Resilient Infrastructure for Sustainable Services
Latin America: Mainstreaming of Disaster Risk Management in the Water Supply and Sanitation Sector
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Foreword

A recent study states that, internationally speaking, catastrophic natural events generated costs in the amount of US$ 575.2 trillion1 from 1996 to 2005. It has also been observed that, in particular, developing countries are relatively more affected by these events as they present greater drops in their Gross Domestic Product (GDP) than the more developed countries2.

The main motivation for organizing the conference “Disaster Risk Management (DRM) for the Drinking Water and Sanitation Sector” in Oaxaca, Mexico in June 2011 was to determine an agenda for the effective implementation of DRM policies and practices for the water and sanitation service providers in the region. This initiative was jointly headed by the government of the State of Oaxaca through its Infrastructure and Sustainable Territorial Planning Secretariat and The World Bank Water and Sanitation Program, with the support of The World Bank Sustainable Development Department Global Fund for Disaster Risk Reduction (GFDRR) and the Latin America and the Caribbean Regional Urban Water and Disaster Risk Management Unit (LCSUW).

The event gathered 78 participants from 12 Latin American countries and experts from Japan, Pakistan, and the United States, and Latin American authorities, professionals and policy makers interested in becoming familiar with and gradually developing a risk prevention culture. The Conference meant a qualitative leap for regional development management in favor of the poorest populations who are usually the most affected when natural catastrophes affect the infrastructure of public utilities vital to the countries, such as water and sanitation services.

We would like to give special recognition to the Government of Mexico through the Secretary of Infrastructure and Sustainable Land Management of the Government of Oaxaca, led by Mr. Netzahualcóyotl López Salvatierra and Wilhem Castillo Bustinza, who committed efforts for this important conference.

This conference -as well as the present analytical paper, also received valuable support from several teams of the World Bank Group, especially Guang Zhe Chen, Sector Manager; Francis Ghesquiere, Head of the Risk Disaster Management Unit; Harold Bedoya, Operations Manager; Gustavo Saltiel, Water and Sanitation Specialist; Saroj Kumar Jha, Manager, and Apurva Sanghi, Senior Economist, both from the Global Facility for Disaster Reduction and Recovery; Iris Marmanillo, Senior Water and Sanitation Specialist, Gustavo Perochena, Senior Economist, and Cecilia Balcázar, Consultant of the Water and Sanitation Program.

The conference specialists came from Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Peru and Guatemala, and also specialists from the U.S., Japan and Pakistan. We thank them for their valuable participation.

The Oaxaca Conference allowed identifying advances, new challenges, and opportunities in the region, as well as strengthening the awareness that disaster risk management contributes to a country’s development agenda. The underlying motivation remains the well-being of the most vulnerable communities in the society, who are always the most affected when a catastrophe hits.

Glenn Pearce Oroz
Regional Team Leader

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Executive Summary

Handling threats and vulnerabilities poses challenges to countries with medium and low incomes. If such challenges are not well managed beforehand and afterwards, the risk is very high and, once the risk becomes a reality, it may be a disaster, a situation in which damages and losses may be very high, in terms of human lives and the economy.

One of the infrastructures that are critical or crucial for the society is the water and sanitation system infrastructure. The importance of water and sanitation sector disaster risk management is justified by the need to ensure safe water and sanitation operation and provision in the cities and even in rural areas.

The International Conference “Mainstreaming Disaster Risk Management in the Water and Sanitation Sector” (hereinafter called the Oaxaca Conference) was the chosen venue for drafting solutions to this problem, for progressing in building a roadmap for the next few years, and for gradually advancing in incorporating DRM into the water and sanitation sector at a reasonable cost.

In the framework of the Oaxaca Conference, there were three messages of utmost importance regarding prevention and the contribution of DRM to the sustainable development agenda: i) prevention is worth the effort and it is not always more expensive; ii) it is necessary to increase well-focused expenditure; and iii) no measure alone is sufficient.

Regional evidence regarding DRM showed that the municipal government’s role is key not only for urban planning aimed at establishing restrictions on building houses in high-risk zones - mainly as an emergency and disaster prevention measure - but also because it must go hand-in-hand with demanding that the water and sanitation systems in such zones comply with construction regulations. The coordination among service provider, municipal government, and other DRM system institutions is a key issue.

Water and sanitation providers have adopted DRM when the governments have clear laws and regulations as well as the political willingness to take measures regarding DRM. Likewise, inside their organizations, service providers have been incorporating instruments that enable them to adopt good DRM practices. As concerns budgeting, service providers have actually incorporated DRM into their investments rather than allotted a specific budget heading for DRM.

The information shared during the Oaxaca Conference showed that the countries’ preparation to confront catastrophic events is essential and that financing strategies for risks of this nature - risk retention and risk transfer - are positive because they increase the government’s financial capacity to respond to catastrophes and, therefore, to protect their fiscal “soundness”; they reduce financial vulnerability and, therefore, macroeconomic risk; and they create incentives for the governments to adopt mitigation actions. Some countries in the region have developed specific mechanisms, especially for risk transfer, after using probabilistic risk assessments to quantify risks. For other countries, institutions such as The World Bank have a mix of instruments available, to enable them to finance risks in accordance with their coverage objectives, availability, and in a manner that minimizes costs. Therefore, probabilistic risk estimation as a springboard for designing risk retention and risk transfer strategies is more than just a decision-making tool for the service providers and the governments of each country.

In addition, the Oaxaca Conference showed that comprehensive disaster risk management comprises risk identification and assessment, reduction, financial protection or risk transfer, disaster preparation and response, and recovery. All of the above is part of the implementation of DRM in public policy and in regulation. Nevertheless, its effectiveness can be affected by information gaps regarding the classical characteristics of natural threats and their impacts.
on goods and services in the local ambit. When information exists, its disclosure is normally weak, out of scope, and it cannot be efficaciously used either by the agents who produce it or by the end users (the vulnerable population).

Just as information is a key element for DRM, the existence of a legal and regulatory and institutional framework to enable service providers to act in a preventive manner or to decisively confront situations of disasters with clear rules is a crucial element for public policy. Specifically in the water and sanitation sector legal and regulatory environment, the conditions to ensure service continuity and the rates to be charged, as well as defining service provision standards in the event of natural disasters are fundamental topics for DRM. Furthermore, the case of the 2010 earthquake in Chile showed, on one hand, that service provision companies taking out insurance is an important mechanism for risk transfer and, on the other hand, their need to overcome operational and structural problems in order to confront a catastrophe.

Regarding the possibilities of incorporating DRM into the project cycle, the Oaxaca Conference evidenced that prevention is worth the effort and that not only it is not expensive, but it can also be profitable if appropriate methodologies are adopted for incorporation during the pre-investment phase.

Finally, one year after the Oaxaca Conference, the region has gone from reflecting upon DRM to taking actions and it has experienced some remarkable progress in incorporating DRM in national public policy and practices. Some evidence of the latter is the upcoming proclamation of the Civilian Protection Law in Mexico and the creation of the Administrative Public Management Department National Disaster Risk Management Unit in Colombia. But perhaps what is most significant is that, based on the knowledge and experiences shared during the days of the Conference, some actions specifically for the water and sanitation sector have been implemented. Formalizing the rules and regulations in Honduras, the studies to incorporate the risk factor in the utility rate setting process in Colombia, such as the studies on probabilistic risk estimation conducted in Manizales; the development of a methodological guide for regulated companies to develop their emergency plans in Chile; and the Quito service provider EPMAPS project to implement a tool for quantitative probabilistic risk estimation using the CAPRA platform in Ecuador, all reveal the influence of the lessons learned in the Oaxaca Conference.
Introduction

Frequently, most of the debate is dominated by three aspects that identify the actions that are carried out after a disaster hits: the three “Rs” – Relief, Recovery, and Reconstruction. Nevertheless, not enough interest is placed on two other actions called the two “Ps”: Prevention and Preparation.

In 2002, Mozambique requested less than US$ 3 million from donors, in order to prepare for the floods; they did not obtain even half that amount. But after the floods occurred, the same donors granted more than US$ 100 million in aid just for recovery and an additional US$ 450 million for reconstruction. An appropriate balance between the “Ps” and the “Rs” would clearly reveal that prevention is convenient if it is well done^3.

Handling threats and vulnerabilities poses challenges to countries with medium and low incomes. If such challenges are not well managed beforehand and afterwards, the risk is very high and when the risk becomes a reality, it may be a disaster, a situation in which damages and losses may be very high, in terms of human lives and the economy.

Threats caused either by natural events or by human action (for example, unplanned urban growth and environmental degradation) are increasingly defying the safety of public infrastructure and causing costly public utility interruptions. Nowadays, it is not very common to take into account threat information when locating, designing, building, and operating critical infrastructure for urban conditioning. As a result, exposure and vulnerability are high and damages and losses are also high, particularly in case of intense events.

One of the infrastructures that are critical or crucial for the society is the water and sanitation system infrastructure. Nevertheless, provided that most water and sanitation infrastructure is underground, meaning, it is not visible, the need for policy makers and professionals to manage risk is neither evident nor a priority unless a big catastrophic event severely damages the water and sanitation systems. Disaster risk management (DRM) aimed at those systems should be as essential as it is in all other sectors, due to the importance of having safe, secure water and sanitation services, especially, for the poorest segment of the population, who do not have the capability of relocating to safer, more secure areas when a catastrophic event hits. Therefore, the development of DRM policies and practices for the water and sanitation sector should be a mandatory part of any country’s development agenda, not only to improve disaster preparation and the reaction capacity but also, and even more importantly, to promote knowledge, prevention, mitigation, and transfer of risk in the sector.

The importance of disaster risk management in the water and sanitation sector is justified by the need to ensure safe water and sanitation operation and provision in the cities and even in rural areas. Prompt knowledge of the threats and risks to which the system components are exposed when faced with catastrophes; a vulnerability analysis of such components; and a risk assessment of the system in the area of influence are all aspects that the water and sanitation sector policy should contemplate during its design and implementation phases^4.

This context leads to posing some questions. What would happen in these countries if the water and sanitation sector incorporated information on natural hazards in urban areas when designing, locating, and operating its infrastructure? Also, what would happen if utilities designed and carried

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^3 Based on the keynote lecture made at the Oaxaca Conference by The World Bank Global Fund for Disaster Risk Reduction (GFDRR) Senior Economist, Apurva Sanghi.

out Emergency Plans to improve its response capacity? That is to say, what would be the results of sector disaster risk management? Certainly, there would be less damage and economic loss in the sector and their collateral effects on the population to whom the services are provided would be notably reduced.

To begin answering these questions several partners designed and developed The International Conference “Disaster Risk Management for the Drinking Water and Sanitation Sector” (hereinafter called the Oaxaca Conference). A roadmap was drafted for gradually progressing in incorporating DRM at a reasonable cost into the water and sanitation sector of the Latin American region in the next few years. This roadmap was thought of taking into account the human, technical and financial capabilities of the institutions in the countries of the region.

The Conference program was distributed into the following sessions:

Session I. DRM in the Sustainable Development Agenda
Session II. DRM in Local Water and Sanitation Systems
Session III. Risk Management in Water and Sanitation Providers
Session IV. Risk Retention and Transfer in the Water and Sanitation Sector
Session V. DRM in Public Policy and in Regulation
Session VI. DRM in the Context of Climate Change
Session VII. Prevention in the Project Cycle.

This document summarizes the main topics analyzed during the Oaxaca Conference. Section I. DRM in the Sustainable Development Agenda herein emphasizes the importance of prevention and shows the quantitative impact of not adopting this practice on infrastructure sustainability and on the provision of water and sanitation services. Section II. Regional Evidence of Disaster Risk Management discusses the topics addressed in the Conference sessions, based on specific cases of catastrophes in different countries in the region, from the perspective of the lessons learned from each situation. Section III. Disaster Risk Management from Reflecting to Action presents some of the main actions that are being carried out in the different countries of the region almost one year after the Conference. Section IV. From the Oaxaca Conference Agenda to Policy Recommendations states the policy recommendations that were gathered in the Oaxaca Agenda and that constitute strategic DRM lines of work. Finally, Conclusions summarizes the main results of the above analysis.
I. Disaster Risk Management (DRM) in the Sustainable Development Agenda

A culture of prevention regarding disaster risk management is, without a doubt, the basis for a city’s urban sustainable development. In the framework of the Oaxaca Conference there were three messages of utmost importance regarding prevention:

a. Prevention is worth the effort and it is not always more expensive.
Prevention cost-benefit analysis indicates that the benefits of prevention broadly surpass prevention costs. Nevertheless, one of the reasons why families do not make more prevention decisions is that distortions in the housing market—where rent control does not allow tenants to recover any investment made in enhancements—or distortions in the property market—where there is an extensive lack of ownership, which hinders individuals from spending money on home improvements—discourages the families from taking prevention actions.

In addition, it is evident that post-disaster expenditure has been clearly greater than pre-disaster expenditure. But an analysis of the effectiveness of such government expenditure shows that in many countries, public expenditure is allotted in an insufficient, inefficient manner, meaning that not only is very little money invested in prevention but also that the governments spend money on building new infrastructure instead of maintaining the current infrastructure. Therefore, when faced with a threat, reconditioning costs are higher.

Prevention is Worth the Effort: A Memorandum to Ministers of Finance

How can Ministers of Finance be motivated to allot resources to prevention? A first argument is justified by the fact that disasters affect a country’s fiscal situation. As a result of observing disasters impacts in 140 countries over a period of 20 years, a study revealed that, in developing countries, disasters of a large magnitude increase the budget deficit that ranges from 0.23% to 1.1% of the GDP. Although it is true that such percentages seem small, just consider that, for example, the GDP in Mali is near US$ 1 billion and that 1% of that amount would be sufficient to buy 2 million mosquito nets, to fight that country’s situation of malaria.

A second argument is that, no matter what the danger or the sector, disasters reduce a country’s growth. And although the GDP does not measure well-being, in the words of Nobel Prize winner Amartya Sen, “A disaster affects our freedom to attain the quality of life that we value nowadays. And it is precisely disaster prevention that enables avoiding those adverse consequences on a country’s well-being and economy.”

Therefore, Ministers of Finance alone cannot solve the problems that cause urban overcrowding, climate change, and catastrophes. Certainly strong local and national institutions are needed. What Ministers of Finance can do is allot economic resources. And everything they do to finance actions to confront tomorrow’s problems will be greatly appreciated by future generations.

Based on the keynote lecture made at the Oaxaca Conference by the World Bank Global Fund for Disaster Risk Reduction (GFDRR) Senior Economist, Apurva Sanghi.

5 This discussion of the three messages is based on the keynote lecture made at the Oaxaca Conference by the World Bank Global Fund for Disaster Risk Reduction (GFDRR) Senior Economist, Apurva Sanghi.
In most countries with medium to low incomes, it is common to find basic infrastructure in a condition of abandonment and limited operation. The infrastructure for providing water and sanitation services is no exception: the infrastructure can be 40 years old or more, has not benefited from much maintenance, and was built using little or no threat information. Therefore, when an intense event hits, the consequences are worse at many more levels and to greater degrees of magnitude. For example, a recent study in Peru estimates that that country could have saved up to 27 times the reconditioning expenditure for the water and sanitation infrastructure after the 2007 earthquake if the affected systems had had proper maintenance and had been built using earthquake-resistant materials.6

The 2007 Earthquake in the South of Peru: The Economic Impact of a Disaster

On August 15, 2007 an earthquake reaching a magnitude of 7.9 on the Richter scale shook the southern coast of Peru. The magnitude of the earthquake and the lack of risk management resulted in more than 79% of the population in that area being affected (among the wounded, the persons who lost their homes, and the deceased) and in the collapse of the infrastructure used to provide basic services to the population. Some indicators presented in a study conducted by The World Bank’s Water and Sanitation Program illustrates the economic impact of the situation:

- The monetary amount of the damages caused by the earthquake could have been used to install more than 8,183 drinking water connections and 7,925 sewer system connections for the benefit of 16,888 inhabitants.
- If there had been proper infrastructure maintenance, the estimated value of the damages would have been 5.9 times less. And if the infrastructure had been built using pipes made of ductile materials, if the quality of the soil where the systems were installed had been evaluated, and if the installations had benefited from ongoing maintenance, there would have been significant savings in the recovery of the drinking water and sanitation systems.
- The indirect effects were equal to 29% of the service provider’s 2007 total sales.
- A total of 81% of the homes had no water service or had inconstant water service over an average period of 16 days. That generated a weekly expenditure in each home representing 4% of the weekly income of an average home in the affected region.
- In 16% of the homes, the women had to leave their jobs to devote themselves to non-remunerated housework activities; therefore, they did not receive 1.2% of the total income of all of the women in the Peruvian State of Ica in 2007.
- In the business sector, 25% stated that the damage and problems with the water and sanitation services had had great impact on their activities. Regarding Investment plans, 43% of them were frozen.
- The drop in the 2007 and 2008 water and sanitation service GDP in the affected region, attributed to the earthquake represented 1.8% and 1.3% of the estimated GDP for those years, respectively, in the region of Ica, where the earthquake hit.
- The heads of household of the region under study lost earning in an amount equal to 0.2% of the GDP of the affected region in 2007.

Based on the presentation made at the Oaxaca Conference by the World Bank’s Water and Sanitation Program Consultant, Geoffrey Cannock.

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b. **Prevention is often possible and cost-effective.**
Studies for the report examined the costs and benefits of specific prevention measures that homeowners could take in hazard-prone areas of four low- and middle-income countries. Prevention pays for assumed (but reasonable) costs and discount rates. Other prevention measures are embedded in infrastructure (such as adequate drainage ditches). The report examines government expenditures on prevention and finds that it is generally lower than relief spending, which rises after a disaster and remains high for several subsequent years. But effective prevention depends not just on the amount but on what funds are spent on. For example, Bangladesh reduced deaths from cyclones by spending modest sums on shelters, developing accurate weather forecasts, issuing warnings that people heeded, and arranging for their evacuation. All this cost less than building large-scale embankments that would have been less effective.7

That many measures do not work well together in poor countries explains why they have more disasters. The poor may know the hazard risks they face but depend more on public services that are often inadequate. They live near work on cheaper land exposed to hazards if buses are unreliable, while the rich with cars have better alternatives. The poor would willingly move to safer locations if their incomes rose or if public transport became more reliable. Many governments in poor countries struggle to provide such services, and until they do, the poor will remain vulnerable.8

In many countries in the region, local authorities are in charge of most of the decisions regarding the use of the territory, as well as the provision of public utilities. When a disaster hits, the National Government has to intervene, providing aid. Likewise, although the law sets forth the provision that disaster risk areas must not be populated, local authorities allow it. The scale tips towards reconstruction rather than towards prevention.

c. **Many measures—private and public—must work well together for effective prevention.**
Low-lying areas around Jakarta illustrate the complexity of ensuring this: residents raise the plinth of their houses to protect against floods, but they also draw water through borewells causing the ground to subside. Even knowing this, a person has no choice if the government does not provide piped water. So, the prevention measures an individual undertakes also depend on what the government does—or fails to do—and vice versa.

7 Taken from "Natural Hazards, UnNatural Disasters, The Economics of Effective Prevention". 2010. The International Bank for Reconstruction and Development / The World Bank.

8 Taken from "Natural Hazards, UnNatural Disasters, The Economics of Effective Prevention". 2010. The International Bank for Reconstruction and Development / The World Bank.
Water and Sanitation DRM in the Local Level
For public utilities such as water and sanitation, facing a situation of disaster and, even more so, preventing one, is not the responsibility of the service provider alone. Interaction and articulation with other agencies that are a part of the risk management system is absolutely necessary. And interaction and working together with the local government is essential.

The Oaxaca Conference issued some indications on the topic:

a. **As an emergency and disaster prevention measure Municipal planning must include restrictions on housing building in high-risk areas.** The rapid, and significant growth of urbanization that cities have lead to the need for displacing communities to high-risk areas, the vulnerability of which is accentuated by the settlers’ lack of proper water system management. Vulnerability is a dynamic process. In a big portion of small towns and villages, land is taken first and urbanized later. And the water and sanitation systems arrive as elements that consolidate the urbanization process even in very high-risk areas.

b. **An important aspect of the interaction between the municipal government and the service provider is the requirement to comply with water and sanitation system building codes and regulations in high-risk areas.** The municipal government’s enforcement of earthquake-resistant construction standards, along with the service provider’s implementation of earthquake micro-zoning studies, enables confronting scenarios in which squatters or other illegal occupants in outlying areas or illegal urbanization are common problems.

c. **The existence of a disaster management protocol for the service provider, the municipal government, and other risk management system agencies is a prevention measure in itself.** The service provider’s actions will be strengthened if there are also disaster prevention and attention systems in place in the local setting and such protocol further includes the participation of the community through its local organizations.
Local Strategy for Disaster Mitigation: Interaction among the Municipal Government, the Service Provider, and the Community in Medellín

Empresas Públicas de Medellín (EPM) is in charge of providing domiciliary water and sewer system public utility services, among others, in a territory through which the Medellín River crosses, in a very narrow valley that makes the area vulnerable to landslides and floods.

The fact that this service provider is a municipal company has meant better articulation with the municipal government in terms of disaster prevention and attention. However, in an effort to strengthen both, EPM has sought to integrate the community into said activities, by creating community brigades for carrying out mitigation activities in high-risk areas, with the participation of the community, volunteer EPM employees, and municipal authorities. This has been a domiciliary public utility control and universalization strategy to mitigate the risk associated with the irregular use of drinking water and basic sanitation in low income settlements, within the framework of EPM’s corporate social responsibility policy.

Initially faced with a situation characterized by fraudulent connection, homemade installations, and abundant leaking, EPM has modified its contracting rules and regulations to allow the communities to build their own networks and pay for them. The company grants them 10-year financing at a 3% annual interest rate.

In recoverable risk areas, the National Government Public Works Secretariat builds civil works to stabilize the terrain and the Municipal Planning Secretariat requires that the constructions meet the established standards. EPM presents its water, sewer system, and urbanism plan with long-term financing and low interest rates. Then, the municipal government legalizes the lots and initiates a complete urban installation process (schools, health centers, sports and athletics fields and stadiums, etc.) Finally, the community builds the networks.

Based on the presentation made at the Oaxaca Conference by Colombian public water utility Empresas Públicas de Medellín Metropolitan, Water Manager, Alberto Gutiérrez.

Risk Management in Water Utilities

So far, drinking water and sanitation service providers in the Latin American region have not been very aware of the importance of incorporating DRM practices into their activities.

On one hand, for proper incorporation of DRM in their business service providers demand from their governments, in general, and their local authorities, in particular, clear laws and regulations and political willingness to take DRM measures that may not be popular but that ensure the sustainability of the cities and towns and of their public utilities.

There are however cases of utilities that have incorporated DRM practices inside their organizations. This is the case of Aguas de Manizales S.A., a public utility from Colombia that is in charge of providing water and sanitation services to more than 90,000 families in Manizales, a city located in the central region of Colombia. To confront potential disasters, the company operates using an Emergency Committee that not only acts when a disaster hits but that is also active throughout the year carrying out training, prevention, risk identification, and simulations activities, among others. The Committee is also in charge of managing information and is a focal point for diagnosis and action supported by the Geographic Information System (GIS) that helps identify the location of the networks, the users, and zones that are subject to hazards like floods and landslides. Using that information, the Committee can generate immediate automatic communications to declare the closing of system points that are susceptible of generating damage.
Risk Assessment Using Processes: the Experience of Manizales

The fact that service providers are just beginning to incorporate DRM is due to their lack of knowledge of the risks that they face. Aguas de Manizales S.A. is a water and sanitation service provider in Colombia that has an approach that conceives risks beyond what it calls “pure risks” not only seeks to become familiar with them but also to integrate them into its risk management.

Using the failure mode and effects analysis (FMEA) methodology, it has sought to identify all types of risks, classify them, and manage them. FMEA is a planning tool used to study (analyze / assess) the consequences caused by failures, deviations or real and/or potential risks identified in the procedures, in order to establish proper controls so as to avoid reoccurrence. The tool enables knowing what is controlled and why. It is based on different laws and regulations, and boasts important international standard certifications.

The company has also been using its Incident Command System (ICS), with USAID support, to ensure that all of the entities attending an emergency speak the same communication language.

Another project being carried out with the support of the Pan-American Health Organization (PAHO) is called Water Assurance Plans; it uses a methodology that enables identifying and/or reducing the risks that affect water for human consumption. The project seeks to systematically ensure the safety and acceptability of the water for consumption provided through a supply system.

Based on the presentation made at the Oaxaca Conference by Colombian public water utility Aguas de Manizales (Colombia) Technical Deputy Manager Sebastián Henao.
In the case of Manizales, although the service provider started including a DRM budget item as of 2010, DRM is being incorporated in almost all of the investments that the company makes. The added budget heading aims at considering resource items to undertake specific actions such as studies, and purchase of leak detection equipment or gas measuring equipment. Likewise, the water fee structure in the Colombian water and sanitation sector is designed to include all investments needed to optimize the system and its maintenance, including DRM outlays. The provincial state water and sanitation plans in all of the regions in Colombia have been incorporating DRM and allotting resources for DRM activities.

Risk Retention and Transfer
Natural catastrophes are on an upward trend. The average annual number of events has doubled since the 1980s. Statistics on damages and losses are growing at the same pace as the mortality caused by catastrophes, which has caused 3.3 million deaths during the period from 1970 to 2010. In addition, 680 million persons in large cities around the world were exposed to threats such as hurricanes and earthquakes in 2000 and that figure is expected to rise to 1.5 billion individuals by 2050. Annual losses can triple reaching up to US$ 185 billion, without taking the impact of climate change into account.

The information shared in the Oaxaca Conference showed that the preparedness of countries to be able to face natural catastrophes and their strategies for financing risks of such nature are positive because they increase the governments’ financial capacity to respond to catastrophes and thus protect their fiscal positions. They reduce financial vulnerability and therefore the macro-economic risk and they also create incentives for the governments to adopt mitigation measures.9

Given that municipal government budgets are not unlimited, risks must be identified according to their probability of occurrence and their impact. Certain risks can be retained and others must be transferred to the market. Accordingly, governments must be able to determine the mix of instruments that will enable them to finance risks in accordance with their coverage objectives, availability, and in a manner that minimizes costs.

Processes for creating Risk Transfer Mechanisms
The Latin American region has little experience in designing and implementing risk retention and transfer strategies, especially for the water and sanitation sector. Notwithstanding, the case of Mexico for other kinds of infrastructure has been illustrative and has shown that it is beneficial to develop risk transfer mechanisms and that it is possible to implement them. To do so, it is essential to quantify the risk; the latter demands decisive inter-institutional efforts to achieve damage and loss estimations that allow creating and improving different risk management strategies.

The Oaxaca Conference generated knowledge regarding the existence of different processes involved in creating financial risk transfer mechanisms10:

- During the risk identification process, high-resolution databases are created of the main localities recurrently affected by natural phenomena using geospatial information about the infrastructure; such data is then used to quantify risk arising from natural hazards occurrence. Using the inventory of assets as a base, the next step is to prepare a list of variables for vulnerability estimations. The information to be gathered is the location of the assets, their structural characteristics, and their replacement value.

- As part of the database integration, a sampling process is implemented to verify the quality of location data, as well as the structural characteristics of the assets being studied and their recovery value.

- Then a risk analysis is performed by building probabilistic threat and vulnerability models, studying the phenomena that represent the greatest source of damages.

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9 Based on the presentation made at the Oaxaca Conference by The World Bank Capital Market Department Senior financial Specialist Luis de la Plaza.

10 Based on the presentation made at the Oaxaca Conference by Mexican Treasury and Public Credit Secretariat Insurance, Pensions, and Social Security Unit Specialist Juan Miguel Adaya.
Probabilistic risk estimation has many advantages\textsuperscript{11}. On one hand, given that intensities of hazardous events (threat) have a frequency of occurrence and that there is uncertainty in threat and vulnerability estimations, the risk must be expressed by rates of occurrence or periods of return, which creates the need for advanced quantifications to assess the risk based on the exceedance probability of the losses. On the other hand, the probabilistic risk assessment makes it possible to compare and add losses for different events (multi-threat or multi-risk).

Nonetheless, regarding probabilistic modeling some precautions must be taken into consideration because most natural catastrophes have not yet occurred. Likewise, not only is historical information scarce and do people suffer from short-term memory when it comes to prior disasters, but also very complex thousand-year old events are modeled using barely 50 years of information and relatively simple analytical models. Furthermore, the modeling process also depends on the expert’s criteria.

In the particular case of the Mexican hydraulic infrastructure presented at the Oaxaca Conference, it revealed that some of the challenges regarding obtaining the information needed for risks assessment can increase due to the nature of the assets themselves:

- Certain information can be difficult to access because it may be classified as strategic information.
- The inventory of assets may be very large and may comprise several types of infrastructure that are not very common. The information on the assets is heterogeneous.
- The information is perhaps not centralized but handled by local or municipal entities.

\textsuperscript{11} Based on the presentation made at the Oaxaca Conference by the World Bank’s Water and Sanitation Program, Consorcio Consultor ERN – AL, Specialist, Mario Salgado.
The Importance of Probabilistic Risk Estimation

A methodology that has been used in different probabilistic risk estimations in the region is Probabilistic Risk Assessment Initiative (CAPRA). CAPRA is an open source platform for risk analysis and decision making, which applies probabilistic techniques to hazard and loss assessment. From the very onset, the platform was designed to be modular and expansive. The risk information is combined with exposure and physical vulnerability data, allowing users to determine jointly or in a cascading risk manner using a base with inter-related multi-hazards. That is what distinguishes this platform from former individual risk analyses. The CAPRA software package includes hazard cartography, risk assessment, and cost-benefit assessment, to support the proactive risk management analysis tools. Therefore, CAPRA can also be used for designing risk financing strategies.

The World Bank Water and Sanitation Program entrusted a study in Peru in 2011 for using the probabilistic estimation of the catastrophe risk that water and sanitation service providers have to design risk retention and transfer strategies. Two such service providers, the one in Lima and the one in Ica, were studied as their geographic areas of attention are located in seismic areas and/or areas susceptible to flooding. This was the first time that the CAPRA platform was used to assess water and sanitation systems.

The study sought to propose a general preliminary vulnerability reduction strategy to include building a new infrastructure, repairing and reinforcing the current infrastructure, as well as comparing the two case studies in order to write up principles in common toward a technical proposal for a sector risk retention and transfer strategy that would better adapt to the reality of Peru.

One of the study results showed that, in the case of Sedapal, the service provider in Lima, the capital of Peru, and the largest water and sanitation operator in the whole country, the relative percentage of the estimated loss (expected annual losses) in the event of an earthquake, regarding the value of the company assets exposed, is essentially concentrated in the secondary networks –because they are made of simple concrete –, as well as in the reservoirs, especially, the elevated ones.

### RISK ANALYSIS RESULTS FOR SEDAPAL* USING THE CAPRA METHODOLOGY

<table>
<thead>
<tr>
<th>Component</th>
<th>Exposure Value (US$)</th>
<th>(% of total)</th>
<th>Relative Percentage [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Network Piping</td>
<td>$695,109,878</td>
<td>24.4</td>
<td>16.6</td>
</tr>
<tr>
<td>Secondary Network Piping</td>
<td>$1,553,783,128</td>
<td>54.6</td>
<td>27.2</td>
</tr>
<tr>
<td>Tanks</td>
<td>$146,384,562</td>
<td>5.1</td>
<td>35.9</td>
</tr>
<tr>
<td>Wells</td>
<td>$91,065,627</td>
<td>3.2</td>
<td>9.2</td>
</tr>
<tr>
<td>Drinking Water Treatment Plant</td>
<td>$271,757,768</td>
<td>9.6</td>
<td>5.9</td>
</tr>
<tr>
<td>Waste Water Treatment Plant</td>
<td>$25,796,568</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Control Station</td>
<td>$2,523,779</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Water Service: Repumping Station</td>
<td>$26,768,413</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Sewer System: Repumping Station</td>
<td>$11,724,415</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Administrative buildings</td>
<td>$20,296,886</td>
<td>0.7</td>
<td>3.1</td>
</tr>
<tr>
<td>Total</td>
<td>$2,845,211,024</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* Water and Sanitation Utility in Lima, Peru

The lessons learned from the study are listed below.

- The information gathering process, even inside the company, requires care and validation.
- Detailed studies such as earthquake micro-zoning and site studies are needed to complement the threat.
- When network renovation is done, existing inventories must be updated.
- There is a low level of infrastructure maintenance (mainly for the pipes).
- The degree of affection to the systems from previous events must be taken into account.
- The levels of damage due to earthquakes are high as compared to world statistics for water and sanitation systems in other events.

Based on www.ecapra.org and on the presentation made at the Oaxaca Conference by the World Bank’s Water and Sanitation Program, Consorcio Consultor ERN – AL, Specialist, Mario Salgado.
• In the case of municipal assets, infrastructure historical records or technical memoirs are rarely kept.
• Some surveys can be made to counteract the lack of information, but often times collecting such data is complex because the infrastructure is underground.

All of the above can have an impact on database integration activities; however, depending on the amount of available information, in some cases it is possible to propose estimation methodologies to complement the missing information. Risk analysis activities can present additional difficulties due to the scale approximation of the information needed for risk estimation. The greater the uncertainty regarding the information, the lesser the accuracy of the estimation. Nonetheless, once the information is obtained, it is possible to propose DRM strategies based on technical criteria, which facilitates designing efficacious risk retention and transfer instruments. Although the specific sector of drinking water and sanitation can present important challenges, risk quantification for this infrastructure can feasibly be obtained. Historical damages suggest that there are significant benefits from designing risk retention and transfer schemes for this sector.

Probabilistic risk estimation is not just a decision-making tool for service providers and governments for designing risk retention and transfer strategies. The use of this tool has also enabled developing better insurance market products to properly cover losses in the event of a disaster.

In Peru in coordination with private insurance companies the banking and insurance market regulating agency initiated in 2003 a process for measuring the catastrophic risk of the housing sector insured properties. Until then laws and regulations had set forth a very high percentage of reserves but without technical justification. Therefore, a study was conducted to assess the portfolio of insured properties, which included the earthquake zoning of the districts that comprise the city of Lima and the province of Callao, as well as a vulnerability assessment of the structures in the portfolio of insured assets that the insurance companies kept. The result was the issuance of a technical note that established a methodology for the insurance companies to calculate probable maximum loss, even at an individual level. The study revealed the existence of significant differences due to the quality of the available information. For example, the insurance companies did not have complete, appropriate information on the exact location of each insured property or on the predominant type of structure on the insured property. During the initial period, until 2006, an average Probable Maximum Loss (PML) was applied, but currently each insurance company calculates a PML for its insured assets.

**DRM Financial Products**

The World Bank offers to the countries various financing instruments that, depending on the case at hand, are more appropriate for certain types of risk. Among them are reserve funds, traditional catastrophic insurance policies, contingency loans, derivatives, and catastrophe bonds. The support that the Bank gives its borrowers includes designing their catastrophe management programs and defining the catastrophe risk financing instruments adapted to their needs.

![Catastrophe Risk Financing Framework](image)

The financial instruments that have been promoted in the region have been linked to risk retention strategies, on one hand, such as the Catastrophe Risk Loan with a Deferred Drawdown Option (Cat DDO) that, once negotiated, is frozen until it needs to be used, so it becomes effective when the country officially declares emergency situation after a natural catastrophe occurs. On the other hand, there is a risk transfer instrument called the Caribbean Catastrophe Risk Insurance Facility (CCRIF) which is a joint reserve mechanism designed for Caribbean countries to be able to rapidly access sources of liquidity in the event of a natural catastrophe. Likewise, the Multi Cat Bond Program is a risk transfer product whereby a bond is issued by a trust fund created to such purpose and, if no natural catastrophe hits before bond maturity occurs, the principal amount is returned to the investors. However, if a catastrophe does hit, the investor bears the liability.

Costa Rica. This country ranks second in the list of countries most exposed to multi-hazards; that is why it needed a source of instant financing to reduce its fiscal vulnerability to catastrophes and to avoid budget reallocations that may affect other development programs being executed aimed at reducing and easing poverty. It chose a catastrophe risk loan with a deferred drawdown option (Cat DDO) in the amount of US$ 65 million, equal to 0.25% of its 2007 GDP. That operation supported two key areas of Costa Rica’s policy for its Disaster Risk Management Program: (i) it strengthened the legal and institutional framework and (ii) it incorporated disaster risk prevention into national development and investment programs.

Caribbean Countries. Their capacity to geographically distribute risk is limited, as is their access to insurance markets. They have the challenge to insure short-term liquidity in order to maintain essential services until additional resources materialize. The World Bank worked with donors and member countries to design and implement a secure climate: the Caribbean Catastrophe Risk Insurance Facility (CCRIF) was born. 16 countries were added in the year 2007 and they have annually renewed their membership. To date seven disbursements have been made. The reinsurance market has provided the financial backing for the facility at low rates. The CCRIF does not cover all of the losses that a country may suffer; it requires a critical mass of participating countries.

Mexico. This is one of the emerging countries with most experience in catastrophe risk management; indeed, it has a natural disaster fund (FONDEN) and an institutional framework in the event of a disaster. In 2006, it issued a cat bond in the amount of US$ 160 million to transfer the risk of an earthquake to the capital market. In October 2009, Mexico issued a cat bond in the amount of US$ 290 million to cover multi-risks, through The World Bank MultiCat Program. Cat bonds pay coupons to the investors and insure Mexico against pre-defined natural risks. If a hurricane or an earthquake hits, Mexico retains the principal amount. The bond was oversubscribed by an ample base of investors. For the first time a set of catastrophe risks was transferred to the market. The existence of a good legal and institutional framework was important to facilitate the implementation of the risk transfer to the market. The availability of data and statistics on the probability of occurrence and severity of natural catastrophes was also key and The World Bank’s role as organizer increased the investors’ trust. The cost of this product for which Mexico was responsible was 30% less than the cost of any other instrument.

Based on the presentation made at the Oaxaca Conference by The World Bank’s Capital Market Department, Senior Financial Specialist, Luis de la Plaza.

DRM in Public Policy and in Regulation

The information shared at the Oaxaca Conference evidenced that disaster risk management entails risk identification and assessment, risk reduction, financial protection, disaster preparation and response, and recovery.
However, for DRM to be part of water and sanitation public policy in the region there are certain crucial aspects to be considered closely related to the role service providers play and the challenges they face.

- **Improve the understanding and knowledge of the operational consequences of the risks as well as the impact of disasters on water and sanitation service provision.** The latter demands developing the expertise to be able to assess the vulnerability of the systems, identify the main threats, and make a comprehensive risk assessment. Natural hazards cannot be avoided but building capacities to integrate risk assessment and learn how to attenuate their effects can prevent many hazards from becoming disasters.

- **Review providers capacity for disaster mitigation, preparation, and response.** To this end providers do not need to create a DRM area but they should integrate the approach as a strategy, naming a focal point or champion to lead the process. Contingency plans should consider including alliances among contiguous localities with different levels of risk and capabilities, in order to give mutual support to each other in the event of a catastrophe.

- **Establish a preliminary framework for a service continuity program in the event of a disaster.** Priority must be given to minimizing service interruptions and enabling continuous service.
One consensus reached during the analysis presented at the Oaxaca Conference is that Latin America still has information gaps and missing information regarding the classic characteristics of natural threats and their impacts on goods and services in the local setting. When there is information, its disclosure is weak, out of scope, and it cannot be used either by the agents who produce it or by the end users, the vulnerable population. Such reality constraints effective public policy.

The analysis of Central America, one of the most exposed regions to natural threats in the world, shows that the information on risks and disasters and their possible impacts on the public utility infrastructure needs:

- To be of good quality, in order to represent a reliable support for territorial decision making and to reduce uncertainty when doing large scale risk scenarios approximation in great detail.
- To be reliable, because if it is not, a greater investment must be made for systematic data gathering and obtaining information on the field or DRM cannot be appropriately handled.
- To guarantee access, use and availability, aiming at information transparency, equity, and exchange, harmonizing concepts, standards, and laws and regulations regarding threat, vulnerability, and risk data and information. Although there are current efforts in place in Central America, standardization processes in thematic cartography for natural threats must be initiated, not only in aspects of symbology and coding, but also to certify the level of confidence and validity to other users who are not risk specialists but who require the information.

Just as information is a key element for DRM, the existence of a legal, regulatory and institutional framework to enable service providers to act in a preventive manner or to decisively confront situations of disasters with clear rules are crucial for public policy. For the water and sanitation sector, regional regulation plays an essential role in establishing such rules and, above all, in implementing and supervising them.

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**Disaster Prevention in the Context of Climate Change: Flooding in Pakistan**

Pakistan has 95% access to water provision in urban areas and 91% access in rural areas. It has an average 78% access to sanitation – essentially latrines. Local governments are in charge of implementing regional policies and ensuring that the population has access to the services.

Pakistan confronted inundations in 2010 the likes of which had not been seen in the past 80 years. The estimated cost of the losses was US$ 10.05 billion and reconstruction needs represented US$ 8.9 billion. As to the water and sanitation service provision, 6,841 systems were totally or partially destroyed and damages were calculated at US$ 109 million, a figure higher than the US$ 93.9 million that had been estimated as a necessary investment to rebuild the systems with better options.

Considering the above, the government evaluated two options for water and sanitation system reconstruction: rebuilding using the same available technology or rebuilding using better disaster-resistant options. The big lesson learned was that the damage to private water and sanitation infrastructure exceeded the damage to the public infrastructure.

Catastrophe preparation had been near non-existent at policy decision-making levels and at operational field levels alike. Compliance with the construction code was minimal and many of the constructions and edifications located near river beds were completely razed and devastated. It was also noted that local governments have very centralized procedures and that they do not have the flexibility to take action an emergency response is needed.

As a result of the experience, greater emphasis has been given to controlling the quality of water management and this mechanism has been institutionalized. Water quality control laboratories have started operations in the 78 affected districts, generating good results in terms of contamination reduction. In most of those districts, the personnel have been trained to supervise these processes and a sensitization program has been forwarded with the community.

Based on the presentation made at the Oaxaca Conference by the World Bank’s Water and Sanitation Program, Water and Sanitation Specialist, Masroor Ahmad.
Even though it is true that the normative frameworks at the regulatory level in the water and sanitation sector in the region have not been designed to explicitly take DRM criteria into account, it is very common for them to include provisions regarding situations of force majeure, such as those that would occur after a disaster. The region does not have a standard for service provision after an event of force majeure. Nonetheless, based on the case studies presented at the Oaxaca Conference there are common conditions that are desirable, such as:

• **Service continuity and the quality of the water and sanitation services** are factors that are essential to preserve, except during an event of force majeure. Services providers should be responsible for service continuity.

• **Under normal operating conditions, services fees are set to cover service provision costs.** When an event of force majeure occurs, regulation must be clear regarding both the responsibility for bearing the replacement costs and deadlines service providers have in order to reestablish services. Also, sanctions must be clear in providers do not meet these terms and conditions.

• **Contracting out insurance is not very frequently set forth as an obligation for service providers in the regulatory framework for the sector, especially when they are public sector service providers.** However, it has been common practice among the companies with a concession in the region to seek insurance coverage in order to be prepared to replace their damaged facilities after an earthquake or other natural catastrophes. In such cases, the fees have the cost of the insurance premiums incorporated.

• **Defining service provision standards in events of natural disasters is also a complex task that is seldom regulated,** in spite of there being regulations in place for cases of emergency.

• **Formulating emergency plans and organizing the service provider** to properly face an emergency situation are other aspects that the regulatory framework should incorporate.

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**Water and Sanitation Sector DRM and Regulation: The 2010 Earthquake in Chile**

**The Earthquake.** It reached a magnitude of 8.8 on the Richter scale and directly affected six regions in Chile and 13 million inhabitants, near 80% of the population. Afterwards, a tsunami impacted the coastline of some localities in the regions of Biobio and Maule.

**General Effects.** Interruption of the electricity supply, of the telecommunications systems, of road connectivity; an absence of public transportation; social unrest; looting; robberies; fires; a curfew was imposed.

**Effects on the Sector.** Damages to the urban sanitation sector were estimated at over US$ 130 million. In the regions of Biobio and Maule alone, damages amounted to US$100 million. Rural system infrastructure repairs were paid for using the fiscal budget and represented a public expenditure of near US$ 12 million. Private urban service providers are bound to temporarily replace all damaged sites and afterwards definitively do so, to ensure the continuity of the provided services. They maintain earthquake insurance for their infrastructure, which is what made the rapid replacement of the damaged sites possible.

**Immediate Actions Taken by the Service Providers.** The creation of internal emergency committees; integration with regional emergency committees; rapid contact with local contractors; coordination with electricity distribution companies; supply of emergency drinking water for the population; coordination with the regional authority; supply of fuel and factory inputs; the demand for police and military support; information on the supply situation furnished.

**Immediate Actions Taken by the Regulating Body.** The creation of a work team for the emergency, in order to establish direct communication with the companies and

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13 After the earthquake in Chile in 2010, a study showed that the most damaged companies had taken out infrastructure insurance. The most affected company had insured its networks but the others had only insured their plants. The insurance renewal process after the seism has witnessed higher premiums whereas the rate setting process in some companies – the period of which coincided with post-earthquake recovery – had to be postponed due to the fact that they still have to analyze what premium to take into consideration for deciding on their rates.
gather information on a daily basis (during the first month after); daily service progress reports for all of the localities; the demand of emergency measures for replacing failed services until definitive measures were taken; control and supervision of vulnerable sites and systems; coordination with other institutions (for example, after the collapse of the Clorox gas plant, it suspended the Clorox treatment process at the waste water treatment plants and gave priority to the Clorox treatment process for drinking water); determination of definitive repair programs for the sanitation infrastructure (the work will conclude in December 2012).

Service Mitigation and Replacement Measures (service providers along with local authorities). Drinking water was distributed using tank trucks and portable tanks; waste water in damaged sewer systems was removed in trucks.

Emergency Solutions. To speed up service restitution, different emergency sites were constructed to replace the infrastructure affected by the disaster.

Service Standards. Two days after the earthquake, near 83% of the population was supplied water and on the sixth day after the event 100% of the population had water (93.3% using the networks and 6.7% using trucks).

Service Charges during the Emergency. Invoices were issued charging the services actually provided. That is important because waste water collection and treatment is billed based on drinking water meter reading. There was no charge for waste water treatment systems that stopped operating during the emergency or for sewer system service unless it was effectively provided.

Based on the presentation made at the Oaxaca Conference by Chilean Superintendence of Sanitation Services Superintendent, Magaly Espinosa.

Although a natural catastrophe can turn into a disaster, it also represents a set of opportunities for service providers, local governments, regulating bodies, and the population to improve their preparation and response capabilities. The experience of Chile after the earthquake in 2010 enabled identifying the strengths of the water and sanitation service provision system but it also showed its operational and structural weaknesses. From the Chilean experience some important recommendations for other countries in the region were presented during the Oaxaca Conference14, as follows:

Operational Problems
Disaster response should be performed within the framework of a regional multi sector contingency program. After the event has occurred, one of the main problems affecting water and sanitation systems is the absence of electricity for the drinking water production stage as well as for its distribution stage. To overcome the deficiencies, electric generator sets can be placed in the most critical facilities but that also requires an important quantity of fuel that, generally speaking, has not been previously stored and cannot be acquired in the market during an emergency. A stock of tank trucks and portable tanks as well as a cadastre of contractors and facilities to move them from other regions or camps should be part of the contingency plan. Finally, safer and reliable communications system and a regional emergency communication network are required.

Structural Problems
- Coordination protocols among the service providers, the authorities, and the population, which define the scopes of action and the responsibilities of each of them should be established and disseminated.
- It is necessary to carry out vulnerability analysis of the systems under the scenario of catastrophe and also to define the civil works needed to mitigate the effects of the catastrophe.
- Developing regulatory tools to set forth standardized minimum contents for sanitation company emergency plans is needed. The legal framework that governs the sanitation sector does not encourage safety levels for all types of events. The fee model takes into consideration financing minimum cost solutions; therefore, the companies are not bound to ensure supply continuity in events of force majeure.
- Conducting studies to determine common patterns seen in the most damaged sites.

14 Based on the presentation made at the Oaxaca Conference by Chilean Superintendence of Sanitation Services Superintendent, Magaly Espinosa.
Prevention in the Project Cycle

Although it is true that since the 1990s many countries in the region have started creating their national public investment systems for regulating a viability assessment of investment projects, efforts to develop methodological guidelines for incorporating disaster risk analysis in such systems are new and on very few occasions.

Traditionally, the pre-investment phase (ex ante project evaluation phase) does not take risk into consideration as part of the cost-benefit assessment, so risk appears as a hidden cost. In addition, the assumption has been that the sustainability of a project depends on the operator’s economic and financial strengths and on the availability of resources to cover operations and maintenance costs. When selecting the most “viable” project, the least costly project has been chosen, without taking risk into account.

Upon incorporating DRM into the pre-investment phase, the stream of profits is obviously altered and profit sustainability also depends on safe, secure systems. Thus, selecting the best alternative must take the existence of the risk into consideration.

In the past few years some countries in the region have been designing methodologies for incorporating DRM into the water and sanitation sector project cycle. This is a recent development so practical implementation at a regional level has not yet been achieved.

Indeed, as was analyzed at the very start of the Oaxaca Conference, incorporating DRM into the project cycle shows that prevention is worth the effort and that it is not expensive and can actually be profitable.

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**METHODOLOGICAL APPROACH TO DRM IN THE PRE-INVESTMENT PHASE**

<table>
<thead>
<tr>
<th>Traditional</th>
<th>with DRM</th>
</tr>
</thead>
<tbody>
<tr>
<td>The lowest cost alternative without risk is chosen</td>
<td>The lowest cost alternative with risk is chosen</td>
</tr>
<tr>
<td>Sustainability depends on the operator and on the rate</td>
<td>Sustainability also depends on the vulnerability</td>
</tr>
<tr>
<td>The profit flow is undisturbed</td>
<td>The profit flow can be altered due to hazards</td>
</tr>
<tr>
<td>The risk cost is not visible</td>
<td>The risk cost is visible</td>
</tr>
</tbody>
</table>

Source: Presentation made at the Oaxaca Conference by the World Bank’s Water and Sanitation Program Consultant, Ernesto Zaldívar.

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15 Based on the presentation made at the Oaxaca Conference by the World Bank’s Water and Sanitation Program Consultant, Ernesto Zaldívar.
III. Disaster Risk Management from Reflecting to Taking Action

One year after the Oaxaca Conference, the region has made progress in incorporating DRM into national public policy and practice. Perhaps, what is most significant is that, based on the knowledge and experiences shared during the days of the Conference, some actions have been implemented in the water and sanitation sector, revealing the influence of the lessons learned from the Conference.

One of the countries that had already been working on developing a legal and regulatory framework for DRM at a general level is Mexico. Indeed, its upcoming promulgation of the new General Civilian Protection Law is aimed at preventing and confronting the consequences of natural phenomena. The law also promotes the creation of the risk databases identifying the zones that are hazardous for the population and for public and private assets and recording them in national, provincial state, and municipal levels.

An important aspect of the law is that it considers the construction, edification, and execution of civil works for infrastructure and human settlements in a determined zone without making a risk analysis and without defining measures to reduce the risk, if any, a felony. The law also creates the National Emergency Committee that will coordinate actions during disaster situations; the committee will be chaired by the Secretary of the Governor’s Office Secretariat.

In Colombia, DRM is now more important than ever thanks to the efforts of different entities driven by all of the affectations that the country has endured in recent years. Indeed, rains are more intense and draughts more prolonged. Some years ago, only some sectors of the Magdalena River Valley, among others, flooded every year during the rainy season; however, in the past two years floods have spread to extensive areas in different regions of the country, including the Bogotá Savanna in the areas surrounding the capital of Colombia, representing substantial losses.

These catastrophic events are producing damage and losses affecting high risk zones where, generally speaking, the population with the lowest income settles, but also, for example, in the case of the Bogotá Savanna, private golf and tennis clubs, luxury condominiums, and legacy estates. In the northern region, flooding has covered entire municipalities and the dwellings were completely underwater, causing the loss of crops and of livestock.

Through its Administrative Public Management Department, the national government issued a law in November 2011, through which it created the National Unit for Disaster Risk Management that reports directly to the President of the Republic. This Unit replaces the former Risk Management Directorate that was ascribed under the Ministry of the Interior and of Justice. So, DRM has been granted the highest degree of importance.

Also in the legal and regulatory area, in April 2012 the government adopted a national disaster risk management policy and set forth the national disaster risk management system. Such policy rules the complete DRM process, starting with the definitions, responsibilities for the different levels of government and, in general, orders the entire national scheme not only for disaster response but also for the prevention process.

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16 Taken from information provided by the Mexican National Natural Disaster Fund (FONDEN).
17 Taken from information provided by the Colombian public water utility Agua de Manizales S.A.
The actions identified specifically in the water and sanitation sector are listed below.

a. The government of Honduras\textsuperscript{18} is devoted to improving its legal and regulatory framework aimed at mainstreaming DRM in the National Risk Management Plan entrusted to the National Autonomous Water and Sewer System Service (SANAA), in coordination with the Permanent Commission for Contingencies (COPECO). It has also prepared guidelines for incorporating mitigation measures in drinking water and sanitation projects. The National Risk Management System (SINAGER) law sets forth that DRM is a state policy of a permanent nature and orders the incorporation of the DRM component into territorial institutional programs and strategies. Along those lines, the guideline -now being prepared- works on the assumption of a process of DRM in the technical analysis of projects across the board.

b. In the water and sanitation sector of Colombia\textsuperscript{19}, the regulatory agency Water and Sanitation Regulatory Commission (CRA) is working on updating the methodology to calculate fees the public utility companies must implement. From now on all investment projects will have to include a chapter or a special component of risk analysis. This provision seeks to guarantee project sustainability as of the investment planning phase.

It is worth mentioning that based on the information shared during the Oaxaca Conference, the Vice Ministry of Water promoted a workshop on risk management in the water service and sewer system organized by the CRA with the support of the Colombian Ministry of the Environment, Housing, and Territorial Development and of the Inter-American Development Bank an held in July 2011. The workshop was aimed at promoting the incorporation of the risk analysis into the new user fee structure for the sector.

\begin{quote}
\textbf{Effect of the Rainfall on the Water and Sanitation Sector in Manizales}

In general, Colombia has been greatly impacted by the phenomena of rainfall in the past years, which have affected the drinking water and sanitation service provision in many municipalities in the country. In particular in Manizales during the last quarter of 2011 the damage to the water service infrastructure was evaluated at near US$ 2.3 million, with a loss of profits for the public utility company Aguas de Manizales S.A E.S.P. estimated at US$ 650 thousand, due to interruptions in the service during October and December 2011.

Manizales did not have water service during more than 10 days, after which time partial service was provided after reestablishing one of the two main conduits that feed the city. Six days afterwards, service was completely restored to the city and one month later a rationing process began that only permitted feeding the city with 600 L/sec of the average 850 L/sec that the population requires. 15 more days had to pass before the service was once again provided on a normal basis throughout the city.

In addition to the infrastructure damages and the loss of profits due to business interruption, the population having to be attended using tanks trucks, as well as the safety and security operations and the logistics involved in handling such operations represented a cost of US$ 1.4 million.

Fortunately, the public utility company has an insurance program that, to a good extent, helped to pay off the costs incurred. However, this was not the only emergency in the city; the roads, the gas infrastructure, the electricity were affected as was the Caldas alcoholic beverage industry, among other sectors, which drastically increased the insurance companies risk perception of the city and, therefore, premiums and deductibles were also increased. For example, the premium for Aguas de Manizales S.A. went from US$ 600 thousand to US$ 1.5 million and the deductible went from US$ 15,000 to US$ 500 thousand.

\end{quote}

\textsuperscript{18} Taken from the information provided by the Honduran National Autonomous Water and Sewer System Service (SANAA).

\textsuperscript{19} Taken from the information provided by the Colombian public water utility Aguas de Manizales S.A.
Along those lines, Aguas de Manizales has allotted US$ 560 thousand in its 2012 budget, approximately, to carry out a comprehensive risk assessment study with even greater data quality than the study performed in Peru by the public utility company Lima, SEDAPAL, the methodology and conclusions of which were presented during the Oaxaca Conference. Indeed, the terms of reference for the study have already been prepared and the utility is seeking funds to contract out the study.

c. Chile\(^{20}\), through its Superintendence of Sanitation Services (SISS) has worked on two initiatives described below.

i. The preparation of a methodological guide to help regulated companies develop their emergency plans, aimed at standardizing the different aspects that are important to sanitation service under emergency situation management. The guide was approved by SISS in August 2011.

ii. A risk management study for the drinking water sector, with IADB financing, which is still underway. The study is aimed at adapting foreign risk management methodologies—in countries where there is much more emphasis on risks caused by terrorist acts—to sanitation companies. Simulations have been carried out in three water and sanitation systems in the cities of Antofagasta, Melipilla, and Pichilemu.

d. In Ecuador\(^{21}\), risk management at Empresa Pública Metropolitana de Alcantarillado y Agua Drinking de Quito (EPMAPS) has been strengthened as a result of that public utility company participating in the Oaxaca Conference and adopting some of its conclusions and recommendations.

A preliminary EPMAPS risk analysis identified the main natural threats to which the EPMAPS infrastructure is exposed, underpinning earthquake and volcano threats. Some assessments of a deterministic nature have been made, which analyze the threat as well as its impact on some of the company infrastructures.

Nonetheless, seeking more efficient DRM, EPMAPS has proposed implementing a tool for quantitative probabilistic risk estimation, using the CAPRA platform. Therefore, with the World Bank support, it organized the workshop “Exchange of Experiences in Disaster Risk Management and Climate Change between Costa Rica’s Water Service and Sewer System Service (AyA) and EPMAPS”. The event was held in February 2012 with the participation of 35 technicians from different departments of EPMAPS and 10 outside participants from the Municipality of the Quito Metropolitan District (DMQ), the Secretariat of the Environment, the of National Heritage Institute, CONDENSAN, and the Water Fund.

In that sense, and thanks to the international cooperation received from the World Bank and from the WB/UNDP Project “DMQ Disaster Risk Reduction” implemented by the Security and Governance Secretariat of said district, an agreement has been signed among EPMAPS, the Municipality of DMQ, and UNDP for the implementation of a technical cooperation project aimed at strengthening the public utility company’s internal capabilities for earthquake DRM, using the CAPRA platform.

The project proposition is to apply the study to the company’s main drinking water systems, the Mica-Quito Sur, Papallacta - Bellavista, and Pita - Puengasi systems, using geographic information systems. Fragility, damage, and vulnerability functions are projected for the main elements of the drinking water systems and the project will be technically supervised by the CAPRA developers.

\(^{20}\) Taken from information provided by the Chilean Superintendence of Sanitation Services (SISS)

\(^{21}\) Taken from information provided by the Ecuadorian public water utility Empresa Pública Metropolitana de Alcantarillado y Agua Drinking de Quito (EPMAPS).
Through its Global Facility for Disaster Risk Reduction and Recovery, The World Bank granted DMQ a donation to finance the program “Municipality of the Quito Metropolitan District Disaster Risk Reduction - RRD-DMQ”. The objective of the project is to create a methodology for developing a “culture of prevention” that would incorporate broad concepts of safety and security using a holistic perspective of urban risk prevention and reduction, covering natural and technological risks, crime, and violence, and topics of road safety and security within the municipality’s competence. The methodological scheme proposes probabilistic risk assessment. Therefore, in that sense, the RRD-DMQ project will support strengthening capabilities for implementing CAPRA in EPMAPS.

Finally, many countries in the region agree that one of the limitations for considering DRM an essential factor in all planning and operational processes lies in the reduced capacity of the drinking water and sanitation systems providers, especially in the small municipalities. Constant personnel turnover associated with political cycles, hinders progress in important topics such as DRM. Also, laws and regulations are essential factors for directing the efforts of the different entities towards a common DRM objective. However, laws and regulations alone are not sufficient; management of the knowledge of this sector needs to be strengthened in such a manner that lessons learned can be shared, to apply the good experiences of others and avoid their bad ones. Therefore, it is necessary for cooperation organizations, professional associations, and the State to promote gatherings, for education and sharing experiences at all levels.

Source: Ecuadorian public utility company Empresa Pública Metropolitana de Alcantarillado y Agua Potable de Quito (EPMAPS).
Throughout history, governments at all levels used to be more prone to reacting, which provoked significant expenditure when it came to infrastructure reconstruction and support to the individuals who were victims of natural catastrophes.

The Oaxaca Conference granted a unique opportunity for taking the region’s pulse and for transferring technical knowledge on a worldwide scale, in order to establish a common critical path and consider a regional network for progressing with DRM. The information shared during the conference contributed to acquiring the awareness that the governments in Latin America and in other countries need to implement innovative disaster risk prevention measures regarding the infrastructure, territorial planning, and the environment.

Furthermore, the Conference enabled identifying some challenges and opportunities regarding DRM implementation in the water and sanitation sector. Those aspects were gathered in the so-called Oaxaca Agenda, a set of policy recommendations for the countries in the region. They are based on the proposals made by the participants during the Conference, which can become strategic lines of work for the sector. The Oaxaca Agenda recommendations are enumerated below.

1. Promote DRM in sector public policy and in its regulations.
2. Organize access to information on hazards and risks.
3. Create incentives for the service providers to keep updated technical cadastres.
4. Promote risk management culture education programs for schools and for the community.
5. Promote the articulation among municipality - service provider - community, to improve their capability of risk identification, mitigation, and reduction and to better their response to extreme events.
6. Incorporate threat, exposure, and vulnerability analyses into water and sanitation public investment project creation and assessment.
7. Define strategies for enhancing the financial capacity for risk retention and transfer at the service provider and/or sector level.
8. Encourage the service providers to prepare and implement emergency plans.
9. Promote the incorporation of DRM into total drainage basin management in the context of climate change, taking into consideration that water sources are critical elements in water service provision.
10. Establish a water and sanitation DRM knowledge network for the region.
12. Review the user fee system, to incorporate the DRM-related costs.
13. Promote externally financed investments that include DRM.
15. Establish fiscal incentives for DRM implementation.
Conclusions

The disasters that have occurred in the Latin American region in recent years have had significant effects on the physical condition and the operation of water and sanitation infrastructure; the countries have witnessed not only the total collapse of the networks but also the prolonged interruption of services, which affects the users’ health, their jobs, and, generally speaking, their capacity to generate income.

As a consequence, the International Conference “Disaster Risk Management for the Drinking Water and Sanitation Sector” (hereinafter called the Oaxaca Conference) offered an opportunity to all of those responsible for decision-making in matters of DRM in the countries in the region, to work towards incorporating DRM into the public policy and practice for the water and sanitation sector.

The program for the Oaxaca Conference enabled, first of all, knowing where the region is at (baseline) in matters of DRM for this sector and how it is progressing. That is to say, it led the participants to make a diagnosis and identify what still needs to be done. Indeed, the program included: i) analyzing DRM positioning in the agenda of sustainable development; ii) inserting water and sanitation DRM in the local level; iii) developing a strategy for making DRM an effective tool for water and sanitation companies; iv) studying the conditions and possibilities for creating appropriate risk retention and transfer strategies for the sector; v) understanding the importance of DRM in public policy and in regulations; and vi) realizing the need to include prevention in the project cycle, in order to built safer infrastructure and sustainable services.

Some of the most important aspects revealed during the Oaxaca Conference are listed below.

1. Analyzing DRM in the context of sustainable development left us with the following messages:
   a. Avoiding the negative effects of disasters is a benefit derived from prevention.
   b. Prevention is worth the effort and it is not always more expensive.
   c. With well focused expenditure, effective prevention can be achieved.
   d. A preventive measure or a response alone is not sufficient.
   e. The future can be managed.

2. The economic impact study of the 2007 earthquake in Peru regarding the water and sanitation infrastructure confirmed that preventive maintenance and appropriate construction practices significantly reduce the negative effects of a natural catastrophe such as an earthquake.

3. Japan’s experience shows the continuous development of design and construction standards based on lessons learned from infrastructure destruction due to extreme events since 1923. For water and sanitation, design and construction codes are not mandatory.

4. Drinking water and sewer system network replacements have to be built using flexible, earthquake-resistant joint piping, redundant production systems and dual mains.

5. The good risk management practices of service providers identified in the region can be replicated throughout the continent. However, that requires laws and regulations, political willingness, reliable information, and real user fees. Likewise, service provider – municipality coordination facilitates risk management in the territory and is empowered by the participation of a sensitized, educated community.

6. There are quantitative risk estimation tools available, that is to say, tools for estimating the probable damage to and the probable loss of water and sanitation system
components due to natural catastrophes. That enables risk retention and risk transfer decision making that is currently done at a country level. Notwithstanding, it can be implemented at other levels of government, at the sector level, and at the water and sanitation service provider level.

7. After the occurrence of a disaster (hurricane Mitch), the countries of Central America progressed in incorporating the importance of risk management; they now have a disaster risk management policy. However, they have identified that the main implementation challenge is lack of risk information and a lack of capability to overcome that constraint.

8. The recent earthquake in Chile (2010) taught the region that water and sanitation sector regulation plays an important role in risk management. Chile’s experience also showed that, in addition to service providers having a good capacity for response and, regardless of the business model being public sector or private sector, the regulating agencies need to adjust service provision standards during emergency situations, construction standards, the providers’ emergency plans, and the regulations regarding insurance premium negotiation.

9. Weather forecasts indicate greater frequency, intensity, and variability of extreme events. In that context, the management of water resources must be adapted and, to do so, disaster risk management is a strategic ally for confronting climate change.

10. **Incorporating risk management into pre-investment studies** for public investment in water and sanitation significantly contributes to safer investments in infrastructure and, thus, to sustainable services. Cost-benefit assessment methodologies have been developed to show that incorporating DRM is socially profitable.