

## Scientific, technical, and social research applied to risk reduction in Latin America and the Caribbean.

Peralta B. Henry<sup>1</sup>, Mendoza Jorge E<sup>2</sup>, Velásquez R. Andrés<sup>3</sup>

<sup>1</sup>*Corporación OSSO, Cali, Colombia. E-mail: heperalt@osso.org.co*

<sup>2</sup>*Corporación OSSO, Cali, Colombia. E-mail: jomendoz@osso.org.co*

<sup>3</sup>*Corporación OSSO, Cali, Colombia. E-mail: ave@osso.org.co*

**ABSTRACT:** This paper presents the scientific, technical, social and applied contributions to the risk reduction in Latin America and the Caribbean, developed along 23 years by the Southwestern Seismological Observatory (OSSO). A multidisciplinary Colombian research group, which was originated in the early 1980s, and formally established in 1987 with the support of Administrative Department of Science, Technology and Innovation (*COLCIENCIAS*), *Corporación Autónoma Regional del Valle del Cauca* (CVC) and the Swiss Government. Osso's research has been focused on three topics: (1) Earth sciences: seismology, applied geophysics, geology, environmental geology (natural hazards), geomorphology, oceanography, (2) Engineering and technology: instrumentation development and software for monitoring environmental signals and inventory software for disaster, and (3) Environment and Society: vulnerability, risk reduction, disaster impact assessment methodologies for social understanding of disasters; knowledge transfer, scientific and social disaster information. Since its inception the OSSO group recognized the importance of participating in local networks and international research related to social processes and environmental disasters. From the beginning of the 1990s, OSSO participated in the creation of the Latin America Network for Social Studies on Disaster Prevention (*La Red*), and undertook the task of developing the methodology *DesInventar* to help understand the dynamics of disasters and their real impact at local, regional and global level. In 1997, OSSO received the Global Award for disaster prevention (Sasakawa award), given by the Humanitarian Affairs Office (UN-DHA). Among the investigations developed by OSSO in recent years in Latin America and the Caribbean are: extensive risk analysis: "The urbanization risk and territorial expansion in Latin America" for the global evaluation report on Disaster Reduction Disasters (EIRD 2007 - 2008). The creation, maintenance and the homogenization of inventories historical disasters and everyday events in the Andean subregion, using the methodology *DesInventar*, the "Dynamics Atlas of the Andean Territory: population and property at risk to natural hazards, both funded by Andean Committee for Disaster Prevention and Attention (CAPRADE) / Support Project to Disaster Prevention in Andean Community (PREDECAN)/ EUROPEAN COMMISSION (2006 - 2008). The regional analysis of possible disaster losses and socio-economical variables in "Chaco", a pilot project focusing on Paraguay (2008 - 2009). In Colombia, the evaluation of physical and functional vulnerability to volcanic phenomenon in the area surrounding the volcano Galeras, for the National System for Disaster Prevention and Attention (2008-2009). Finally, the technical and humanitarian mission in support of United Nations Development Programme (UNDP) also stands out for strengthening technical capabilities for inventory losses of the earthquake in Haiti in January 12, 2010.

**Keywords:** *research, knowledge, science, technology, society, DesInventar*

### 1. INTRODUCTION

After the Second World War, people began to take greater interest in losses caused by "natural disasters". In recent decades the conceptualization of disasters has changed: the 1979 Coordinator Office of United Nations Disaster Relief (UNDRO) concepts were focused on threat assessment and preparations for the attention, from a vision of disaster as the result of the manifestation of an external phenomenon to society, a product of Nature. Now, the latest theories understand the risk as "normal", generated by the society in terms of the resources use done for its maintenance and reproduction in a determinate territory. Thus, risks can be transformed and mitigated (can be lowered in advance), through structural measures or engineering and non-structural (standards, planning), for medium and long term.

Since the beginning of the 1990s, in Latin America and the Caribbean, *La Red* introduced a new conceptualization according to which the risks and disasters are socially, historically, and economically constructed, but also a result of policies from people who inhabit different regions [1]. This necessarily, caused a change in the view of disasters as a cause of nature or random and unpredictable phenomenon. Thus, the need to establish more clearly the close relationship between disasters and the models of economic development, social, political, and land use emerged. The understanding of these relationships could be the key of reducing risks more efficiently and ensure the chances of more sustainable social development, environmental and economic

models. Certainly, this new approach maintains and supports actions to prepare for the attention and recovery. The incorporation of the recommendations contained in the Hyogo Framework for Action and initiatives such as the Andean Strategy for Disaster Prevention and Attention in the different countries of the region are clear demonstration of the importance of these new concepts of risk management.

Possibly the last thirty years, international and regional scale have evidenced transformation or transition from one vision of the disaster as something external to society, towards a risk view like socially constructed [2]. Under this approach, since OSSO was created, has been investigating in the field of natural hazards, adverse effects, the strategies and measures to reduce risks. The used methodologies are focused in three areas: (1). Earth sciences: seismology, applied geophysics, geology, environmental geology (natural hazards), geomorphology, oceanography, (2). Engineering and technology: development of instrumentation and software for monitoring environmental signals and inventory software for disaster, and (3) Environment and Society: Vulnerability, risk reduction, disaster impact analysis, methodologies for the social understanding of disasters as well as knowledge transference.

### **1.1 A brief history**

The history of Southwestern Seismological Observatory - OSSO as an interdisciplinary research group, started in the early 1980s in the region of southwestern Colombia, where natural phenomena with potential damage to lives and property are the highest Colombia (earthquake, tsunami, landslides, volcanic eruptions, etc.). OSSO was consolidated after the experiences of November 23 in the Viejo Caldas, December 12, 1979 Tumaco tsunami and earthquake, and the earthquake in Popayan, Colombia in 1983. In 1985, after the eruption of Nevado del Ruiz volcano and the consequent disaster of Armero, was installed the first phase of the South West Seismic Network (1985-2007), with the support of *Colciencias*, the CVC and the Swiss Government [1]. The OSSO group started formally in 1987 with two basic projects: "A regional system of observation and seismic research for southwestern Colombia [4] and the "Study of seismic risk to Cali" [5].

In 1996 members of the group, recognizing a long tradition in forms of cooperation, management, agility and efficiency in Colombia and internationally, created the OSSO Corporation, a non-governmental, non-profit, public benefit; dedicated to "*promote, support and implement scientific research, publish and disseminate knowledge, develop methodologies and technologies, as well as carry out activities in the fields of the dynamics of the Solid Earth, the hydrosphere and atmosphere, and their interactions with society.*" Its main activity is supporting the South-western Seismological Observatory Research Group - OSSO. In the last 12 years the OSSO Corporation has contributed significantly to survival, persistence and projection of the group until today, in a cultural context which still does not perceived properly or to support the need for projects of indefinite duration and continuous observation environmental and social variables, which are essential to help reduce risk in the context of sustainable local development. OSSO takes part of initiatives of research observation networks, in synergy with other national groups (e. g. COLCIENCIAS) and abroad (eg. The Pacific Tsunami Warning Center, PTWC in Hawaii).

At first Osso's mission and goals of scientific and technical research were oriented to acquire process and evaluate the seismic data in southwestern Colombia, the region of greatest seismic hazard of Colombia. Over the years, the working approach was extended to the set of problems and disciplines in the fields of natural hazard research, vulnerabilities, risks and disasters, both in Colombia and in Latin America and the Caribbean. Since its founding until December 2007 had Universidad del Valle's endorsement, however, currently is supported by the OSSO Corporation. In 1997 the group was awarded for global disaster prevention by Sasakawa award, which is given annually to individuals or institutions with outstanding achievements in science and applications for disaster prevention at international level and especially in developing countries.

## **2. LINES OF ACTION**

The construction of scientific and technical knowledge developed by the OSSO group in recent years at local, national and regional (the continent) scale, has been associated primarily with the development of observing systems, acquisition and processing of environmental signals, seeking technological independence through the development of hardware and software, as well as training and training professional for processing and analysing environmental signs. OSSO group designed, implemented and operated for a continuous and uninterrupted period of time, the Southwestern Regional Seismological Network, as part of National System for Disaster Prevention and Response since 1987 until 2007. As well as developed the National Tsunami Detection and Alert - SNDAT of Colombia until today. On the other hand, the OSSO group has also provided methodologies, information, databases and knowledge related to the assessment of threats, vulnerabilities and risks associated with natural phenomena (seismic activity and associated phenomena such as tsunami, strong vibrations, landslides, and volcanic activity) and climate change. The methodologies have been adapted according to local context, its scope and limitations as well as practical activities that have been developed for searching and integrating data from different sources, scales, spatial and temporal resolutions.

Usually the OSSO group relies on free software or public domain tools and makes use of available data on the internet from institutions related with generation of information technology, application of GIS, remote sensing and spatial modelling and social mapping exercises and planning-action-participation with communities and institutions. It is also makes available to the community through Internet, databases on disaster impact and published elements (critical infrastructure, population, economy, etc.). Osso compile, integrate and analyze environmental and anthropogenic variables to assessing retrospective and prospective risks and vulnerabilities of the territories, using the DesInventar software. The group organizes, systematizes and analyzes disaster or emergencies information, through the structuring and development of historical and daily databases of diverse magnitude effects associated with the occurrence of natural, socio-natural and antropics events.

The OSSO group had a long experience in social integration and transfer of technical scientific knowledge to communities and institutions. These contributions, from a holistic approach to risk reduction, have contributed to the development of perceptions and skills by local and national disaster prevention authorities; but have also worked to increase in all levels and sectors of the community (urban, rural, indigenous, Afro-descendant), a comprehensive perception of natural hazards, vulnerabilities and risks. Through the synergy of western scientific knowledge and traditional communities, supported by modern technology such as GPS and satellite imagery and GIS, has contributed to the reduction of risks from natural hazards on populations and strengthening early warning systems - SAT. The results achieved in this field have allowed the identification of recommendations applicable to integrated risk management in the territories and knowledge's generation useful to decision makers and to general public. Finally, it has been achieved the dissemination of information relating to threats and disaster occurrence to the authorities, prevention organizations and the general public, by organizing regional, national and international seminars and workshops, which information is including on the website, also, all the projects that have been made, with maps and databases (see [www.osso.org.co](http://www.osso.org.co)).

In academic circles, the OSSO group has supported the formation and development of human resources for science and technology, from a learning strategy: doing, encouraging interdisciplinary and holistic knowledge for understanding natural phenomena, social relationships and their natural environment. The most of technicians and scientists who currently are working in the OSSO group are the result of a training process since their college, from various scientific, technological, social and human disciplines. At the institutional level and horizontal cooperation OSSO group participates in local, regional and national committees, from the National System for Disaster Prevention and Response, and internationals such as Tsunami Warning System in the Pacific - ITSU. Additionally, OSSO has done consulting for public policy on risk management, provides technical support for humanitarian post-disaster inventory of effects, as well as studies on socioeconomic aspects of natural hazards, risks, and disaster mitigation in Latin America and the Caribbean.

### *3. CONTRIBUTIONS OF OSSO RESEARCH GROUP*

Since its creation, OSSO has been researching and developing technical and scientific knowledge on environmental variables and threatening vulnerabilities to mitigate natural hazards, to be applied to reduce the risks by Earth Sciences, methodologies Social Sciences, Humanities, and technologies. Among the contributions developed by the OSSO, in recent years stands out since 1994 the development and coordination of a disaster inventory system - DesInventar -, able to document not only the effects of major disasters on various geographical and administrative political contexts (i.e. a major disaster expressed as multiple disasters of different vulnerabilities), but also small and invisible daily disasters, which together show that their cumulative effects are equally or more important than high-impact (see <http://online.desinventar.org/>).

Knowledge of spatial and temporal behavior of disasters is a useful and necessary tool for effective risk management. In this regard, inventories of disasters are the empirical evidence of the occurrence of disasters which use and analyze facilitates decision-making, from the preparation and attention to prevention and mitigation, depending on the scale of observation and the purposes for which were developed. DesInventar methodology applied to the inventory of effects of disasters has among its basic principles of information gathering to the most local level and reveals the behavior of disasters to various spatial scales, including any losses regardless of their size, they don't have an specific threshold at which information will be collected and with a proven methodology for over 15 years in Latin America, the Caribbean and Asia, which have built databases for periods of more than 30 years of observation. For its implementation, Osso has been working primarily with public software tools and with data available on the Internet network of institutions related to the information generation on climate change and its effects. Also, the group incorporates databases on disaster impact and exposed elements (critical infrastructure, population, economy, etc.).

DesInventar has been applied to the Andean countries (Bolivia, Colombia, Ecuador, Peru and Venezuela), Central America and the Caribbean (Costa Rica, El Salvador, Guatemala, Panama, Cuba and Haiti); Southern Cone (Chile, Argentina and Paraguay), North America (Mexico); DesInventar has also been important supporter to quantify and express spatially the effects of major disasters like Hurricane Mitch in Honduras and Nicaragua (1998), torrential rains in the state of Vargas in Venezuela (1999) the earthquake in Arequipa in southern Peru (2001), the effects of the tsunami in Indonesia (2004) on several countries in the region and the Haiti's earthquake (2010). In several of these disasters OSSO group members have participated in situ technical humanitarian cooperation mission; in others, such as the Indonesia's tsunami, has supported the implementation of Internet DesInventar, to previously trained local staff. It also stands out the technical and humanitarian mission in support of UNDP for

strengthening technical capabilities for inventory losses caused by Haiti's earthquake from January 12, 2010 (see <http://www.osso.org.co/docu/proyectos/corpo/2010/>).

The recent contributions on the subject are: (1). Creating, updating and standardizing inventories of historical disasters and everyday events in the Andean Region to level CAPRADE / PREDECAN / EUROPEAN COMMISSION (2006 - 2008), (2). Extensive risk analysis: "The risks of urbanization and territorial expansion in Latin America" for the global evaluation report on Disaster Reduction, 2009, (ISDR 2007 to 2008). DesInventar is currently used by multiple entities, from national governments to local communities, through academic and research groups in Latin America and Caribbean, and Asia. Also has been used by research groups in over nine countries in the analysis of ENSO effects (El Niño, La Niña) and climate variability in the draft Disaster Risk Management ENSO in Latin America sponsored by *La Red*, and the International Institute for Global Change Research -IAI (see [www.cambioglobal.org](http://www.cambioglobal.org)).

On the other hand, OSSO directed the Atlas of the dynamic of the Andean Territory: population and property exposed to natural hazards, both funded by CAPRADE / PREDECAN / EUROPEAN COMMISSION (2006 - 2008), which seeks to be a reference for countries in terms of binational or multinational issues mitigating planning, and therefore input to the awareness of stakeholders and policy guidance and joint programs (see <http://www.osso.org.co/docu/proyectos/corpo/2009/atlas/web/>) [3], the regional analysis of disaster losses and socio-economic variables in the Chaco, a pilot project focusing on Paraguay (2008 to 2009) (see <http://www.osso.org.co/docu/proyectos/corpo/2009/>) locally in Colombia highlights the vulnerability assessment of the physical and functional volcanic phenomena in the area surrounding the Galeras volcano for the National System for Prevention and Treatment Disaster (2008-2009), study conducted for 11 municipalities around the volcanic complex (see <http://osso.org.co:8000/>).

#### 4. CONCLUSIONS

It is essential, especially in the context of Latin America and Caribbean countries, to support projects properly, observing and monitoring environmental and social variables, which, as far as possible, open-ended, and also continuous monitoring processes that allow human resources training scientific and technological capabilities to generate useful knowledge for actions to reduce risks and enable social, economic, and environmental development.

From a cultural context of science and technology, OSSO promotes the design or redesign of research institutions dedicated to the observation of environmental and social variables on a comprehensive, interdisciplinary and holistic risk for countries of the region, which can make better use of development and the challenges facing the world today. It is likewise appropriate to approach the question of how to obtain and how to build scientific technological knowledge, to provide a positively impact to society, institutions and community.

Finally, it is necessary recognize the existence of a transition from a vision based on the disaster and the development of a new vision based on the risk, the latter with a more modern, scientific and holistic character to move towards comprehensive risk reduction policies in the territories and communities that inhabit it.

#### 5. REFERENCES

- [1] La Red (1997). "*Hechos y desechos*". Red de Estudios en Prevención de Desastres de América Latina – La Red. Desastres y Sociedad/Nº8/año 5.
- [2] Corposso (2009). "*Anexo II – consideraciones sobre un marco conceptual para la gestión de riesgos en Colombia*". Informe final de actividades. Proyecto Lineamientos de política para la gestión de riesgos en Colombia – para Ministerio del Interior y de Justicia – Sistema nacional para la Prevención y Atención de Desastres – Dirección de Gestión de Riesgos.
- [3] Comunidad Andina (2009). "*Atlas de las dinámicas del territorio andino: población y bienes expuestos a amenazas naturales*". Secretaría General de la Comunidad Andina. Corporación OSSO.
- [4] Meyer, Hansjürgen (1984a). "*Un sistema regional de observación e investigación sísmológica para el suroccidente colombiano*". Proyecto a Colciencias, Universidad del Valle. Inédito.
- [5] Meyer Hansjürgen (1984b). "*Estudio del riesgo sísmico para el Municipio de Cali. Primera Etapa: Estudio de amenaza sísmica de fallas locales y zonificación preliminar de formaciones superficiales*". Proyecto para el Municipio de Cali – Planeación Municipal, Universidad del Valle. Inédito.