to risk and no to disaster. Having a clear interrelationship between the elements of the threat and its conjunction with the vulnerability is essential to optimize the Disaster Risk Management in a specific locality and to develop the logic model. This model, when computerized and fed real-time data from satellite stations can generate programs and portfolios for immediate action in response to the disaster, so that the social and economic damage is minimized. But also, it is a model that prevents the imminence of disaster generating alerts in different ways to both the authorities and civil society organizations to put in place programs of action. Figure 1 shows how the projects (specific actions), programs (operational management planning), portfolios (logical management framework) and clustering of the entire system (synergies between components and raw materials for interconnect automation, efficiency assessment and improvement model and its application).

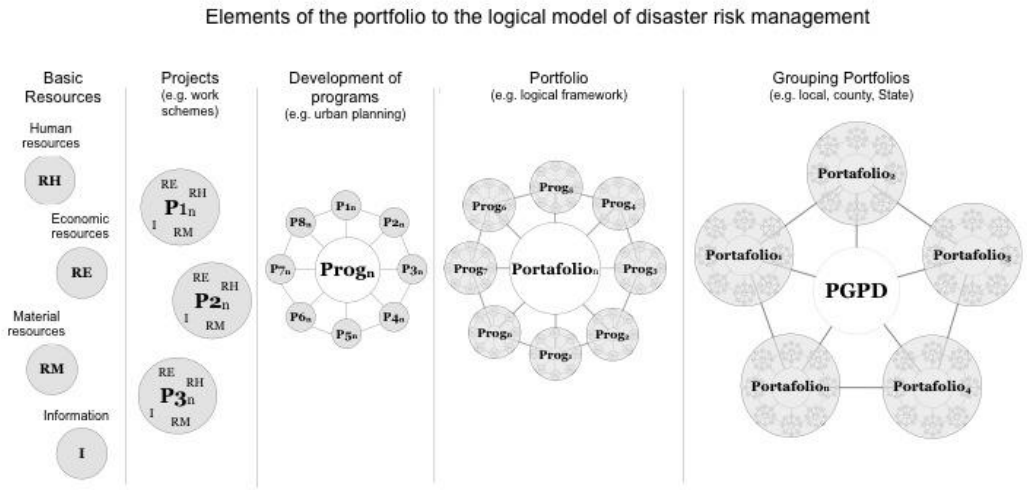

Fig. 1: Constituent elements of a logic model for disaster risk management.

Having identified the components of the logic model, the model with the holistic management structure develops, which comprises four components: inputs, processes, outputs and feedback units. Thus, functional model style systems through hierarchical organization have specific weighting. These models correspond to

bootstrap methods to be fed-back, constantly updated and improved. In Figure 2, the input elements of the model are shown. The first component are the inputs of the system are represented by the above aspects in the evaluation and management of disaster risk at this point must be known the current status of the above. The second is the process of bringing the actions and aspects holistic approach to compliance with the proper DRG disaster cycle. The output (third component) is represented by the expected result to reduce disaster risk. The fourth component is the system feedback processes and verification of its operation, which connects the different units of the bootstrap model for continuously improved and updated automatically. Importantly, this fourth element functions as control.

All continuous monitoring system with bootstrap must have a control subsystem. The control subsystem performs monitoring activities to measure the effectiveness of efforts to reduce disaster risk, identification of corrective actions, and new aspects of the risks, updating and communicating information, planning and risk management

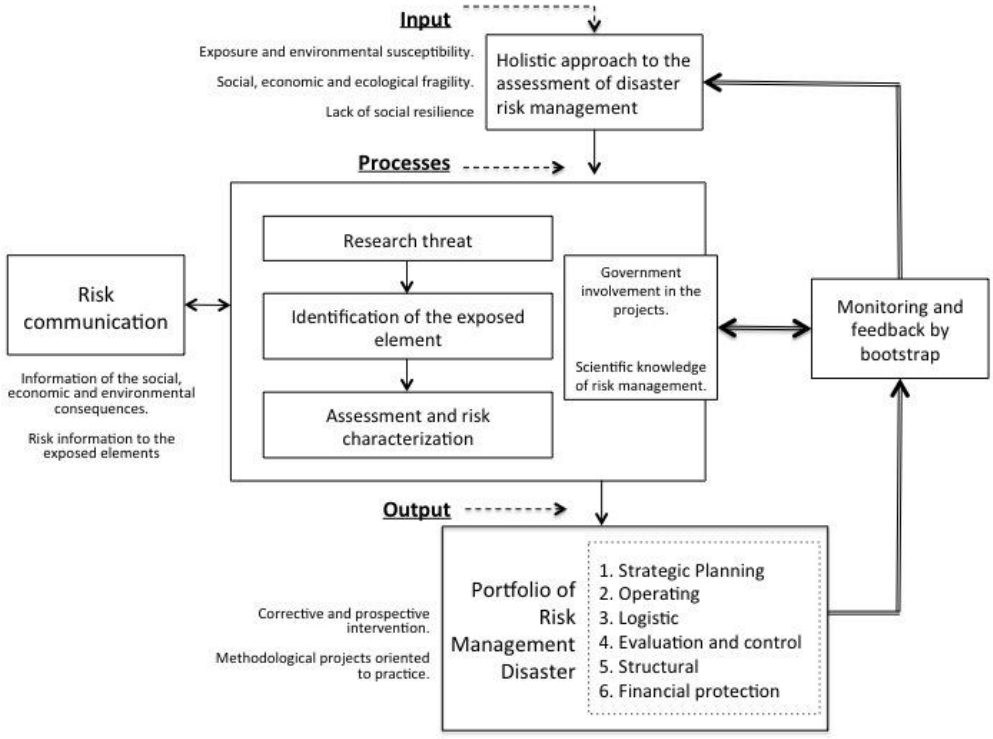

Fig. 2: Software for disaster risk management model.

4. Discussion

In many societies, progress depends on the development in society has a culture of prevention [2]. Mexico as a nation in the process of development, has social inequality, as reflected in the different degrees of vulnerability to environmental threats. Approximately 50% of the Mexican population (over 50 million) is below poverty thresholds established by UN. This is, lacking in many urban services such as drainage and drinking water, complete health services, education services, decent housing and a healthy and adequate environment to develop their activities [9]. Indigenous communities are indexes lowest human development of the country [10]. Most of these people living in areas with high risk of disasters. This vulnerability is magnified because the population is not aware of the danger that threatens or has no alternative to go live somewhere else.

Due to the lack of a disaster risk management collateral damage that are not provided for each activity are presented repeatedly. What it brings consequences as human, economic and environmental losses, which are reflected in the country's economy. Ignorance of the threats and vulnerabilities to which one is exposed causes the probability of occurrence of a disaster area increases. This probability also increases when economic activities increase vulnerability, performing actions that cause a depletion of natural resources and environmental degradation. The greatest danger is uncontrolled urbanization in areas with high potential to

cause disasters. Finally, it is worthy to notice that approximately 6.9% of the brut income is designated to cover damages produced by environmental catastrophes [11].

5. Conclusions

- The biggest lesson learned after living a disaster, is the need to be prepared for the next.
- The disaster risk management is a process for making decisions before the materialization of a risk in order to prevent or reduce human, economic and environmental losses.
- The human and material losses in Mexico remain high; making it clear that must be modifying the existing management strategy the risk of disasters.

6. References

[1] Estrategia Internacional para la Reducción de Desastres. Living with the risk. World wide report concerning how to reduce the risk of a disaster. United Nations. Visited in: http://www.unisdr.org/eng/about_isdr/bd-lwr-2004-spa.htm [18th January, 2006].

[2] R. Spence. Risk and regulation: can improved government action reduce the impacts of natural disasters? *Building research and information*, 2004. 32(5): 391-402.

[3] I.M. Shaluf et al. A review of disaster and crisis. *Disaster Prevention and Management*, 2003, (12)1: 24-32.

[4] R. Perry, E.L. Quarantelli. *What is a Disaster? New Answers to Old Questions.* Xlibris Corporation. 2004.

[5] C. Gómez et al. *Tecnologías respondiendo a los desastres*. Soluciones Prácticas. Perú. 2007.

[6] S. Mansor et al. Spatial Technology for natural risk management. *Disaster Prevention and Management*, 2004, 13(5): 364-373.

[7] O. D. Cardona. *Gestión integral de riesgos y desastres*. Notas de curso. Barcelona. Julio 2007.

[8] CONAPRED. National Atlas of Riks. Visited in: http://www.atlasnacionalderiesgos.gob.mx/index.php? [30th September, 2013

[9] P.J. Gutiérrez-Yurrita, A. Ortega, A. Álvarez, L. García, M. Rebollar. The holistic management of the landscape of ethnic communities will reduce climate change and promote its sustainability. *International Journal of Environmental Science and Development*, 2014, 5(3): 317-323.

[10] United Nations Program for Development. Panorama socioeconómico de los pueblos indígenas en el estado de México. Comisión para el Desarrollo de los Pueblos Indígenas. UNPD. México. 2010.

[11] National Institute of Statistics, Geography and Informatics. *National satellite counting*. México. 2010