

Technical Assistance Project (TAP), San Salvador, El Salvador

Reducing Risks to Prevent Disasters: Probabilistic Risk Assessment in Central America

The Challenge: Reducing Vulnerability

Central America is one of the regions most vulnerable to natural hazards in the world. Located on the fringe of an unstable dance of tectonic plates, the region is threatened by earthquakes, a chain of active volcanoes, the notorious “Pacific ring of fire,” hurricanes, and storms. Population growth, unplanned and unregulated land use, lack of environmental controls, and poor application of building standards worsen the impacts of natural events and result in disasters with the accompanying loss of life, property, and wealth.

Central American governments have been improving their ability to reduce the impacts of natural hazards through activities promoted by the Centre for the Prevention of Natural Disasters in Central America (CEPRENAC), an inter-governmental organization, founded in 1987, within the Central American Integration System (*Sistema de la Integración Centroamericana*, SICA). As part of this effort, the Probabilistic Risk Assessment, CAPRA Initiative, was developed to strengthen regional capacity to understand risk.

The Project: Innovation for a Multi-Hazard Approach

The CAPRA software suite is a free, modular, open-source, and multi-hazard tool for risk assessment. CAPRA provides a risk calculation platform (CAPRA-GIS) integrating exposure databases and physical vulnerability functions under a probabilistic approach. CAPRA evaluates risk in terms of physical damage and estimates direct economic and human losses. CAPRA uses a display platform geographical information system (GIS) to estimate the disaster risk of earthquakes, tsunamis, hurricanes, floods, landslides, and volcanoes.

This multi-hazard approach allows users to determine the risk of more than one associated hazard. For example, a hurricane can be assessed in terms of precipitation, wind speed, and storm surge. The assessment continues through to an analysis of flooding. An earthquake is assessed in terms of shaking ground. Secondary hazards include tsunamis, whose effects include the run-up height modeling (maximum height above sea level).

CAPRA began in January, 2008, as a partnership of CEPREDENAC, the United Nations International Strategy for Disaster Reduction (ISDR), the Inter-American Development Bank (IADB) and the World Bank, through its Latin America and Caribbean Disaster Risk Management team. The Global Facility for Disaster Reduction and Recovery (GFDRR), the Spanish Fund for Latin America and the Caribbean (SFLAC), the IADB, and the World Bank provided financial support for the initiative. The engineering consulting consortium *Evaluación de Riesgos Naturales-América Latina* (ERN-AL) developed the CAPRA software and provided training services.

The CAPRA Initiative was first implemented in Costa Rica and Nicaragua as pilot cases. The Inter-American Development Bank (IADB) funded parallel activities in Belize, El Salvador, Guatemala, and Honduras. The initiative included designing the software platform, developing the probabilistic risk assessments, and providing workshops and other training activities.

CAPRA for Decision-Making

During the second phase, the CAPRA Technical Assistance Projects (TAPs) are providing capacity building for national and regional governments, support for data collection, development of disaster risk management strategies, and is creating a community of users. Most importantly the TAPs are generating information for decision makers in policies related to disaster risk management. These activities require partnerships with public institutions, educational networks, universities and scientific associations.

The second phase is expanding the CAPRA program into Colombia, Chile, Ecuador, El Salvador, Panama, and Peru. This *Project Highlights* describes the challenges and results in Costa Rica, El Salvador, and Panama.

The Results

Costa Rica: Protecting the Water Supply

According to Luis Carlos Vargas, Director of Research and Development of the Water and Sanitation Institute (*Instituto Costarricense de Acueductos y Alcantarillados*, AyA), disaster response usually means the restoration or reestablishment of systems after an event; risk management, however, addresses the expected impact of an event before it occurs. The TAP in Costa Rica is focused on preserving and protecting the water supply and ensuring a working water and sanitation system as soon as possible after the earthquake in: (i) the San José Metropolitan Area, (ii) the San Isidro area and (iii) the Higuito area. In a series of meetings, the participants began the process of building capacity in disaster risk assessment and building a database to evaluate risk in water and sanitation infrastructure.

To safeguard Costa Rica's water and sanitation systems, CAPRA gathers information from the historical record, and applies models that facilitate analysis of what is likely to happen during a probable earthquake. The program analyzes the seismic information and calculates physical damages in the infrastructure network. The final compilation and analysis, site impacts, and microzoning provide authorities the necessary information to prepare a seismic risk reduction program of short-, medium-, and long-term investments and a contingency plan for the next seismic event.

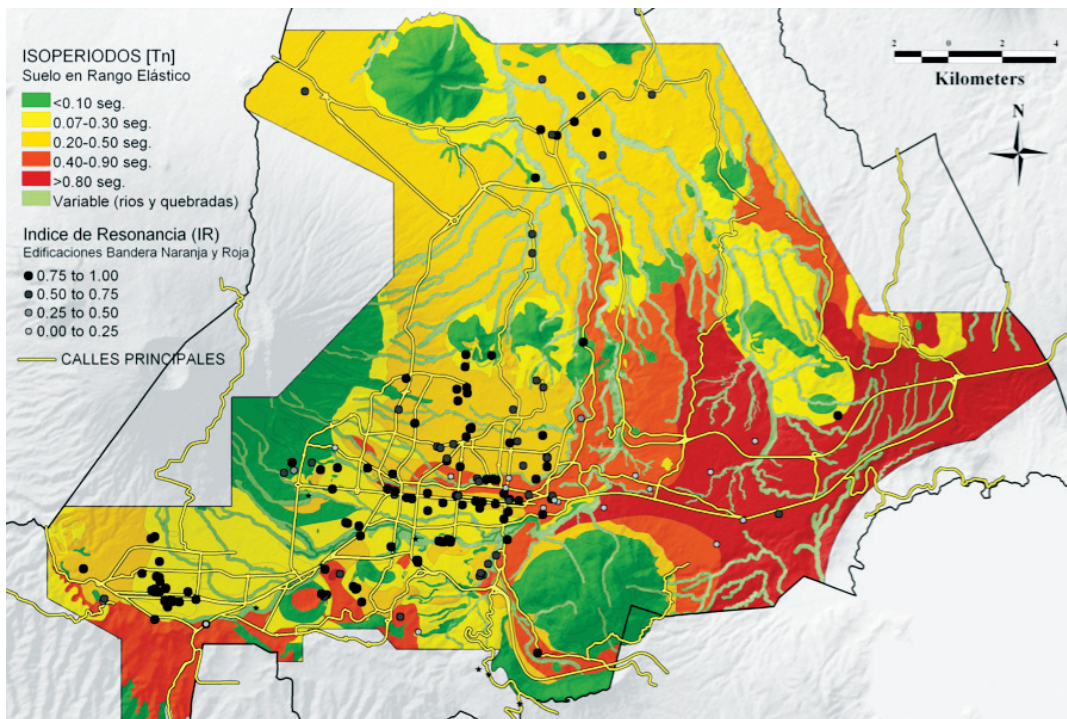
In the future, implementation of the seismic risk reduction program will reduce the risk of poor location of infrastructure, (inadequate design or construction), and unsafe operation. A final output of the TAP will mean that the people have access to drinking water and adequate sanitation in a time of need. Reestablishing these essential services also reduces the spread of disease.

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—Luis Carlos Vargas, Director of Research and Development of the Water and Sanitation Institute



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Seismic Risk Modeling for San Salvador Metropolitan Area.

El Salvador: Defending the Built Environment

In El Salvador, Minister of the Environment and Natural Resources *Hernán Rosa Chávez* requested support and technical assistance for seismic assessment of critical infrastructure. He commented that risk management is one of the fundamental pillars for the ministry. “Our responsibility is not only to see what is happening now, but also what can happen.”

The TAP focused on seismic risk assessment of education, health and government buildings portfolio in the San Salvador Metropolitan Area (*área Metropolitana de San Salvador, AMSS*). The most recent earthquakes, in 1986 and 2001, made evident the city’s vulnerability, which was a direct result of poor planning and poor oversight of existing seismic-resistant standards.

Beginning in January, 2011, the TAP, led by Ministry of the Environment and Natural Resources (MARN), began building capacity and developing knowledge on earthquakes. The first workshop provided specific training on the CAPRA software suite and developed the modeling work plan. Follow-up workshops introduced participants to the CAPRA Platform, methodology and organization, and demonstrated the application and its results. They also reviewed the region’s geology, seismology, and the information gathered on public buildings.

The TAP produced several regional studies of seismic hazards and vulnerability from locations around the city. These included geological, geotechnical (characteristics of the soil), and accelerographic (measure of ground movement) records from past events. The program gathered information on a total of 1550 buildings in 257 institutions with a distribution of 352 healthcare facilities, 1050 educational

structures, and 148 government buildings in the AMSS. The probabilistic seismic risk assessment integrated these data, knowledge of hazards, exposure and vulnerability functions to determine probable physical and direct economic losses.

In March, 2012, the MARN produced the final output of the TAP, a probabilistic modeling of seismic risk scenarios for the AMSS, including analyses of the portfolios of the Ministries of Education, Health, and Government. The risk reduction program described by the report seeks to identify the most affected areas (to guide assistance) and provides guidance for investment priorities in the short-, medium-, and long-term. The seismic risk reduction program will seek to reduce current and future vulnerability. It also provides results from the analysis of pure premiums for exposed structures, in percentage of exposed value and total value. These results represent the total amount per structure that should be set aside each year to cover the costs of the risk. They also enable the government to set priorities and assess the cost effectiveness of improving or replacing a building.

Panama: Preparing the City of David

In Panama, the CAPRA Initiative is focused on the city of David, the country’s second largest city and one of its most vulnerable to natural hazards urban centers. According to a study by the Specialized University of the Americas, David experienced earthquakes in 1934, 1945, 1979, and 2003. However, a recent study by the Norwegian geo-science research foundation NORSAR revealed that the high risk is mainly through lack of planning and poor use of seismic resistance standards.

The process began in a meeting in September, 2011. Representatives from the Ministry of Housing and Land-Use Planning and the Institute of Geosciences of the University of Panama partnered with the World Bank to collect the seismic



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hazard information and build the databases on population, neighborhoods, roads, hydrology, and buildings belonging to the Ministries of Housing and Land-Use Planning, Health, and Education. During a second meeting, in January 2012, the analysis focused on assessing the vulnerability of the buildings and maximum probable losses. A third and final meeting is scheduled for May, 2012 to close the capacity building cycle and set up the final results.

An important goal is to build institutional capacities for probabilistic seismic risk assessment. Results of these exercises will include a compilation and analysis of the seismic hazard and impacts for each portfolio. To assess these impacts, the TAP analyzed geological and geotechnical characteristics of the selected sites. The TAP also uses survey data on health centers, schools, and city blocks. Through the CAPRA platform, the results will lead to an understanding of the hazard, exposure and vulnerability of the selected building and housing stock.

The expected output of the TAP, in the short-, medium-, and long-term, is a seismic risk reduction program to guide the Panamanian government’s risk prevention and mitigation activities. The Ministry of Housing and Land-Use Planning is responsible for the design of the program with the coordination of the Ministries of Health and Education.

Risk Assessment to Ensure Progress Made

Risk arises from a natural hazard in combination with socio-economic developments. Risk measurement and management depend on the particular circumstances of a country, its institutions, capacities, and sources of information. Thus, CAPRA addresses the particular needs and capacities of each

country in terms of its national historical experiences and development processes. Director Luis Carlos Vargas of Costa Rica’s AyA pointed out that “these platforms are only utilized, or knowledge of these processes gained, if we engage in the exercise of calibrating them to our own reality.”

Beyond the software, CAPRA’s main innovation is bringing to the table participants who are not experts in risk management. They are specialists in other sectors interested in managing risk. Indeed, every sector should participate in risk management; if not, their plans and programs will fail in the wake of a natural hazard, such as earthquakes, floods, or landslides. In addition, as César Amilcar Medina, Chief of the Environment Unit in San Salvador’s Office of Planning, said, among of the challenges are how institutions respond to the seismic hazard and reforms of the legal framework.

In the end, the purpose of risk management is to save lives and property and preserve economic progress already achieved by modifying economic and territorial processes that create vulnerability. As Minister Rosa Chávez said, preparing for the next natural hazard is part of the effort to ensure economic progress. “If each time an event happens, we lose infrastructure, for which we have gone into debt, we won’t be able to progress; if the risk management policy does not progress, the economy will not progress.” CAPRA, therefore, is more than just predicting the effects of earthquake; it is a contribution to Central America’s progress.

Finally, as Fernando Ramírez-Cortés, World Bank Senior Disaster Risk Management Specialist and CAPRA Coordinator, said, “The ultimate objective is not to ensure that the CAPRA platform is utilized, but to build the technical capacity in the region to generate its own disaster risk data” and to be able to use that data effectively in decision-making. This is the challenge and aim of the CAPRA Initiative as a whole.