

ECUADOR: BASIC REFERENCES FOR RISK MANAGEMENT 2013 - 2014











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Introduction



María del Pilar Cornejo de Grunauer Secretary of Risk Management Guayaquil, December, 2012

An essential part of the mission of the Secretariat of Risk Management (SGR) is to generate policies, strategies, and norms to promote the capacities to prevent and mitigate risks in the National Decentralized System, as well as to recover and rebuild the social, economic, and environmental conditions affected by emergencies or disasters.

This document gathers, in an easily readable document, a series of basic reference material to know and reflect on the progress and challenges of risk management in Ecuador, in the new legal framework established by our Constitution, in 2008. The material covered and its participatory nature showcases the interest and effort shared by more than 50 Ecuadorian institutions, mostly comprising the National Decentralized System of Risk Management.

When the preparation of this text started, it was going to be named 'Country Document' (Documento País) following its traditional denomination, but after some work, the contribution given by each institution to risk management became evident, so we decided to call it 'Ecuador: Basic References for Risk Management.' Risk management in Ecuador is a task carried out by citizens and institutions; therefore, the information gathered in this publication has been selected based on its potential use for people and institutions. As general reference, this information serves to guide the actions of international cooperation as a support to national efforts.

We are grateful for the fact that this document relied on the support of the European Commission's Humanitarian Aid and Civil Protection department (ECHO), within the action plan of the DIPECHO projects, as well as on the orientation of the International Strategy for Disaster Reduction (ISDR) staff, that helped promote this effort among the countries in the region.

The Secretariat of Risk Management deems this document, containing information until the year 2012, to be a useful tool to plan and assess risk management in coming years, in terms of vulnerability reduction in Ecuador, according to our Constitution and the international commitment of CAPRADE and the Hyogo Framework for Action.

We appreciate all your contributions to make risk management the best tool for safe development, which is also development for Good Living.

Description and summary

The initial goal of this paper was to provide a tool for project development on disaster preparedness supported by the European Community Humanitarian Office (ECHO). This tool should be regarded as part of the DIPECHO Program framework for the 2013-2014 action plan. Nevertheless, preliminary meetings identified the need to provide a tool not only focusing on a particular donor, but also serving as a common reference on Disaster Risk Management and Planning for governmental, nongovernmental and international organizations. The need to know the National System situation, its capabilities and weaknesses related to Risk Management was also determined so that guidelines to strengthen the system can be defined.

To develop the present paper the following process was carried out:

- a. Set up of a follow-up team
- b. Development of a methodological proposal
- c. Development of theme workshops with the participation of national secretariats, ministries, technical-scientific organizations, nongovernmental organizations, international organizations, and autonomous decentralized governments.
- d. Data collection and analysis processes
- e. Outline of strategies and action lines

This paper has been structured in two main sections:

- Section one related to the document "Ecuador, 2013-2014 Basic Reference for Risk Management", its development process and results.
- Section two includes an information breakdown which led to establish strategies and action lines.

In the first section, five priorities are introduced, related to the Hyogo Framework for Action and the Andean Strategy for Disaster Prevention and Assistance. Within these priorities, 16 strategies and 80 key actions are grouped. During development processes, these actions were proposed to be accomplished from 2013 to 2014 as a temporary framework.

In the second section an information breakdown can be found. This includes discussions during six national workshops and eight technical meetings. The information provided by secretariats, ministries, institutions and organizations can also be found. In order to offer a better knowledge source, each chapter provides theoretical and conceptual information, current situation of the country and specific recommendations to strengthen the system.

Chapters of the second section are structured as follows:

a. General Description and scope of the Country Paper

It provides a conceptual description from a regional level, according to the United Nation Office for

Disaster Risk Reduction, as well as a conceptual description from a national level according to Secretariat of Risk Management.

b. Hyogo Framework for Action

It includes priorities and strategies. Country implementation progress report.

c. Platforms for Disaster Risk Reduction

It deals with regional and global structure explanation, state members' importance and level of participation. Situation of the national platform and identification of existing bodies that can strengthen it, and recommendations for this purpose.

d. Humanitarian Reform

International model description for large disaster response; Proposed relationship between the international and national systems. Available International funding in case of emergencies or disasters.

e. International standards on disaster response

It identifies the status of the application of international standards in the country, specifically those related to the Sphere Project, INEE, SEEP and LEGS.

f. Geographical features

It includes a national context description related to the Ecuadorian orography, natural regions, hydrography, climate, precipitations, political division, means of communication, environment, etc.

g. Population and society

It provides information and basic analysis on the main population variables such as: age distribution, population distribution, home, education, access to services, population projections, etc.

h. Population and economic features

It deals with information about economic indicators and their relationship with the Ecuadorian population and the Indicators' Evolution.

i. Territorial division

It describes the organization model based on zones, their conditions and capabilities.

j. State organization

General State Structure based on roles, and its sectorial organization. The organization model for Risk Management is described through Risk Management Committees.

k. Legal and regulatory framework

It identifies legal supporting tools for Risk Management in Ecuador. It recognizes the key framework of the Risk Management Decentralized National System as well as competence descriptions.

I. Strategic Framework for Risk Management in Ecuador

The Ecuadorian Risk Management framework related to the main strategic plans of the country. ("Plan for Good Living")(National Safety Plan) (Safety Agenda).

m. Historical analysis of disasters

It takes into account the information provided by technical and scientific institutions, international organizations, and the Secretariat of Risk Management to gather a data base which allows identifying disaster and emergency impacts in Ecuador. It also evaluates evolution of repeated events and impacts.

n. Threats

It describes the main country threats, monitoring activities, and key recommendations for risk reduction or response if necessary. The following threats are identified: extreme hydrometeorological phenomena, floods and droughts, seismic and volcanic activity, tsunamis, landslides, swell and tidal waves, El Niño weather phenomenon, etc. Finally, the epidemiological situation in case of a disaster is also taken into account.

 Identification and priority setting of threats according to their possible impact and recurrence Some research results from technical and scientific representatives on events and their possible major impacts, and other high impact synergistic events are gathered in this section.

p. Vulnerability in Ecuador

General diagnosis of the vulnerability in Ecuador can be found in this section. Also lessons learned for vulnerability analysis and resulting limitations from the application process are described. Finally, recommendations to improve analysis processes are explained.

q. Institution capabilities and vulnerabilities

A list of main capabilities, vulnerabilities and recommendations from secretariats, ministries, institutions and organizations which developed this paper, is provided in this section, so that key actions to improve the system can be identified.

Finally, several annexes are made available, as important tools expanding the content and supporting not only the planning but also the development process of this paper.

Acronyms

ADRA	Adventist Development and Relief Agency
AECID	Spanish Agency for International Development Cooperation
AME	Municipality Association of Ecuador
ATD	Area Technical Direction
BNF	National Development Bank
CAZALAC	Water Center for Arid and Semi-Arid Zones in Latin America and the Caribbean
CCA	Climate Change Adaptation
CEDIA	Ecuadorian Consortium for Advanced Internet Development
CELADE	Latin American and Caribbean Demographic Centre
CENAPRED	Mexico's National Center for Prevention of Disasters
CENPER	Remote Perception Training Center
CERF	Central Emergency Response Fund
CIDA	Canadian International Development Agency
CIGMA	Center for Geological, Mining and Environmental Information
CIIFEN	International Research Centre on El Niño
CLIRSEN	Ecuadorian Centre for Integrated Remote Sensing Application for Natural Resources
CNAT	National Centre for Tsunami Warnings
CNE-MSP	Ecuadorian Focal Communication Centre for the Ministry of Public Health
COF	Climate Outlook Forum
CONAGOPARE	Municipal and Rural Governmental Council of Ecuador
CONGOPE	Consortium of Autonomous Provincial Governments of Ecuador
COOTAD	Code for Territorial Organization, Autonomy and Decentralization
COPLAFIP	Planning and Public Finance Code
CRECTELAC	Regional Centre for Space Science and Technology Education for Latin America and the Caribbean
DGAC	General Direction of Civil Aeronautics
DHN	Digital Humanitarian Network
DIPECHO	Disaster Preparedness Program of the European Commission's Humanitarian Aid and Civil Protection Department
DIRNEA	National Direction of Aquatic Spaces
DREF	Disaster Relief Emergency Fund
DRM	Disaster Risk Management
DRR	Disaster risk Reduction
EAP	Economically Active Population
ECHO	European Commission's Humanitarian Aid and Civil Protection Department
ECLAC	Economic Commission for Latin America and the Caribbean
EHP	Entry Level Humanitarian Professional Program
EIP	Economically Inactive Population
ENOS	El Niño Phenomenon Southern Oscillation
EOC	Emergency Operations Committee
ERFEN	Regional Study of the El Niño Phenomenon
ERT	Early Response Team
ESPOL	Polytechnic University of Ecuador
EWS	Early Warning System
FAE	Ecuadorian Air Force
FAO	Food and Agriculture Organization of the United Nations
FEMA	Federal Emergency Management Agency

FORECCSA Enhancing resilience of communities to the adverse effects of climate change on food security

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GAD	Autonomous Decentralized Government
HDI	Human Development Index
HFA	Hyogo Framework for Action
IASC	Inter-Agency Standing Committee
IDB	Inter-American Development Bank
IESS	Ecuadorian Institute of Social Insurance
IFRC	International Federation of Red Cross and Red Crescent Societies
IGEPN	Institute of Volcanology and Seismology of the State University
IMF	International Monetary Fund
INMAHI	National Institute for Meteorology and Hydrology
INOCAR	Oceanographic Institute of the Army
INEC	National Institute of Statistics and Census
INEE / CLIRSEN	Ecuadorian Spatial Institute
INEE	International Network for Education in Emergencies. Minimum Standards for Education in Emergency
INFA	Institute for Children and Family
INIGEMM	Metallurgical Geological and Mining National Research Institute
INP	Fishery National Institute
IOM	International Organization for Migration
ISR	International Sanitary Regulation
ISRR	International Strategy for Risk Reduction
ISSFA	Armed Force Social Security Institute
ISSPOL	Police Force Social Security Institute
т	Information Technology
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
LEGS	Livestock Emergency Guidelines
MAE	Ministry of Environment Ecuador
MAGAP	Ministry of Agriculture Livestock and Fisheries
MIDUVI	Ministry of Urban Development and Housing
MIES	Ministry of Economic and Social Inclusion
MIPRO	Ministry of Industry and Productivity
MSP	Ministry of Public Health
МТОР	Ministry of Transport and Public Works
MTT	Technical Work Discussions or Round Tables
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
OCHA	Office for the Coordination of Humanitarian Affairs
ODH	Human Rights Organization
OIG	International Intergovernmental Organization
PACC	Pacific Adaptation to Climate Change
РАНО	Pan-American Health Organization
PDI	Personal Data Interchange
PDOT	Performation and development Plan
PHEIC	Public Health Event of Netional Interest
PHENC	Public Health Event of National Interest
PRAA	Adaptation to the Impact of Hapid Glacier Hetreat in the Tropical Andes Project
PREDECAN	Andean Community Disaster Prevention Project
PIWC	
RENAC	
RENGEO	Geodelic National Network

RENSIG	National Seismographer Network
REPET	Data Transmission and Repetition Network
RIB	Rapid Intervention Brigades
RMC	Risk Management Committee
ROVIG	Network of Volcano Observer
SAT Nacional	National Early Warning Integrated System
SDI	Spatial Data Infrastructure
SEEP	Minimum Standards for Economic Recovery
SENACYT	National Secretariat of Science, Technology and Innovation
SENAGUA	National Water Secretariat of Ecuador
SENASV	Volcanology and Seismology National Service
SENESCYT	National Secretariat for Higher Education, Science, Technology and Innovation
SENPLADES	State National Planning Secretariat
SGR	Risk Management Secretariat
SHOA	Hydrographic and Oceanographic Service of the Chilean Navy
SMHN	Hydrological and Meteorological National Service
SNDGR	Risk Management Decentralized National System
SIN	Information National System
TERRA	Volcanic Seismic Warning Processing Information Centre
UNDP	United Nation Development Program
UNEP	United Nation Environment Program
UNESCO	United Nations Organization for Education, Science and Culture
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNISDR	United Nations Office for Disaster Risk Reduction
US OFDA	Office of U.S. Foreign Disaster Assistance
USGS	Geographical Center of the United States
WAP	Working Age Population
WFP	World Food Program
WHO	World Health Organization

WMO World Meteorological Organization



Process and Results of the document Ecuador 2013-2014: Basic References for Risk Management

I. General description of the process

For the creation of the document Ecuador: Basic References for Risk Management 2013-2014, sector ministries, national secretariats, technical-scientific institutions, international organizations and NGOs that are part of the National Decentralized System of Risk Management took part. The coordination of the process was carried out by a team comprising organizations participating in the 2011-2012 DIPECHO Action Plan, under UNISDR.

The different stakeholders of the system participated in five national workshops to lay out the situation of the actions and institutions related to risk management, both at sector level and as a whole system, and to provide various recommendations.

The results, once systematized and discussed, led to the present proposal, whose structure includes recommendations related to the strategic priorities of the Hyogo Framework for Action. Each of these priorities goes along strategic themes and actions for the 2013-2014 period. This document is expected to be updated globally in 2015 and to be annually adjusted.

II. Summary of Priorities and Strategic Themes

Priority 1. To have disaster risks reduction as a national and local priority for all institutions and organizations of the National Decentralized System of Risk Management and for the community, through a solid institutional base.

Theme 1: To articulate and improve the National Decentralized System of Risk Management in the different territories and levels of the government.

Theme 2: To develop a national communication strategy for Risk Management.

Theme 3: To promote strengthening and assessment of Risk Management public policies in the institutions of the National Decentralized System of Risk Management.

Theme 4: To promote best practices in Risk Management in all the SNDGR (National Risk Management System).

Theme 5: To strengthen the capacity to recover after a disaster.

Theme 6: To implement action plans for using risk transfer mechanisms as a general policy.

Priority 2. To strengthen the National Integrated Early Warning System as well as the identification, evaluation and surveillance of emergency and disaster risks.

Theme 1: To create the National Integrated Early Warning System with technical-scientific institutions of the public sector, private organizations and the civil society (National EWS).

Priority 3. To use knowledge, innovations and education to create and strengthen integrated security and resilience criteria at all levels.

Theme 1: To strengthen the National Risk Management Information Subsystem as part of the National Information System (SNI-SENPLADES).

Theme 2: To strengthen professional training and research on risk management.

Priority 4. To reduce underlying risk factors through actions integrated to the Autonomous Decentralized Governments and the other entities of the National Decentralized Risk Management System.

Theme 1: To strengthen and diversify the livelihoods of vulnerable populations through programs and norms.

Priority 5. To strengthen the preparation of the National System for emergencies and disasters to ensure an effective response.

Theme 1: To standardize and share the tools and norms related to the emergency and disaster response.

Theme 2: To strengthen the response capacity of volunteers and community relief mechanisms.

Theme 3: To apply and develop minimum norms and other instruments for emergency and disaster assistance, considering the national and international legal framework on the rights of the population.

Theme 4: To develop and/or unify post and pre-disaster evaluation methodologies.

Theme 5: To ensure the appropriate performance of the National Decentralized Risk Management System in emergency and disaster situations.

Theme 6: To define activation mechanisms and protocols for international cooperation in adverse events.

III. Strategic proposals for HFA priorities

Priority 1. To establish disaster risk reduction as a national and local priority for all the institutions and organizations of the National Decentralized Risk Management System and the community through a solid institutional base.

The following strategic themes are proposed:

Theme 1: To articulate and improve the performance of the National Decentralized Risk Management System in the different territories and levels of government. **Action 1.** Preparation and implementation of the National Strategy, the National Plan and the Territory Emergency and Disaster Risk Reduction Plans, including actions for climate change adaptation.

Action 2. Development of coordination norms, mechanisms and tools with stakeholders of the decentralized system for the implementation of the Strategy and the Plans.

Action 3. Creation of contingency plans based on the scenarios of impact determined by the Secretariat of Risk Management (SGR).

Action 4. The development of manuals, guidelines and other tools for preparing and implementing the Risk Management agendas and other competences of the Risk Management committees and their Work Groups in the different territories.

Action 5. Creation and updating of protocols of the technical groups and determination of roles and responsibilities for each stakeholder.

Action 6. Strengthening of the monitoring and accountability of Risk Management committees and their Technical Work Groups at the different government levels.

Action 7. The creation of neighborhood organizations and local work mechanisms as a basis for Risk Management directed by the Risk Management Committees in high exposure zones, especially in rural periurban areas.

Action 8. Institutionalization of risk management units in the National Decentralized System focused on the Autonomous Decentralized Governments, to ensure the appropriate staffing, structure and funding, based on the guidelines of the coordinating entity.

Action 9. Development of legal and planning frameworks in the Autonomous Decentralized Governments to strengthen Risk Management as a crosscutting element of land development and use.

Action 10. Creation of a regulatory framework that promotes and facilitates the full incorporation of the private sector in risk management, focused on social responsibility and risk transfer.

Action 11. Development of an updated national database of national and regional experts in risk management.

Theme 2: To develop a national communication strategy for Risk Management

Action 1. To generate a national communication strategy to be implemented by the coordinating body and the National Decentralized System entities, focused on critical topics and populations for risk reduction, according to their corresponding competences.

Action 2. To develop communication materials and actions focused on personal and institutional respon-

sibility within the management of corresponding risks and accountability.

Action 3. To determine mechanisms that incorporate communication media for educating the population about emergency or disaster situations.

Action 4. To design protocols and mechanisms to use the official platforms of Communication and Information Technology and amateur radio operators' networks for information and orientation in emergency or disaster situations.

Action 5. Creation of competence and responsibility matrixes in communication and information.

Theme 3: To promote the strengthening and evaluation of Risk Management public policies in the institutions that are part of the National Decentralized Risk Management System.

Action 1. Implementation of Disaster Risk Reduction policies by the National Risk Management System (SNDGR) institutions in more vulnerable populations and territories at national level.

Action 2. The implementation of a joint Agenda of Risk Management by the Secretariat of Risk Management (SGR), AME (Association of Ecuadorian Municipalities), CONGOPE (Consortium of Autonomous Province Governments of Ecuador) and CONAGOPA-RE (National Council of Rural Parish Governments of Ecuador).

Action3. Generation of instruments to encourage and foster Disaster Risk Reduction actions in the productive sector.

Theme 4: To promote best practices in Risk Management in all the National Risk Management System (SNDGR)

Action 1. Systematization of Risk Management best practices developed in different territories, governments, institution levels, and at community and neighborhood level, and promotion of those learnings. Best practices in risk management are those which link policies with planning, budget, monitoring and accountability.

Action 2. Creation of indicators at national, province and canton level to measure the progress in Disaster Risk Reduction results within existing legal and regulatory norms.

Action 3. Implementation of monitoring and social participation mechanisms to support and promote compliance with Risk Management norms in the territory and the planning objectives of Risk Management units and Committees.

Action 4. Promotion of Disaster Risk Reduction in Development and Territory Organization Plans by Autonomous Decentralized Governments.

Theme 5: Strengthen the capability of post-di-

saster recovery.

Action 1. Development of tools and capabilities to generate plans of early recovery of informal productive sectors.

Action 2. Generation of an inventory of rural and urban areas with high levels of exposure and vulnerability, as key supply for eventual projects of relocation.

Action 3. Generation of an inventory of critical areas and essential infrastructures as key supply for eventual projects of post-disaster recovery.

Action 4. Establishment of regulations and mechanisms of verification, so that all the projects of investments of the public and private institutions can have plans of contingency and early recovery.

Action 5. Strengthening of the capacities, resources and regulations from the Units of Risk Management of the institutions of the system to guide the actions for the early recovery within the scope of their competence.

Action 6. Establishment of a line of training in the use of methodologies of post-disaster planning in the Autonomous Decentralized Government and in the Units of Risk Management of the system to strengthen the technical capacities of the HR (Human Resources) responsible for the recovery in the public institutions.

Action 7. Training for the application of the Minimum standards for the Economic Recovery – (SEEP) as part of the training on Sphere Project.

Action 8. Strengthening of the component of psychosocial care for the affected population in the programs of recovery.

Acción 9. Generation of financial mechanisms for programs of recovery in coordination with the organization and ministries of economics, productivity and agricultural production.

Theme 6: Implement plans of action for the use of mechanisms of risk transfer as a general policy

Action 1. Implementation of a plan to secure the infrastructures, services and products of the State.

Action 2. Development of options to secure the production and means of livelihood.

Priority 2. Strengthen the Integrated National Early Warning system like identification, evaluation and surveillance of the risk of emergencies and disasters.

The following themes and actions are proposed:

Theme 1: Create the Integrated National System of Monitoring and Early Warning with the technical-Scientific Institutions of the public sector, private organizations and civil society (National SAT). **Action 1.** Definition of a matrix of competence and responsibilities for analysis and monitoring with the technical-scientific institutions articulated to the Decentralized National System of Risk Management.

Action 2. Establishment of criteria and guidelines for the generation of standardized information.

Action 3. Preparation of a baseline of information available for the structuring of the National SAT (System of Early Warning).

Action 4. Analysis of functional and structural vulnerability of the technical-scientific institutions, level of exposure and plans of contingency for continuity in case of disasters.

Action 5. Definition of a road map to create a System of Early Warning at a National scale (Multi-threat), including the procedures for the local networks and systems of monitoring and early warning.

Action 6. Design of a plan for the strengthening of the technical-scientific institutions, including actions that will provide personnel of high levels and capabilities, guaranteeing their permanence and development.

Action 7. The determination of routes to disseminate warnings to the population, including the communities that are geographically isolated, with few communication means or lack of relief organizations.

Action 8. Design of procedures to transfer specialized information to the Autonomous Decentralized Government and the community.

Action 9. Development of awareness schemes to improve the perception of risk of those in charge of making Risk Management decisions.

Action 10. Definition of protocols for the integration of work between the National System of Situation Rooms, Technical-Scientific Institutions, Sector Ministries and Executive Secretariats, and the joint establishment of products.

Priority 3. Use knowledge, innovations and education to create and strengthen the comprehensive security criteria and resilience at all levels.

The following themes and actions are proposed:

Theme 1: Strengthen the National Subsystem of Risk Management Information as key part of the National System of Information (SNI-SENPLADES (National Secretariat of Planning and Development))

Action 1. Identification and systematization of the services of key information provided by the institutions of the public sector for Risk management

Action 2. Determination and agreement on the risk management information standards (statistics, mapping) and update protocols and procedures.

Action 3. Dissemination of the services and products of the institutions that generates information for the risk management.

Action 4. Risk management strengthening of the National Council of Geographical-Information (CONAGE)

Theme 2: Strengthen the professional training and research associated to Risk Management.

Action 1. Development of programs of third level education focused on the risk management components (Reduction, Response and Recovery).

Action 2. Development of the strategies for the professional training in risk management at postgraduate level.

Action 3. Development of the spaces of reflection and research programs in the universities of the country on risk Management and CC (Adaptation to Climate Change).

Action 4. Research applied over areas, sectors and risk factors, with a Risk management and CCA approach..

Action 5. Establishment of strategies and mechanisms to strengthen the universities and scientific institutions networks in the area of Risk management and CCA.

Action 6. Creation of a bank of case studies based on the experiences of the country and the region for use in the process of training and development.

Priority 4. Reduce the underlying risk factors, through integrated actions of the GAD (Autonomous Decentralized Government) and the other entities of the Decentralized National System of Risk Management.

The following theme and actions are proposed:

Theme 1: Strengthen and diversify the means of livelihood of the vulnerable population through programs and regulations.

Action 1. Creating a baseline for the populations whose means of livelihood and basic service access are threatened.

Action 2. Determining strategies and mechanisms for protection and recovery of the populations affected by emergencies and disasters.

Action 3. Identifying scenarios with seasonal impacts on watersheds, considering the corresponding regulation.

Action 4. Identifying scenarios with potential major impacts on watersheds (dam collapse, large impoundments, pollution)

Action 5. Designing models and methodologies for the implementation of the existing regulations of risk management and adaptation to climate change.

Action 6. Generation of proposals of regulations for the management of watersheds, considering the reduction of risks and adaptation to climate change.

Priority 5. Strengthen the preparedness of the National system for emergencies and disasters in order to ensure a good response.

The following themes and actions are proposed:

Theme 1: Standardize and disseminate the tools and regulations related with the response in case of emergencies and disasters.

Action 1. Systematization, standardization and dissemination of the best practices at local and community level in the initiatives for early recovery.

Action 2. Operation of an interagency work group, including mechanisms of international cooperation to implement the standards, guides and other tools for national implementation in case of emergencies and disasters.

Action 3. Establishment of mechanisms to disseminate effectively the key information for the warning and the response of emergencies and disasters, including the communities isolated geographically.

Theme 2: Strengthen the capability of the response of the volunteer workers and the community relief mechanisms.

Action 1. Standardization of the training and development processes of the Risk Management volunteers and the members of the community relief mechanism

Action 2. Compatibility of the technical characteristics of the equipment used in the response (Supply catalogues, tools and compatible equipment)

Action 3. Evaluation and update (and expansion where applicable) of the protocols and procedures of response in different levels of government: parish, municipal, provincial, and national.

Action 4. Consolidation of an updated data base, which has to be available to the Risk Management committees, about the personnel, trained and developed on Risk management at parish, municipal, provincial and national level.

Theme 3: Apply and develop the minimum regulations and other instruments for the emergency and disaster support, considering the national and international legal framework on the population's rights

Action 1. Training of the personnel from all institutions and organizations of the Decentralized National System of Risk Management, in the use of the minimum regulations for emergencies and disasters support.

Action 2. Standardization of the system of temporary shelter and the goods for humanitarian aid, according

to the existing national and international minimum regulations.

Action 3. Documentation of the response timings and the percentage of coverage with humanitarian assistance on the served areas.

Action 4. Implementation of control and accountability mechanisms of the distribution of humanitarian aid.

Theme 4: Develop and/or unify the methodologies of pre and post- disaster asessment.

Action 1. Development of a work system that allows consolidating the tools, groups of work and the internal distribution of roles for an effective assessment of damage and needs, including the structural evaluation.

Action 2. Link of the damage assessment with the processes and standards of the National Chamber of the National Secretariat of Risk Management.

Action 3. Centralization, validation and socialization of the generated information by the processes of preventive and damage assessments.

Theme 5: Ensure the appropriate functioning of the Decentralized National System of Risk Management in emergency and disaster situations.

Action 1. Implementation of the Risk Reduction Agenda of the Risk Management Committee in all levels, the Technical Discussion Groups and preparation of contingency plans for the systems identified as keys by the committee.

Action 2. Permanent Monitoring of the timely update of the plans of contingency from the entities of the public and private sector by the discussion groups of the committee and the municipal Units of Risk Management

Action 3. Verification of the use of the procedures and protocols that commits different entities during emergency or disaster situations according to the scope of its competence.

Action 4. Simulations and drills directed by the different government levels to test the plans of contingency in the cities, big companies and key public services.

Theme 6: Define mechanisms and protocols of activation for the international cooperation in case of adverse events.

Action 1: Establishment and regular operation of the Country Humanitarian Team, including the formulation of protocols for the activation, operation and accountability.

Action 2: Establishment of programs and projects with international organizations and the NGOs (non-governmental organizations) for the strengthening of the capabilities of the country.



1. General description of the document

1.1. Description and scope of the document at regional level

According to the Methodology Guideline for the creation of the *Country Document*, proposed by the Coordination of the Regional Project DIPECHO-UNISDR of the Americas, the purpose is "to give an integrated view of the disaster risks situation at national level, the progress made in management to reduce them, the definition of priorities and strategic lines, and the main challenges to reduce loss of lives and the economic, social and environmental impacts generated".

For the execution of the DIPECHO-UNISDR Regional Project of the Americas, a common format was developed for different countries so that they can have a similar structure in the South American region, in order to facilitate the comparative analysis and creation of regional documents.

Ecuador's document gathers information and recommendations for Disaster Risk Reduction. It has been developed to be a reference document for decisions and interventions by stakeholders of organizations and institutions working in Disaster Risk Reduction in the country. It is aimed at increasing community resilience in disasters and strengthening national risk management efforts, within the framework of international strategies on this topic.

The purpose is that the information gathered can be periodically updated and enhanced with suggestions that add value to this document and turn it into an institutional memory of Disaster Risk Reduction in the country.

1.2. Country Document description and scope for Ecuador

The *Country Document* is the main official reference document for formulating programs and projects and, in general, for the development of cooperation activities for emergency and disaster risk reduction in Ecuador.

It offers a macro vision of the threats and vulnerabilities of national priorities for disaster management reduction, of institutional problems in the creation of the National Decentralized Risk Management System, of tools and strategies development to achieve the objectives of the Good Living Plan and the National Secretariat of Risk Management's Agenda.

The creation of the document, under the Secretariat of Risk Management (SGR) supervision, emphasizes the participation of main public and private stakeholders related to Disaster Risk Management. It also includes experiences of previous years and systematizes the information of the country and the region gathered by national and cooperation entities.

The *Country Document* will be valid for three years and will serve as the basis for creating annual reports that show changes in risk conditions in the country, as well as progress reports that show achievements in the projects, programs or actions carried out throughout the mentioned period in the different areas of Risk Management. The review and updating of the Country Document will be the National Secretariat of Risk Management's responsibility, in collaboration with NGOs, donors and inter-government organizations.

To facilitate handling and use by the different stakeholders, including decentralized autonomous governments, the text will be written in simple and understandable language. During its disclosure, the document is expected to be joined by main institutions and organizations related to Risk Management in the country.

According to the design, the document has the same format as those of other countries in South America (Argentina, Bolivia, Colombia, Chile, Paraguay, Peru and Venezuela), which encourages a closer regional approach to risk management problems and solutions in South America.

2. International context of disaster risk reduction

2.1. HYOGO framework for action HFA: Increase resilience of nations and communities in case of disasters

2.1.1. Description

The World Conference on Natural Disaster Reduction held in Kobe city, Hyogo Prefecture, in Japan, on January 18-22, 2005 - according to resolution 58/214 of the General Assembly of December 23, 2003 agreed to approve the Hyogo Framework for Action (HFA), considered the most important instrument for implementing disaster risk reduction adopted by the member states of the United Nations (1). Its main objective is to increase resilience in nations and communities, focusing on achieving considerable reduction of losses caused by disasters, by 2015.

The HFA (1) has three **strategic objectives** known as strategic areas:

- More effective integration of disaster risks in the development of policies, plans, and programs at all levels, emphasizing on disaster prevention and mitigation, preparedness for disaster events and vulnerability reduction.
- 2. Creation and strengthening of institutions, mechanisms and media at all levels, especially at community level, that can systematically contribute to increased resilience to threats.
- 3. In the reconstruction phase of affected communities, systematic incorporation of risk-reduction criteria in the design and implementation of emergency preparedness, response and recovery programs.

There are also five **priorities for action**, as well as guiding principles and practical ways to increase the resilience of communities vulnerable to disasters in the sustainable development context. The priorities are (1):

- 1. To ensure that disaster risk reduction constitutes a national and local priority comprising a solid foundation for institutional application.
- 2. To identify, evaluate and monitor disaster risks and enhance early warning.
- To use knowledge, innovations and education to create a culture of safety and resilience at all levels.
- 4. To reduce underlying risk factors.
- 5. To strengthen disaster preparedness in order to ensure an effective response at all levels.

For measuring progress on a regular basis and based on multi-sector consultations, countries are making national reports on the progress of the Hyogo Framework for Action implementation in their countries. In Ecuador, according to the 2009 – 2011

Report¹ (2), the following progress regarding the strategic objectives of the HFA has been done (a transcript of the achievements was included in the 2009 – 2011 Report):

In relation to Area 1:

"In Ecuador, the National Development Plan, "2009-2013 National Plan for Good Living: Building a Plurinational and Intercultural State", prepared by the National Planning and Development Secretariat (SENPLADES) incorporated RISK considerations in its objective 4 "To ensure nature rights, and to promote a healthy and sustainable environment", policy 4.6: "To reduce social and environmental vulnerability caused by the effects produced by natural and manmade processes that generate risks." Also, within the new management model, paragraph 8.6.4 includes"Comprehensive management and risk reduction." In this regard, the importance of transversely incorporating the risk variable in the planning and implementation of all public works in order to reduce vulnerability in the population and infrastructure is mentioned.

In the Ecuadorian Constitution in force since 2008, Art. 280 mentions that "The National Development Plan is the instrument observed by policies, programs and public projects; the planning and implementation of the State budget; as well as the investment and the allocation of public resources; and it will coordinate the exclusive powers between the central State and autonomous decentralized governments. Its observance will be mandatory for the public sector and indicative for the other sectors" (2).

In relation to Area 2:

The National Development Plan, in its policy 4.6, gives general guidelines to all stakeholders so that they can implement policies related to Risk Management, as follows: Policy 4.6: "To reduce social and environmental vulnerability under the effects produced by natural and manmade processes that generate risks. This helps identify competences and roles in each State body and the institutionalization of the topic in entities and the community, thus increasing their resilience".

The National Planning and Development Secretariat, as the leading agency for public investment, developed the Multi-year Investment Plan for the period 2011-2014, which issued guidelines that apply to all public sector entities. Planning is the first policy guideline. It sets out development objectives and supersedes public policies and the allocation of public resources in general.

That is to say, based on the development objectives raised in the national planning, investment projects

¹ For October 3, 2012, the Secretariat of Risk Management (SGR) has developed, along with the institutions of the *National Decentralized Risk Management System, the National Progress Report in the Implementation of the Hyogo Framework for Action (2011-2013)*, which can be found at the website of the United Nations Office for Disaster Risk Reduction - UNISDR / ISDR.

and programs must be developed to fulfill the goals so that the institutions can have resources to implement investment projects on risk reduction" (2).

In relation to Area 3:

"In order to strengthen the response and reduce the population vulnerability, the Secretariat of Risk Management created the Emergency Operations Committee Manual (EOC). It is the official interagency coordinator, responsible for planning actions of preparation, warning, response and recovery for emergencies and disaster situations in its territory. Decisions for response and recovery improvement take place here as well² (a)".

Therefore, for the Emergency Operations Committee (EOC) - as a space for inter-agency and interdisciplinary coordination- to observe the guiding principles of subsidiarity, security and solidarity decentralization, three levels of organization are established, which will be activated as part of the EOC by decision of its members.

The organization levels are:

- Emergency Operations Committee
- Operations Control
- Work Groups

It will be coordinated by the highest political authority of the territory and it is responsible for the administration and management of resources, interagency coordination, provision of information to the media and channeling of external aid coming as support for the emergency.

It is where political- administrative decisions are made within response plans regarding events occurring at that moment, and where financial inputs used for the emergency are monitored within the existing regulatory framework.

The actions by the EOC are supported by Executive Decree 486 signed by the President of the Republic of Ecuador, in the Regulation of the Public and State Security Act, Chapter II of the Organizations of the System Article 24 "(2).

It is important to analyze the progress made in the **Strategic Planning** of each area, as well as to the **Progress and Verification means of each priority**, registered in the Report 2009 - 2011 on the implementation of the HFA in Ecuador. It can be accessed in the location indicated in the references of this document (3).

2.1.2. Situation in Ecuador

After the consultation workshops for the creation of the document, it was possible to have a vision of the situation in the country within the priorities of the Action Framework. Therefore, the results were:

Priority 1. To ensure that disaster risk reduction constitutes a national and local priority, with a solid implementation institutional basis.

The most important progress in Ecuador to date is the constitutional mandate (2008) which establishes risk management as a responsibility of the State and the creation of the Secretariat of Risk Management (SGR). The latter is a risk management coordinator in the country and its mission is "to build and lead the National Decentralized System of Risk Management to ensure the protection of persons and communities from the negative effects of natural or manmade disasters. This is carried out through policies, strategies and rules that promote capacities to identify, analyze, prevent and mitigate risks to cope with and manage disaster events; as well as to recover and rebuild the social, economic and environmental conditions affected by potential emergencies or disasters".

Based on the current Constitution, the State is developing a new legal regulatory framework and a series of methodological instruments that govern and guide the competencies and activities of the public and private sectors in the field of risk management. Currently the efforts of the Secretariat of Risk Management (SGR) are concentrated in the consolidation of the National Decentralized Risk Management System, which has required the creation of risk management units associated with all public and private institutions of the country. In addition, as part of the system development, it is proposed that the Autonomous Decentralized Governments assume the responsibility to regulate, run and promote actions of prevention, response, mitigation, reconstruction and transfer of risks in the territory, as required. There is a clear political will to implement the National System.

The path toward these achievements has not been easy since Risk Management, as it was recently created, has required guidelines, methodologies and financial resources for the implementation of the Risk Management System at the local, regional and national levels. This implementation presents different degrees of progress in each level, being the local level where learning is emphasized, because in many Autonomous Decentralized Governments the institutional capacities and resources to assume these functions are not sufficient.

A very important role in the creation of an institutional framework for risk management is the Organic Code for Land Use, Autonomies and Decentralization which orders decentralized autonomous governments to prepare their development and land use plans considering risk factors. These plans are linked to the budget allocation and they harmonize policies, funding and planning of development.

Another important institutional basis for risk reduction will be consolidated with the Risk Management Law, which is currently under creation. This will complement

² In 2011, with Resolution N° SGR- 367-2011, the National Secretariat of Risk Management (SGR) published the Risk Management Committee Manual, in which the institutions are organized not only for disaster or emergency response, but it also focuses on all Risk Management components and on coordinated work of the participating institutions.

the Ecuadorian Construction Standard, which will regulate seismic resistance of buildings in the country, and construction standard for safe spaces.

Additionally, the following actions will take place in the country:

- Development of various management models for municipal risk management units, along with the Association of Municipalities of Ecuador.
- Generation of Disaster Risk Reduction agendas in the province and canton Risk Management committees.
- Development of technical standards and certification for Disaster Risk Reduction.
- Design and implementation of projects with support from international agencies and NGOs for the strengthening of the National Decentralized System of Risk Management.

Priority 2. To identify, assess and monitor the risks of disaster and enhance early warning.

The early warning systems (EWS) are ideally based on four main components: identification, technical/ scientific monitoring of threats, education/awareness, dissemination of warnings to the community and early response. In Ecuador, these components have been developed in varying degrees depending on the various threats, for example: the EWS for volcanic eruption threat in Tungurahua area is the most developed and has four components; the EWS for tsunamis is being created; the EWS for floods in the low river basin Guayas is installing monitoring stations. It is worth mentioning that there are a number of agencies that have competencies associated with each component of the EWS, so the challenge to achieve better coordination and articulation is increased.

A challenge identified by the National Decentralized System regarding the EWS is the creation and consolidation of an early warning system at national level. It shall focus on addressing multiple threats, clearly defining the standards, and guidelines for institutional and community implementation. This will be done differentiating each component that must be developed, and linked to the design of methodologies, definition of stakeholders and protocols that must be taken into account.

To integrate all the entities that study and monitor threats, a National Commission for Early Warning Systems has been created under the coordination of the National Secretariat of Risk Management. And, since there are a number of agencies that have competencies associated with each component of the EWS, clear and effective operational protocols to improve coordination and articulation, are required. Another critical factor is the component of dissemination of warnings to the population, especially in communities that are geographically isolated, with few communication media and little presence of aid and respond agencies with good preparation.

The support of cooperation agencies has been relevant in the implementation and consolidation

of the early warning systems that operate in the country. International agencies such as UNESCO, Oxfam, CARE, ECHO, IDB, US OFDA and others have cooperated in the creation of coordination platforms at regional, national and local levels. They also collaborated in the review and validation of operational protocols, education and awareness of the population, and other actions that have significantly contributed to this priority.

Given that there are a number of agencies that have competencies associated with each component of the EWS, clear and effective protocols are required to improve coordination and operation. Another critical factor is the component of dissemination of warnings to the population, especially in communities that are geographically isolated, with few communication media and little presence of aid and response agencies with good preparation.

It is also important to consider evacuation plans as part of the EWS, which shall be articulated in a comprehensive manner to include how people evacuate the risk areas, and their safe and planned return.

A key point in the creation of the EWS has been the management of information related to Risk Management. To date, information (maps, studies, plans, etc.) has been generated, but it is necessary to work on its validation, articulation and accessibility to be used in Disaster Risk Reduction processes.

Regarding the EWS in the country, the following actions will be performed:

- Strengthening of the National Information System on Risk Management
- Development of the EWS for floods in the lower basin of Cañar river
- Dissemination of instruments, tools, methodologies to Autonomous Decentralized Governments and institutions of the SNDGR
- Development of mechanisms for the articulation of EWS with macro-processes and with agencies at national or local level
- Expansion of the methodology use for analysis of vulnerabilities to a greater number of municipalities

Priority 3. To use knowledge, innovations and education to create a culture of safety and resilience at all levels.

The shift in approach that the National Decentralized Risk Management System has implemented moving from a response to an integrated logic, presupposes a substantial progress that should gradually result in a better understanding of the process for disaster risk reduction and increase of resilience.

Particularly in the education sector, under the leadership of the Ministry of Education and with support from the SGR, Ecuador has promoted a set of policies and programs designed to generate a culture of safety and resilience. The main strategy is the creation of a Risk Management Committee in The education sector is absolutely essential in the inclusion of risk management in the culture of the people. There are several initiatives for the content of the curriculum, for activities additional to existing subjects and for the creation of new spaces as part of educational projects in the education centers.

At community level, progress began in 2010 in rural and urban high risk areas occupied by vulnerable populations. Local risk reduction committees have been created in 10 of the 24 provinces of the country.

It is necessary to acknowledge that there are still high-risk areas that are illegally used for housing and production. The resettlement programs have had progress in urban areas, in coordination with the Ministry of Housing and with the decentralized autonomous governments. This is, however, an issue that has complex challenges and that will require a continuous effort in education, local organization and inter-agency coordination at different government levels (national, regional, provincial and local).

At the Secretariat of Risk Management (SGR) level, the Under-secretariat of Social Construction has been created and strengthened. It has competencies in education and training on Risk Management, in coordination with sector ministries responsible for the issue. The methodology for estimating vulnerabilities has also been established, which is a basis for planning Disaster Risk Reduction.

For this priority in the country, there will be:

- An increase in the number of facilitators/trainers in Risk Management in the National Education System
- Strengthening of the local Risk Reduction Committees in rural and periurban areas.
- Implementation of projects approved for Safe Hospitals with multiple donors
- Unification of tools for Risk Management planning

Priority 4. To reduce underlying risk factors.

This is one of the greatest challenges for the National Decentralized Risk Management System in Ecuador, mainly due to the high incidence of three key elements: disorganized and explosive urban development, vulnerability of the livelihoods and living conditions of large segments of the urban and rural populations, and growing environmental degradation in many areas exposed to threats. Progress on this issue is essential to the Good Living Plan 2009 - 2013 (Strategic Development Plan) in Risk Management.

Until December 2012, all municipalities shall prepare their Development and Land Use Plans considering several risk factors. This is one of the most powerful new tools for local and provincial governments to organize and regulate the use of urban and rural spaces. Given that this is a recent tool and that disorder has been present for several decades, its impact will be seen in the medium term.

To support the preparation of the Development and Territory Organization Plans, the Secretariat of Risk Management (SGR) and SENPLADES generated coordination spaces with local governments and developed methodologies to estimate vulnerability. They are now applied in 21 municipalities of the country, with the support of the Belgian Cooperation, UNDP and the Association of Municipalities of Ecuador.

Diversification of livelihoods in high vulnerability contexts is highly relevant for risk reduction as it is related to food, health, education. Consequently, there are State initiatives in terms of micro entrepreneurship, nutrition, production insurances, etc. Part of the goals will be to further elaborate mechanisms to ensure that the aid provided does not affect the local markets and/or production, that is to say, the promotion of "action without harm." Some important actions for not affecting the local market are the implementation of virtual storage rooms with local suppliers, initiatives for host families and local temporary accommodation for victims during adverse events.

Institutional contingency plans can promote alternatives that support livelihoods and that prevent erosion of productive capital. In this regard, Ecuador has developed replicable experiences in the use of 'cash for work' and distribution of 'bonds' exchangeable for goods or food. They have been an efficient alternative that reduces distribution and storage costs, and has greater acceptance by beneficiary populations. The contact points among contingency, response and recovery plans with the support of livelihoods can help reactivate the local economy.

At the environmental level, there are factors that must be taken into account in the process of underlying risks reduction. For example deforestation, which has led to erosion on hillsides, river banks and estuaries and resulted in the occurrence of landslides. Additionally, pollution of water resources, mainly due to sewage waste disposal from the industrial sector, which affects the safe water supply to the population, in terms of quality and quantity.

There is a National Policy on Safe Hospitals, whose temporary scope is 2015 and it is aimed at improving healthcare facilities. At the moment, the creation of hospital disaster plans has been promoted.

Mitigation works have been carried out, especially in urban areas in order to reduce disaster risk.

In the technical work group on productivity and livelihood, planning for the recovery of livelihoods after a disaster is a priority as part of the structure of the Risk Management Committee. The actions to be performed and that are associated with this priority are:

- Creation of the resettlement Program, MIDUVI
- Relocation of the population in high-risk areas by Autonomous Decentralized Governments
- Design and implementation of prevention and mitigation local projects
- Connection of Risk Management with environment, climate change and underlying risks
- Planning of land use based on risk maps
- Introduction of crop insurance schemes

Priority 5. To strengthen disaster preparedness in order to ensure an effective response at all levels.

The country has made great progress in disaster preparedness with the active participation of the State, the people, international agencies and cooperation organizations with competences in Risk Management. There are currently various programs aimed at preparation, with the support of donor agencies such as ECHO, AECID, US OFDA, World Bank, IDB, JICA, CIDA, GTZ, Belgian Cooperation, among others.

The most evident step is the scientific-technical development, focused on the knowledge and monitoring of threats, the development and application of methods to estimate vulnerabilities in development and land use plans by municipalities, and the preparation of risk scenarios that allow decision-making and planning. There are floods and landslides maps by cantons on a 1:50000 scale, and 1:5000 scale maps are being created. There are also maps of flood-prone areas due to Tsunamis for Galapagos and 30 other areas of the continental coast.

It is important to strengthen response capabilities at local level, considering operating groups and coordination by decentralized autonomous governments (province, canton and parish level).

One of the greatest challenges in the country is to achieve strong local leadership and greater commitment and a closer relation with communities, both in the preparation phase, and the response and recovery phase. The incorporation of the community as an important stakeholder in the risk management process in the analysis, planning, design, implementation, monitoring and evaluation of actions is a key objective to ensure success and sustainability of actions.

The National Risk Management System (SNDGR) has improved by having indicators for humanitarian aid based on international standards (Sphere). It is also consolidating the National System of Situation Rooms, and the implementation of monitoring and assistance centers (ECU 911). Work with the community has been prioritized and there are tools to strengthen them.

Regarding this priority, in the country there will be:

- Work along the border with refugees Health
- Improvedf access to health services
- Systematization of Disaster Risk Reduction experiences by the Secretariat of Risk Management (SGR).

- Implementation of Risk Management decentralization and of instruments and tools -Secretariat of Risk Management (SGR)
- Creation of neighborhood brigades for Risk
 Management
- Capacity-building for humanitarian response in the municipal units of Risk Management.

2.1.3. Recommendations to the governing body, related to the Hyogo Framework for Action

- To incorporate the HFA in all planning instruments related to Risk Management, incorporating the National Decentralized Risk Management System and international cooperation.
- To promote intersector participation agendas and processes for the dissemination and implementation of the HFA at national level.
- To promote the implementation and evaluation of HFA progress through the National Platform for Risk Reduction.
- To support the development of national platforms for coordination, technical work groups, alliances (clusters) and training networks.
- To share the National Report about progress in the implementation of the HFA at all levels.
- To design a common approach that will allow the strengthening or creation of Risk Management units in the Autonomous Decentralized Governments and the Central Government.
- To identify the competencies associated with each component of the EWS. To define clear and effective operational protocols for emergency and crisis response.
- To improve communication means for alerts to the population, especially in communities that are geographically isolated.
- To improve the response capabilities of relief agencies and community mechanisms.
- To support the Risk Management policy of the Ministry of Education.
- To implement a National Relocation Program for people living in risk areas and to strengthen resett-lement and relocation plans in safe areas.
- To promote the preparation of contingency and response plans that support livelihoods and to help early recovery of communities affected by emergencies or disasters.
- To create guidelines for the technical and financial sustainability of the processes initiated by Risk Management at territory and sector levels.

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- To issue guidelines to harmonize land use planning organized by Autonomous Decentralized Governments with Risk Management.
- To incorporate private enterprises in the Risk Management processes.
- To have a national EWS with a multiple threat approach.
- To have a Law, a national plan, a strategy and territorial plans of Disaster Risk Reduction.
- To improve the knowledge and understanding of vulnerabilities at national level to facilitate the formulation of disaster risk reduction policies and programs.
- To establish a system for monitoring, evaluation and follow-up of progress in the HFA in Ecuador.
- To improve decentralization and deconcentration of responsibilities and functions related to Risk Management.
- To increase the number of trained staff and/or specialists on Risk Management.
- To establish strategies of development and conservation of specialized human resources in the Risk Management National System.
- To standardize tools for Disaster Risk Reduction.
- To promote public investment programs with a Disaster Risk Reduction approach.
- To strengthen the capacities of the technicalscientific institutions with responsibility in monitoring threats and vulnerability.
- To foster strategies and programs for risk transfer.
- To issue policies for connecting Environmental Management, Development and Risk Management.
- To promote initiatives for urban risk management.
- To systematize and promote Risk Management best practices at all levels.
- To structure a national volunteer Risk Management program.

2.2. Platforms for disaster risk reduction

2.2.1. Description of the Global Platform for Disaster Risk Reduction The Global Platform is the main consultative forum for disaster risk reduction on a global scale. It gathers a wide range of participants from different sectors of development and humanitarian work, as well as environmental and scientific fields related to disasters risk reduction. It seeks to expand the political space dedicated by governments to disaster risk reduction and contributes to achieve the Millennium Development Goals, particularly the one regarding the reduction of poverty and environmental sustainability. Its main objective is to increase the commitment and action for the implementation of the Hyogo Framework for Action (HFA). (1).

The Global Platform for Disaster Risk Reduction is replacing the Interagency Task Force on Disaster Reduction, but it maintains the same duties.

There have been three sessions developed worldwide, the last of them was held in Geneva, Switzerland from May 8 to 13, 2011 under the theme **"Invest today for** *a safer tomorrow: Increased investment in local action*", its key achievements focused on (2):

- Urban Risk Resilience
- Risk reduction of disasters as a national, local and international priority
- Investment in Disaster risk reduction
- Prioritization of Risk management in government strategies and policies
- Responsibility of local governments in Risk management
- Participation of the private sector in the prevention, resilience and disaster risk reduction –DRR
- Support for community health initiatives as a key factor for disaster reduction
- Relationship between Risk Management and Environmental Management

The following critical steps have been identified (2):

- Increase investment in DRR (disaster risk reduction) at local and national levels.
- Strengthen capacities of local governments and ensure resources availability.
- Develop standards and indicators for measurement of the effectiveness for the DRR.
- Account for disaster losses in a standardized manner.
- Increase specific budgetary allocations for the DRR.
- Create incentives to invest in prevention.
- Protect public finances with mechanisms of contingency.
- Provide guidance to National Platforms.
- Ensure that the responsibility of DRR (disaster risk reduction) is supported by the political authority.
- Universal access to information on the Risk management.
- Avoid the inefficient use of existing resources.
- Ensure the availability of specific climate information with scientific basis.
- Adapt innovative mechanisms of social protection and ecosystem management.
- Support identification and preparedness for emerging risks.

Based on the above-mentioned achievements, the actions implemented in Ecuador are identified in the HFA progress reports. It is possible to see that the main achievements are related to the construction of legal frameworks and responsibilities of the DRM (Disaster Risk Management) in local governments and ministries. However, it is important to mention that not all the frameworks and tools can be applied in local contexts, mainly due to the lack of knowledge.

2.2.2. Description of the Regional Platform for Disaster Risk Reduction in the Americas

The Regional Platform for Disaster Risk Reduction in the Americas held its first session in the city of Panama in March 2009, with the following objectives (3):

- Evaluate the progress of the implementation of the HFA (Hyogo Framework for Action).
- Increase the disaster risk reduction profile
- Exchange experiences and learn from best practices.
- Identify gaps and actions needed to accelerate the national and local implementation of the HFA.

The Regional Platform is intended specifically to:

- Increase the disaster risk reduction profile in a comprehensive way from sustainable development to adaptation to climate changes.
- Reiterate the commitment of the decision makers with the implementation of the HFA.
- Learn from the best practices.
- Provide practical suggestions for initiatives.
- Evaluate the progress in the implementation of the HFA.

In the Second Session of the Regional Platform for Disaster Reduction – 2011, which took place in Mexico, the following strategic objectives for the Reduction of Disasters in the Americas 2011, were set (4):

- Accept and apply DRR (Disaster Risk Reduction) in the Adaptation to Climate Change.
- Increase the investments in DRR.
- Promote cities, schools and hospitals that are resilient to disasters.
- Review the HFA.

As the result, the second session called upon all the states and territories, regional and sub-regional organizations, the civil society, the academic, scientific and private sectors, international organizations and in general to all the participants to take action on:

- Moving forward in the integration of Disaster Risk Reduction –DRR and Adaptation to Climate Changes in the policies, regulatory frameworks and plans of development.
- Promote permanent programs of training and strengthening of capacities.
- Promote the design and implementation of instruments of Result-based Management
- Guide the resources and create the mechanisms of management to promote the strengthening of the links between the academic and private sectors as well as the civil society.

- Promote the development and use of risk scenarios in multi-threat conditions.
- Promote the development of the capabilities that will allow evaluation and generation of knowledge about the environmental, economic and financial impact of the DRR and CCA.
- Strengthen the system of climate, ocean and earth monitoring for the development of Early Warning Systems
- Promote the incorporation of the DRR as a crosscutting theme at all levels and modalities of the educational system.
- Promote the creation and dissemination of information services.
- Encourage the social media to be present during the formal and non formal education processes in the actions of the DRR.
- Use efficiently the university and other scientific and educational institution networks
- Incorporate the criteria of DRR in the process of territorial ordering, public planning and investment.
- Strengthen the capabilities of management of economic resources, human capital and installed capacity, taking into account the achievements of the DRR and CCA.
- Develop and/or Implement the instruments of control to guarantee that the disaster risk reduction measurements are integrated in the activities of post-disaster recovery and rehabilitation.
- Consolidate the development of (national and international) protocols and procedures that will facilitate the gathering and exchange of information during emergency and disaster situations.
- Promote the consolidation of the regulatory frameworks and guidelines related with the fast and timely support of the international community in case of disaster.
- Develop and strengthen the mechanisms of horizontal cooperation in topics related to DRR, including considerations about the CCA.
- Strengthen, from a sustainable development approach, a comprehensive view about the territory management, biodiversity, fragile ecosystems, the environmental degradation process and water resources management.

In the regional context, Ecuador has participated in the initiatives related with the objectives of the Platform, among them (3):

- Incorporation of the DRR and CCA in the Plan of Development – "Plan of Good Living"
- Strengthening of the university networks of knowledge with a vulnerability analysis approach, with the support of international organizations.
- Strengthening of the structure of the Ministry of Environment in the area of CCA (Climate Change Adaptation)
- Processes for the consolidation of Early warning Systems for Tsunamis and Volcanic Eruptions (Tungurahua and Cotopaxi)
- Organic restructuration of the Ministry of Education to strengthen Risk management
- Incorporation of risk in the national guidelines for the territorial ordering.
- Provision of international support in case of

disasters, regulated on the basis of a manual developed by the Ministry of Foreign Affairs and SGR (National Secretariat of Risk Management)

• Participation of local initiatives.

In order to complement the information, it is recommended to check the communication of Nayarit – Mexico about the lines of action (4).

2.2.3. Description of the National Platform for Disaster Risk Reduction in Ecuador

According to the UNISDR (United Nation Office for Disaster Risk Reduction), a National Platform for the DRR (Disaster Risk Reduction) is a committee or forum composed of multisector groups, disseminated at national level to develop a sense of belonging. Additionally, the agent that promotes the DRR in several national levels (5) must offer coordination, analysis and counseling to the priority areas that require concerted action through a coordinated and participatory process. It is the mechanism of coordination to achieve the full incorporation of the DRR into the development programs, plans and policies, in accordance with the implementation of the HFA (Hyogo Framework for Action).

The primary objective of a National Platform for the DRR is to further increase the resilience in the country and achieve the following specific objectives:

- Constitute a mechanism of coordination to intensify the multisector collaboration.
- Promote an environment for the development of a culture of prevention (promote and increase the DRR awareness).
- Facilitate the integration of the DRR in the planning policies and the national programs of several development sectors.
- Become the linking point inside the system of National Strategies for Disaster Reduction (ISRR).

In Ecuador, the SGR (National Secretariat of Risk Management), as a governing body of the Decentralized National System of Risk Management, is the entity responsible for leading the National Platform, having as support the current legal framework. The Platform has not been formally structured, but it has developed technical and scientific sectoral actions, which will be the basis for its creation.

The SGR by means of the resolution Res N° SGR 367-24, ordered the creation of the committees of Risk Management with an approach to all phases and not only in the response to disasters. These committees have a regulated functional, sectorial and special structure in which all the public and private participants are integrated. This would be one of the National Platform components (6). On the other hand, according to the regulations of the public security Law and the state, there is a Consultative Committee for Risk management, which can be considered as the basic structure for the definition of strategies. With the purpose of widening its action, they should establish the technical commissions that support their work.

2.2.4. Recommendations for the discussion groups of the Country Document

- Socialize at national and local levels the global and regional agreements and recommendations.
- Establish the National Platform, having as basis the structure of the committees of Risk Management, which are the ones responsible for the implementation of the DRR agendas for a local, provincial and/or national level.
- The National Platform should establish indicators and mechanisms of participation monitor the agenda of the DRR (The Frontline View methodology of evaluation can be used as basis, which provides the possibility of gathering information from the social organization to give track of the application of the HFA).
- The accountability reports of the ministries and secretariats must include the progress and limitations in relation to the recommendations of the platforms.
- Determine the need of platforms focused on the establishment of key actions for the implementation of strategies in the corresponding territory.

The contingencies and emergencies should not be considered a limitation for the work of the National Platform or for the performance of the related structures with Risk Management. On the contrary, they should be seen as an opportunity for the assessment and identification of new actions.

2.3. Humanitarian reform

2.3.1. Description

In 2005, the international humanitarian community established a process of coordination to improve the effectiveness of the international humanitarian response in case it is required. At country level, it is proposed to strengthen the national structures and to set as counterparts the international structures.

The main objective of the Humanitarian Reform is to improve the humanitarian response in terms of their capacity, predictability, accountability and association when the capacity for the humanitarian response of a country has been surpassed or when the support has been requested (2).

The Humanitarian Reform is based on four main objectives:

- 1. Improve the capacity of humanitarian response, ensuring well trained personnel, accessible and appropriate supplies, development of capacities, guidelines and agreed standards.
- 2. Rely on appropriate, timely, predictable and flexible funding through the Central Emergency Response Fund CERF.

- 3. Improve the humanitarian coordination and the leadership at inter-sectoral and sectoral level.
- 4. Obtain a better collaboration among the different humanitarian participants inside and outside the System of United Nations.

The principles that the Reform follows are (1):

- Improve the "predictability" for the response to disasters
- Accountability of humanitarian actions
- Promote and act under the work alliances.

The reform is composed of the following elements (1):

- 1. Cluster or Sectoral group approach.
- 2. Strengthened Humanitarian System / Coordinator.
- 3. More appropriate, opportune, flexible and effective Humanitarian Funding.

The key support of the Reform is the development of strong alliances among participants of the United Nations and humanitarian partners like the NGOs (non-governmental organizations), The Red Cross and Red Crescent, and authorities.

2.3.1.1. Cluster or Sectoral Group Approach

According to Valdivia (2011), the cluster is a "group or structure of people or organizations that work collectively to achieve a goal in a certain field". In accordance with the recommendations of the "humanitarian Response Review", this model is proposed to correct the gaps and strengthen the effectiveness of the humanitarian response through the establishment of alliances or groups of work, splitting the work and papers and defining the competence and responsibilities among the organizations. Hence, the International humanitarian community will become more structured, responsible and professional, with a better relation of association among recipient governments, local authorities and local civil society.

In December 2005, The Inter-Agency Standing Committee – IASC (2), appointed the worldwide leaders of the groups of nine activity sectors (3) as follows:





2.3.1.2. Humanitarian System / Coordinator

During a disaster, it is required to have efficient coordination and effective leadership, both nationally and internationally, which is achieved though plans and protocols integrated with a clear definition of competence, requirements, scopes and responsibilities.

A Scheme that is consolidating in the countries of the region is the Humanitarian Country Team, also known as Humanitarian Network (4) that is made up by the main national and international humanitarian organizations / institutions present in the country, including the agencies of the United Nations, International Organization for Migration, the non-governmental organizations (NGO) and the International Movements of Red Cross and Red Crescent, that has a commitment of participation in accordance with the coordination agreements. The Direction is a collective work among the Executive Director of the national organization of emergency and disaster management (in the case of Ecuador: SGR (National Secretariat of Risk Management)) and the Local Coordinator or Humanitarian Coordinator of the United Nations.

The Humanitarian Country Team – EHP is the entity where information is exchanged and decisions are made with regards to humanitarian actions that the GNO and International organizations execute as part of the National System.

2.3.1.3. Humanitarian Financing

During a disaster, the capabilities of a country can be reduced, either by the effects of the disaster or by shortfalls in resources or means. Consequently, additional support by systems, governments, international organizations, NGOs and private companies is required. This type of aid must be channeled appropriately to increase its impact.

The main global financing tools are as follows:

a. Call for international assistance - Flash Appeal (5)

The call for international assistance is a tool for structuring coordinated humanitarian response for the

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first six months of a disaster. The Appeals are linked to an early response strategic plan and specific projects formulated within 5-7 days after a disaster. If there are any uncertainties about the evolution of the event, it is possible to work as per the most likely scenarios and strategies for responding to each one of them. A month after the Appeals are made, they are reviewed according to the information available.

The Appeal is the basis for requests for international funding through various funds, contributions from governments, donations, etc. The United Nations Resident Coordinator in the affected country, in accordance with the National System and with the support of the Office for Coordination of Humanitarian Affairs of the United Nations - OCHA, performs the appeal/call based on the information and consultation with humanitarian stakeholders that take part in the response.

The appeals include projects from UN agencies, international organizations and NGOs. In principle, the National Red Cross Society can be part of the appeal as a partner of a UN agency. Governmental structures cannot apply directly to the funds, but they can be partners of UN agencies and NGOs.

b. Central Emergency Response Fund - CERF (5)

The CERF is a humanitarian fund established by the United Nations General Assembly in 2006, which allows for timely and effective humanitarian assistance to those affected by disasters and armed conflicts.

The objectives of the fund are:

- To promote early action and response to prevent life losses
- To improve the response to requests in critical times
- To strengthen the key elements of crisis humanitarian response, that do not have sufficient funds

The CERF has a grant mechanism for USD 450 million and credit facilities of USD 50 million. The Fund is annually endowe with donations from the private sector and governments. Two-thirds of CERF funds are intended for quick response in the first 72 hours after receiving a request from the Resident Coordinator. The remaining third is distributed through a 'funding window' in two rounds per year for programs that demonstrate a significant gap between needs and available funds.

2.3.2. Use of the mechanisms in Ecuador

- The Risk Management Committees System is being consolidated with a structure of seven technical work groups, based on the international model of 9 clusters.
- There are no sector coordination protocols between the National System and the international system for disasters or aid requested by the Ecuadorian government.
- The work among technical work group leaders and those responsible for the clusters is occasional. Du-

ring the floods of 2008 a coordination matrix was created by the responsible parties.

- The Ecuador Humanitarian Team is being created, and has a work plan to be formalized.
- International cooperation for disasters has coordination manuals.
- No funds have been requested to CERF.
- The DREF fund of the International Red Cross and Red Crescent Movement has been requested through appeals by the Ecuadorian Red Cross and the International Federation of the Red Cross on several occasions, by request of the national Risk Management authorities.

2.3.3. Recommendations

- To establish the Humanitarian Country Team, to develop their work plans and define coordination and performance protocols.
- To prepare Disaster Risk Reduction agendas of the Humanitarian Country Team in accordance with the Risk Management Manual in force.
- To perform integrated drills and training of all those responsible for humanitarian response.
- To prepare action plans and aid requests based on scenarios, using the resources and requirements of the organizations (this should be a preparation activity for potential disasters that could require international support).
- To structure protocols among clusters and technical work groups.
- To appoint national counterparts to perform preparation actions.

2.4. International policy tools for disaster response

2.4.1. Description

2.4.1.1. Sphere Project: Humanitarian Charter and Minimum Standards for Humanitarian Response.

The Sphere Project was initiated in 1997 by a group of non-governmental humanitarian organizations (NGOs) and the International Red Cross and Red Crescent Movement. The goal is to improve the quality of their actions during disaster responses and to be accountable. The Sphere philosophy is based on two essential convictions: first, that people affected by a disaster or an armed conflict have the right to live with dignity and, therefore, to receive aid; and second, that all possible measures must be taken to alleviate human suffering caused by disasters and armed conflict (1).

The Sphere Project, in collaboration with multiple agencies and specialized persons, drafted the Humanitarian Charter and developed a set of minimum standards in some key areas to save lives. These standards are set out in four technical chapters of the Manual: water supply, sanitation and hygiene promotion, food safety and nutrition, accommodation, human settlements and non-food items, and health action. There are also protection principles and essential rules focused on the processes, which apply to all the technical chapters.

The minimum standards are based on experience and in each technical chapter, they represent a predominant consensus on best practices for disaster response. Each standard contains key actions, key indicators and guidance notes (1).

The minimum standards indicate the levels to be attained in any humanitarian response to ensure that people affected by a disaster can survive and recover stable living conditions, with the dignity required by their rights. The participation of the affected people is a determining factor for an adequate humanitarian response and Sphere provides guidelines for such participation. The Manual recognizes the importance of early recovery and refers to it on a continuous basis (1).

The Sphere Manual is a code of voluntary acceptance and a self-assessment tool that helps ensure Humanitarian Response quality and accountability. It is not necessary to be "signatory" of Sphere, or to be a member or to initiate an accreditation process (1).

2.4.1.2. Minimum standards for Education: preparation, response and recovery. INEE

The Minimum Standards for Education - INEE (Inter-Agency Network for Education in Emergencies) were first published in 2004 and updated in 2010. They are standards complementary to Sphere since 2008. They are the framework for ensuring the essential links among education and health, water, sanitation, hygiene, nutrition, housing and protection. They also aim to improve safety, quality and accountability of preparation and response in terms of education. At the global level, this tool established the minimum level of quality and access enforceable in terms of education in emergency situations until reconstruction. Each standard contains key actions, key indicators and guidance notes (2). Like Sphere, it is a voluntary code.

2.4.1.3. Livestock Emergency Guidelines and Standards - LEGS

They were published by the LEGS Project (Livestock Emergency Guidelines and Standards) in 2009 and they are a set of international guidelines and standards for the design, implementation and evaluation of livestock interventions in emergencies, in order to provide assistance to people affected by humanitarian crises. It takes into account the important role of livestock as a livelihood and the importance of livestock interventions in aid responses.

The current weather trends increase the frequency of humanitarian crises and diversify them, affecting the communities that greatly depend on livestock.

These guidelines, besides defining emergency responses, also include recovery and long-term

development processes (3) (1).

LEGS and the Sphere Manual are supplementary standards since May, 2011 and maintain their voluntary modality.

2.4.1.4. Minimum standards for economic recovery after a crisis

The minimum standards for the economic recovery after a crisis, developed by the Small Enterprise Education and Promotion- SEEP, propose strategies and interventions aimed at improving cash flow, asset management and growth in homes and businesses affected by a crisis (1).

They include strategies on financial services, productive assets, employment and business creation to promote businesses revitalization and strategies for livelihood generation, as well as the improvement of productivity and market regulation.

The SEEP standards do not address macroeconomic interventions as a means of economic recovery (4).

These standards and the Sphere Manual are complementary since May, 2011 and maintain their voluntary modality.

2.4.2. Situation in Ecuador

- From 2011 the Secretariat of Risk Management recognizes Sphere as the normative basis for humanitarian response in Ecuador.
- Ecuador has developed national instruments, complementary to the international ones, which allow fulfillment of the minimum Sphere standards (these instruments are related to the standardization of food rations, shelter equipment and non-food aid to people affected by disasters).
- Sphere started its consolidation in Ecuador from the second half of 2011, when it set the Ecuador work group, constituted by NGOs responsible for humanitarian response, IGOs, public institutions, and led by the National Secretariat of Risk Management.
- Ecuador has Sphere facilitators in public institutions, NGOs and IGOs.
- The INEE process is being consolidated in the Ministry of Education, as it is the leading institution in this field. Staff has been trained in the application of INEE standards. There are facilitators as well.
- The LEGS standards have not been disseminated and there is little knowledge about them. There are few people trained in the application of LEGS standards in the Ministry of Agriculture. The training process in South America is being consolidated.
- There is no clear information on livelihood recovery processes and economic recovery in the international context. No staff has been trained on SEEP in the country. Only a revision of the rules and guidelines has been performed.
- No national instruments have been developed besides INEE, LEGS or SEEP.

2.4.3. Recommendations

- The Secretariat of Risk Management should develop its knowledge and the application of different standards and guidelines of humanitarian response in institutions that are directly or indirectly involved in humanitarian issues.
- The Secretariat of Risk Management (SGR) must organize training on Sphere and the national complementary instruments to be used as key tools for response planning and preparation processes and damage assessment.
- The Ecuadorian Sphere work group requires strategic programming, an annual work plan and a system for monitoring the implementation of the supplementary standards (INEE, SEEP and LEGS).
- In the short term, it is necessary to build national tools complementary to INEE, LEGS and SEEP standards.
- To update the database of personnel trained in the different standards and norms, at both national and provincial level.

3. National context

3.1. Geographic aspects (1)

3.1.1. General Information

The territory of Ecuador, including its mainland and insular area, is located in the Western Hemisphere, in the northwest of South America. Mainland Ecuador is located between latitudes 01 ° 28' N approximately, at the mouth of Mataje river, at 05°02' S, in the inflow of San Francisco ravine; and between longitudes 75°11' W, confluence between Napo and Aguarico rivers, and 81°04' W, Isla de la Plata. The island territory, the Galapagos Islands, is located west side of the mainland at a 1000 km distance. Its capital is Quito, located in the Northern Andean region. The country has an area of 256 370 km²

The borders of Ecuador are:

- North: Colombia
- South and East: Peru
- West: Pacific Ocean

3.1.2. Orography (2)

The Andes is the main mountain range of the country, and divides it into regions, going through its entirety from North to South. The mountain range is divided into three clearly defined ranges (West, Central and Eastern). They are bound by a series of transverse knots that divide the Inter-Andean region in different valleys.

The Chongon-Colonche range is located parallel to the Coastal region. It goes from nearby Guayaquil toward Esmeraldas province. Its highest point reaches 1,070 m above sea level.

Napo-Galeras branch is significant in the Amazon region. It is part of the southeastern range, which is the third branch of the Andes. It goes from Pastaza River to the North, and its highest part reaches 1,500 m above sea level. It has some volcanoes; Sumaco is the main one.

The Llanganates massif is located in the easternmost region of the Eastern Range, which goes between the Mulatos and Guapante rivers, in the north; and Pastaza, in the South. Its highest peak is Cerro Hermoso or Llanganati Yurac summit, which reaches 4,571 meters above sea level.

There is also the Cutucu mountain range, which is part of the southeastern mountain range and goes from Pastaza to the river Santiago, with an average height of 2,500m above sea level. There, Upano Valley, of great fertility, is located. This is where settlers of this part of the Eastern region live.

Condor mountain range is located toward the southern end. It goes from Santiago river - in Zamora-Chinchipe province - up to the Eastern Range of the Peruvian Andes. Its average altitude is 3,000 meters above sea level.

3.1.3. Natural Regions (1)

As mentioned above, the Andes mountain range divides the country in three different regions: Coast, Highlands and Amazon. They have a high biodiversity, several types of climates and soils, uneven sunshine, winds with varied intensities and directions, a large number of landscapes and dissimilar rainfall patterns. There is also the Island region, with islands of volcanic origin. It has one of the most important world biological reserves.

3.1.3.1. Coastal Region (1)

It extends from the coastline to the western slope of the Andes Range at an approximate altitude of 1,200 meters above sea level. Its greatest width is 180 km and is located in the Guayaquil - Portoviejo latitudinal band; towards the south of Guayaquil the band is reduced to a small strip of 20 to 40 km.

The region has the following characteristics:

- a. Eastward a foothill zone characterized by homogeneous relief with slopes of less than 25%;
- b. Following the above, there is a low zone of 30 to 80 km wide, located in the Central-Eastern and Southern region. This is a great plain, with reliefs of flat to slightly undulating surfaces. In South Babahoyo, these undulated flatlands are replaced by a completely flat alluvial plain, with altitudes of less than 20m.
- c. An occidental zone with high and moderate reliefs.

This region is composed of the following ecosystems (3):

- Tropical rain forests, northeast
- Tropical savannas, Central and Southwestern
- Dry Forest, western and southern stretch
- Mangroves
- Beaches and cliffs

The average temperature is 22°; winter runs from December to May, and summer from June to December. This region receives the direct influence of warm and cold ocean currents that in turn have an impact on its climate and biodiversity (terrestrial and aquatic).

The following hydrographic basins have their origin in the western foothills of the Andes with watersheds in the Pacific Ocean: Chota, Esmeraldas, Guayas (with an area of approximately 40,000 km2), Cañar, Jubones and Macara.

3.1.3.2. Highland (Sierra) Region (1)

This region is also known as Interandean region. It is formed by two mountain ranges in southern direction and with very steep outer watersheds. The ranges are characterized by a general decline of altitudes and decreasing size and volume of the mountains from North to South. From the border with Colombia to Alausí, the mountain ranges have two rows of volcanoes: from Alausí to the South, the relief is rather low, with high plains and undulating surfaces.

The region occupies a strip 600 km long and 100-120 km wide with an average height of 4,000 meters above sea level. (3)

The mountain ranges are joined by minor ranges among which are the valleys, where populations have developed. The Azuay minor range divides mountain range in modern volcanism to the North and Ancient volcanism to the South.

In the Sierra region, the average temperature is 12°C to 18°C; winter lasts from October to May and summer from June to September. (3)

Due to weather conditions and volcanic activity, there is a special development of species; the tenth of the total area corresponds to moorlands and dry vegetation, which are located between 3,500 to 4,500 meters above sea level.

3.1.3.3. Amazon Region - East (1)

Located at the base of the eastern slope of the Andes Mountain Range, it covers an area of approximately 131,000 km2 (3). Its boundaries are the Andes Mountain Range to the west: Peru and Colombia are the limits on the north, south and east.

Between 500 m and 1,500 m above the sea level, there is a strip of approximately 50 km wide that is similar to a third ridge that starts from its northern boundary to the area of Puyo. To the east and below 300 meters above sea level we find the 'Amazonian plain' with elevations not higher than 50 meters.

This region is rich in water and lush vegetation; in fact the rivers with highest flow which are tributary of the Amazon River are located here and are part of its watershed; among the main ones are the Napo, Curaray, Pastaza, Tigre and Morona (3).

The main climate in the region is the equatorial, with an average temperature of 25°C and 90% relative humidity. The rainfall averages 2,500 mm per year, but in the foothills of the mountain range, these values can be doubled up making the 'Amazon' Andes among the rainiest places on earth.

In this area, there are about 3 million hectares (30,000 km2) of national parks and protected areas.

3.1.3.4. Insular Region - Galapagos (1)

The region is formed by 13 bigger islands and many smaller ones and islets (over 70), which are located between 900 and 1200 km from the mainland. They have an area of approximately 8,010 km2 and its origin is volcanic; Volcanism on the islands is very active, in fact there are frequent eruptions that shape the topography of the zone (3).

There are no major water bodies in the region; there are small ponds, springs and groundwater.

Its weather condition and ocean currents favor unique evolutionary events that have marked and have been the basis of evolutionary theories. Therefore Galapagos is considered a World Heritage Site.

97% of the territory is part of the Galapagos National Park and 3% is managed by the municipalities of Isabela, Santa Cruz and San Cristobal

3.1.4. Hydrography (6)

The country has an extensive hydrographical network in almost the entire territory, except in the arid western and southern areas of the Coast.

Almost all of the rivers originate in the high Andean regions and then head to the Amazon basin or to the Pacific Ocean; because of the proximity of the mountainous region to the coastline, rivers discharging into the Pacific Ocean have a brief but fast flow and they are navigable in some sections.

3.1.4.1. Catchment basins of the Pacific watershed

The main catchment basins of this watershed are (6):

- **a. Chota:** begins in the Olivo Mountain, between Imbabura and Carchi, and flows into the Colombian Pacific with the name of Mira.
- **b. Esmeraldas:** runs in the Province of the same name. It is formed by three big tributary systems: the Guayllabamba, the Blanco and the Quinindé; in its lower course it receives the contribution of the Teaone and Viche rivers.
- **c. Guayas:** It flows into the Gulf of Guayaquil and receives contribution of the Daule and Babahoyo Rivers. The Daule, with its tributaries, runs through Manabí, Los Rios and Guayas provinces. The Babahoyo, is formed by the Yaguachi river, which in turn is formed by the confluence of the Chimborazo and Chanchán rivers that cross the Chimborazo, Guayas and Los Rios Provinces. Guayas Basin is the most important of all.
- **d. Cañar:** It begins in the Culebrillas lagoon with the name of San Antonio and flows into the Gulf of Guayaquil. It runs through Cañar and Guayas provinces.
- e. Jubones: It is formed by the rivers Leon, Girón, Rircay and San Francisco that begins in the foothills of the Portete – Tinajillas small range. It runs through Azuay and El Oro provinces.
- f. Macará: At the beginning it is called Espíndola, in the Sabanilla small range. When it passes through Loja it is called Calvas, and at the end it is called Macará. It flows into the Catamayo and arrives in the Peruvian Pacific with the name of Chira River.

3.1.4.2. Catchment basins of the Amazon watershed

This watershed is formed by the contribution of many Ecuadorian rivers that begin in the Eastern Range of the Andes (Cordillera Real) and in the Amazon Range (Tercera Cordillera). They are fast flowing rivers that are navigable in the middle and lower parts of their basins. Major basins are (6):

- **a. Putumayo:** it mostly belongs to Colombian territory, but the Ecuadorian river San Miguel flows into it. The Putumayo flows into the Amazon.
- **b.** Napo: It is formed by rivers from Tungurahua and Cotopaxi provinces; while flowing it receives the Coca, Aguarico and Curaray rivers; when flowing into the Marañon it forms the Amazon.
- **c. Tigre:** It is formed by the Conambo and Pituyacu rivers, in Pastaza Province. It flows into the Marañón River.
- **d. Pastaza:** It begins in Tungurahua province as Cutuchi and Patate rivers flow into the Chambo river of Chimborazo Province and then the Palora and Guasago flows into it. The Pastaza flows into the Marañón.
- e. Santiago: It is formed by the Namangoza and Zamora rivers. The Namangoza is formed by the Paute and Upano rivers. The Zamora is formed by the Nangaritza and Yacuambí rivers. The Santiago flows into the Marañón.

Ecuador has 79 catchment basins, 72 in the Amazon watershed and 7 in the Pacific watershed (5). On basis of the total area (256.370 Km2) the following coverage of the catchment basin has been estimated:

- Area of the catchment basin of the Amazon watershed, 131.726 Km2 (51.38%)
- Area of the catchment basin of the Pacific Watershed 123.216 Km2 (48.06%)
- Insular areas near the Coast 1.428 Km2 (0.56%)

3.1.5. Climate (6)

Due to its geographical position, ocean currents and the presence of the Andes Mountain Range, there is a great variety and considerable changes of climates over very short distances, from warm to extremely cold ones.

Certain areas of Ecuador receive the alternative influence of air masses with different characteristics of temperature and humidity as they are located within the area of low atmospheric pressure, where the Intertropical Convergence Zone (ITCZ) (INAMHI, 2011) is located.

The change of season has two periods:

- Rainy, from December to June known as 'winter' or rainy season.
- 'Summer' or dry season, with less rain from June to December.

Variations in temperature between these two periods are not noticeable in the Coastal and Amazon regions, but in the Highlands, drastic changes and micro climates can be observed in some areas.

The Coast is influenced by humid equatorial air masses in winter and subtropical, warm and dry masses from the Pacific in summer. The warm waters of the West equatorial countercurrent contribute to the increase of precipitation in the northern part of the coast. The cold waters of the Humboldt current travel away from the shoreline line near Manabí and turn to the Galapagos Islands.

The average temperature of the Coastal region ranges between 28°C (winter) and 25°C (summer). The summer heat is mitigated by the wind from the sea, which is cold and dry called 'Chanduy wind'. Generally, rainfall decreases from north to south. The basins of the Santiago and Esmeraldas rivers, and much of the Guayas Basin belong to a sector of constant precipitation, while in Santa Elena Province there is a maximum annual rainfall of 500 mm; similarly, the upper zone in El Oro province has been affected by drought in several instances.

The Highland region has diverse climate, not only in terms of altitude, but also because of the orientation of the Andes Mountain Range with respect to the movement of air masses. The lower parts of the outer flanks of the western and eastern mountain ranges have temperatures that in average do not drop below 20°C, and the average rainfall in different areas is 1,500 mm to 5,000 mm over a year.



Climates zones according to the Geographical Atlas of the Republic of Ecuador

3.1.6. Precipitation (7)

The rain or precipitation conditions of Ecuador are influenced by the Intertropical Convergence Zone, the Pressure Nuclei located in the Pacific and the North Atlantic oceans, the Amazon disturbances, the South river bed, as well as the behavior of ENOS and the cold Humboldt Current.

All Ecuador is located within an equatorial belt characterized by low atmospheric pressures, high humidity and high temperatures The air masses coming from the two hemispheres clash and generate an intertropical front, a zone of instability with atmospheric disturbances because one mass tries to prevail over the other. (8).

INAMHI -following the World Meteorological Organization (WMO) guidelines, which stipulate that a climatological series shall be taken every 30 years to establish normal weather conditions prevailing in an area - used series 1971- 2000 to develop the series, and maps.

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The precipitation map (isohyetal lines) of the climatological average provides information on the space and quantitative distribution of the annual precipitation at national level. The annual and monthly maps have been attached here.

According to the Climates of Ecuador study (9), rainy periods remain, with some exceptions, along the Coast and the Andean Region. On the Coast, rainfall generally is stronger in December-May, while intensity is lower in the remaining months. In the Highlands, there are generally two rainy periods, with peaks in April and October, and a dry period between June and September, when rainfall is scarce or non-existent.

The Amazon Region is influenced by disturbances coming from the Amazon basin, which causes great atmospheric instability and permanent precipitations that determine a prevailing humid water regime, which differentiates it from the previous regions (9).

The winter in the Inter-Andean region begins in the northern part of the country in September and continues in October, ending in northern and central areas of the region. Between the Center and the Center-south regions there is an important nucleus, where winter begins in February and March, while it starts in October in the southern area.

In the Coast region, the winter occurs in December in the internal part and in January in the coastline. Between Manta and Playas and a surrounding area there is little rainfall throughout the year.

There are isolated nuclei in the Highlands and the Coast, where rainfall is abundant. The Amazon region has abundant precipitation throughout the year and the starting month cannot be determined.

Some areas of Guayas, Manabí, Cotopaxi, Pichincha, Imbabura and Carchi have an annual rainfall ranging from 1,230 millimeters per year. The Amazon region has up to 5,420 millimeters per year.

3.1.7. Political Division (1)

According to the National Institute of Statistics and Census (INEC) - which has to issue periodical updates on territorial division - in Ecuador there are 24 provinces, 2 metropolitan districts, 221 cantons, 405 urban parishes and 778 rural parishes. The provinces are distributed as follows:

- **Coastal Region:** 7 provinces (Esmeraldas, Santo Domingo de los Tsáchilas, Manabí, Guayas, Los Ríos, Santa Elena and El Oro).
- **Highland Region:** 10 provinces (Carchi, Imbabura, Pichincha, Cotopaxi, Tungurahua, Bolívar, Chimborazo, Cañar, Azuay and Loja).).
- Amazon Region: 6 provinces (Sucumbíos, Francisco de Orellana, Napo, Pastaza, Morona Santiago and Zamora Chinchipe).
- Island Region: 1 province (Galápagos).

3.1.8. Communication Channels (4) (1)

The road network of the country has 43,200 km of roads, according to 2001 data. The core network has 9,485 km (5,600 km of primary roads and 3,885 km of secondary roads); rural roads have approximately 22,000 km. Depending on their type of surface, 13% are paved, 59% are unpaved roads and 28% are dirt or improved roads. The road network in the eastern provinces has grown significantly and it is complemented by the river network.

Part of the ground network also has the railway network, which has 2,500 km. It connects the Coast and the Highlands and it is used mainly for tourism purposes (there are sections unused and/or in recovery).

The port system has seven state ports, private terminals and fishing ports. From the major ports, three include oil ports (Balao, La Libertad and Salitral) and four general loading ports (Guayaquil, Puerto Bolívar, Esmeraldas and Manta). Manta port is the largest tuna unloading port in the world.

There are two international airports. Latacunga airport is now an international loading and logistics airport. There are also several domestic airports and runways. 33.6% of passenger flow is with the United States, 23% with Colombia, 12% with Spain, 9% with Panama and Peru together.

The Manta-Manaos project is a binational proposal (Ecuador - Brazil), with multimodal features. The transportation system includes road and rail networks, ports and airports. Its purpose is to save time in product transportation compared to the current path by Panama.

3.1.9. Environment (1)

The geography features and the exposure to weather factors give the country a great variety of climates, soils, biodiversity, landscapes, etc. This fact has not been fully understood or used. Only in the last few years, it has been acknowledged that there is a need to protect our environment not only as an asset of the country but also of the entire world.

It is important to link environmental management with Disaster Risk Management, to identify their linking points and define the interrelated factors that can affect the population. So it is necessary to describe the environmental features of Ecuador.

According to the Atlas of Ecuador (1), biodiversity is recognized as one of the main resources of the country. For its protection, three strategic objectives have been established:

- 1. To protect biological diversity
- 2. To sustainably use biological resources
- 3. To ensure fair and equitable sharing of benefits from the use of genetic resources

The variety of flora, fauna species and ecosystems

are factors that make the country biologically rich. By relating this wealth to the territorial extension, it has been established that Ecuador is the country with the highest mega diversity per km2 in the world.

Some data related to that biological wealth are: 18% of the territory is considered as a protected area. Three of the ten 'hot spots' of the world are in the country (areas of the planet where there is a great number of endemic species unique to that area and whose natural habitat is under anthropogenic pressures). There are 11 of the 121 most important world areas for bird preservation. 10.7% of all vertebrate animals of the planet are in Ecuador, among other indicators (1).

Until 2001 (1), natural areas represented 56% of the surface, 29% of intervened areas (agriculture, human settlements and roads) and 15% of other territories. From 2001, 90% of the Andean vegetation has undergone changes and alterations: 70% of rainforest, 13% of Amazon forest, 25% of moors, and between 40% and 50% of mangroves and wetlands. These changes have been caused by droughts, floods, volcanic eruptions, water collection, expansion of agricultural areas and urbanization.

Pollution at local level varies depending on the area (1), but the following activities are identified as causing pollution:

- 1. Cars. Pollution produced by cars is high, especially in urban areas. Measures to restrict movement and mechanical control have even been taken in some cities.
- 2. Industries. Some of the most polluting activities take place in industrial hubs, generally located in the outskirts of cities. Sometimes polluting wastes have been disposed with no control or treatment and/or illegally. This situation is aggravated when industrial zones are absorbed by urban growth, so their polluting processes affect a greater number of people.
- **3.** Hospitals. Hospital waste, including infectious waste, classified as bio hazardous and toxic. In most areas, they are treated as common waste and even disposed through sewage systems.
- 4. Agriculture. The uncontrolled use of pesticides, fertilizers and fungicides, as well as their quality and composition, contaminate and affect people's health, especially in areas with intensive production.
- 5. Fishery and Aquaculture. Especially in major industrial fishing ports such as Manta, waste processing does not have a final treatment. The chemicals used in shrimp farms can affect the environment and people's health.
- 6. Oil and oil products. Whether it is due to exploitation, faults in transportation systems, industrial accidents or direct intervention of people, the oil industry can be a threat to ecosystems and populations. Pipelines go through sensitive environmental areas and villages. The pipeline

network goes through large urban centers such as Quito, Latacunga and Ambato. The lack of planning and control has allowed human settlements with no compliance with the safety standards related to these systems. Oil exploitation has produced environmental liabilities in Santa Elena peninsula and in the Amazon.

- 7. Mining. Non-technical and artisanal exploitation has caused contamination of soils and rivers, seriously impacting on the productivity and health of people. Some ecosystems are severely affected and have irreversible damage.
- 8. Deforestation. Deforestation is related to contamination processes due to slash and burn to change land use. Soil degradation due to water erosion and residues also produce contamination.
- **9.** Solid Waste. There is deficiency in waste handling and disposal process. 80% of the waste generated is stored in open spaces, frequently including hazardous waste. 60% of the garbage goes to dumps, 17% to controlled landfills, 20% to sanitary landfills and 3% to other destinations such as rivers.
- **10. Technology.** The expansion of technology has caused increasing associated waste, which is frequently highly toxic and of complex handling; for example batteries and accumulators. Another aspect is radioactive energy sources used on multiple devices, particularly for medical and hospital work.

Environmental pollution is a factor of vulnerability for the population. Therefore, air pollution, especially in large cities, affects people's health and causes greater susceptibility to diseases. This is also a factor for microclimates creation, which are associated with heavy rainfall in small areas. This can produce landslides and floods, such as those occurred in Quito, in 2011.

Water pollution is another vulnerability factor almost entirely associated to health, but it is also related to livelihood. Under this perspective, the populations exposed to contaminated water will be more vulnerable than those that are not. This is a national problem in Ecuador. There are very few cities that treat their waste water before sending it to rivers. Pollution is also caused by the excessive use of pesticides and fertilizers, soil erosion, garbage and industrial disposal. Soil contamination is mainly caused by the transformation of soils for agriculture, urbanization, landfills and construction. This type of pollution increases the vulnerability of people's health and their livelihoods.

The Ecuadorian legislation related to contamination is not fully implemented and its monitoring and control mechanisms are being created. Most Autonomous Decentralized Governments still do not prioritize these actions in their planning.

3.2. Population and Society

According to the Population and Housing Census 2010 INEC(2) (3), there are 14,483,499 inhabitants in a 256,370 km2 in Ecuador. This establishes a population density of 56.5 inhabitants per km2, being the country's most densely populated in South America (Ecuador accounts for 3.5% of the South American population and it covers 1.4% of its surface). The Ecuadorian population is only 2 thousandths of the world population). Based on ECLAC data, there will be over 15 million inhabitants in the country by 2020.

Analyzing the VII Population and VI Housing Census 2010 data, the basic structure of the Ecuadorian population is the following³:

Age Groups	Nationwide	%	Male	Female	
Under 1 year	259.957	1,79%	132.183	127.774	31,27%
1 to 4 years	1.202.320	8,30%	612.122	590.198	
5 to 9 years	1.526.806	10,54%	773.890	752.916	
10 to 14 years	1.539.342	10,63%	782.977	756.365	
15 to 19 years	1.419.537	9,80%	713.548	705.989	62,24%
20 to 24 years	1.292.126	8,92%	639.140	652.986	
25 to 29 years	1.200.564	8,29%	586.950	613.614	
30 to 34 years	1.067.289	7,37%	520.891	546.398	
35 to 39 years	938.726	6,48%	456.202	482.524	
40 to 44 years	819.002	5,65%	399.230	419.772	
45 to 49 years	750.141	5,18%	366.448	383.693	
50 to 54 years	610.132	4,21%	298.728	311.404	
55 to 59 years	515.893	3,56%	253.106	262.787	
60 to 64 years	400.759	2,77%	196.414	204.345	
65 to 69 Years	323.817	2,24%	156.804	167.013	6,50%
70 to 74 Years	240.091	1,66%	116.203	123.888	
75 to 79 Years	165.218	1,14%	78.602	86.616	
80 to 84 Years	115.552	0,80%	53.157	62.395	
85 to 89 Years	60.735	0,42%	26.734	34.001	
90 to 94 Years	25.500	0,18%	10.523	14.977	
95 to 99 Years	8.039	0,06%	3.133	4.906	
100 Years and over	1.953	0,01%	698	1.255	
Total	14.483.499	100%	7.177.683	7.305.816	

Estructura de la población ecuatoriana Según grupos de edad y género

Source: INEC - Population and Housing Census 2010

Based on the table shown above, the pyramidal graph below shows a prevailing role of the young population. It diminishes in its base (under 5 years). Meaning that, in the long run, the Ecuadorian population will be mostly adult and increasing to elderly people. This will have a direct impact in the Social Security System, as well as in Care Services.

³ It is necessary to know the demographic structure of the world for its comparison with the national structure. The world (1) population is rather young, and 28% of the total is under 15 years, about 66% is between15 and 64 years and 7% of its population is over 65 years.

Population Pyramid



Source: INEC Census 2010

The population group between 0 and 15 years old is a highly vulnerable group during disasters. Therefore, to reduce their risk some strategies are required. This group is structured as follows:

Children between 0 and 15 years old in the



Source: INEC Census 2010

Children between 0 and 15 years old grouped by provinces.



Source: INEC Census 2010

According to INEC data, the group area distribution is the following:



The population over 61 years old is also highly vulnerable, requiring specialized care, skilled programs and mechanisms for reducing their vulnerability and exposure. In Ecuador, 1'246.231 people belong to this group and it is distributed as follows:
14.483.499

6.449.355

2.576.287

448.966

712.127

458.581

409.205

398.244

225.184

164.524

183.641

504.583

368.013

3.645.483

308.693

1.369.780

534.092

778.115

600.659

739.814

83.933

147.940

136.396 91.376

176.472

103.697

25.124

32.384



The following table shows a detailed population distribution by regions and provinces. Guayas is the most populous province in the country, together with Pichincha, they both account for 43% of the national population. The former are escorted by Manabí, Los Rios, Azuay, El Oro, Esmeraldas, Tungurahua, Chimborazo and Loja, included among the most populous provinces in the country.

The Coastal region concentrates 49.97% of the population, followed by the Highland (Sierra) region (44.53%), Amazon (5.11%), Insular Areas (017%) and the remaining 0.22% is represented by undetermined areas.

Population group over 61 years old



Country population By region, province, area and gender

Regions and	Se			Ar	
Provinces	Male	Female	ι	Jrban	Rural
Country	7.177.683	7.305.816	9.0	082.869	5.400.6
Highland region	3.129.345	3.320.010	3.	614.585	2.834.7
Pichincha	1.255.711	1.320.576	1.	761.867	814.4
Loja	220.794	228.172		249.171	199.7
Azuay	337.044	375.083	;	380.445	331.6
Chimborazo	219.401	239.180		187.119	271.4
Cotopaxi	198.625	210.580		120.970	288.2
Imbabura	193.664	204.580	:	209.780	188.4
Cañar	105.235	119.949		94.525	130.6
Carchi	81.155	83.369		82.495	82.0
Bolívar	89.875	93.766		51.792	131.8
Tungurahua	244.783	259.800	:	205.546	299.0
Santo Domingo	183.058	184.955		270.875	97.1
Coastal Region	3.635.848	3.600.974	5		2.068.7
Guayas	1.815.914	1.829.569	3.0	080.055	565.4
Santa Elena	156.862	151.831		170.342	138.3
Manabí	689.299	680.481		772.355	597.4
Esmeraldas	271.312	262.780	2	265.090	269.0
Los Ríos	398.099	380.016		415.842	362.2
El Oro	304.362	296.297		464.429	136.2
Amazon	382.313	357.501		287.150	452.6
Pastaza	42.260	41.673		36.927	47.0
Morona Santiago	74.849	73.091		49.659	98.2
Orellana	72.130	64.266		55.928	80.4
Zamora Chinchipe	47.452	43.924		36.163	55.2
Sucumbíos	92.848	83.624		73.040	103.4
Napo	52.774	50.923		35.433	68.2
Insular Region	13.021	12.103		13.021	12.1
Galápagos	13.021	12.103		20.738	4.3
Unfenced Areas	17.156	15.228		0	32.3

Additional data for the chart above: Guayaquil (2.65 millions) and Quito (2.24 millions) are the most populous cities in Ecuador. The population percentage distribution by province is:





Source: INEC Census 2010

The population percentage distribution by region places the Coastal region as the most populous in Ecuador as it is shown in the following graph.



Source: INEC Census 2010

62.71% of the population lives in urban areas increasing the demand for services and decreasing the supply of agricultural products. Not having the skills to meet the demands will have several impacts including: an increase in the disaster vulnerable population, growth of the city outskirts which are not suitably serviced, and a rise of poverty in the cities.



Source: INEC Census 2010

The Ecuadorian population average age is 28.4 years. It is a young and productive age.

79.7% of the population has citizens I.D. according to data from the 2010 Census (and the highest percentage who lacks I.D. ranges between 0-9 years). Elderly retirees account for 12.5%. And there is a downward trend in the average number of children born to Ecuadorian women compared to previous censuses.

It is interesting the way the different ethnic groups⁴ selfidentified themselves in the last census. It is evidenced in the collected answers shown in the following graph.

Ethnic groups in the country



Source: INEC Census 2010

⁴ Ethnicity consists of specific and particular ways of social organization, customs, norms, behavior and interaction values. Other elements to be considered are cultural backgrounds such as language, clothing, and territory, among others. That is, any traditional elements which characterize and tell regions and peoples apart. (INEC)

The graph below summarizes population density, housing, children-women ratio, illiteracy and average age by regions and provinces.

Ecuador Population Characteristics by Region and Province

Regions and Provinces	Population Density	Housing (individual and collective)	Children- Women Ratio*	Illiteracy **	Average Age
Country	56,45	4.654.054	384,30	6,8%	28
		Highland Re	egion		
Pichincha	270,17	873.228	326,3	3,6%	29
Loja	40,58	155.308	396,7	5,8%	29
Azuay	88,70	273.186	352,8	6,7%	29
Chimborazo	70,55	171.520	385,6	13,5%	29
Cotopaxi	66,99	142.766	407,2	13,6%	28
Imbabura	86,81	122.827	379,6	10,6%	29
Cañar	71,58	88.431	386,5	12,2%	29
Carchi	43,52	51.978	362,6	6,2%	30
Bolívar	46,55	65.237	423,6	13,9%	29
Tungurahua	149,01	184.424	331,3	7,5%	30
Santo Domingo	106,77	114.198	413,0	6,3%	27
		Coastal Re	gion		
Guayas	232,09	1.077.883	369,5	5,0%	29
Santa Elena	83,65	101.893	473,1	5,2%	27
Manabí	72,32	400.879	403,0	10,2%	28
Esmeraldas	33,11	159.411	495,6	9,8%	26
Los Ríos	107,99	232.466	430,9	9,3%	28
El Oro	104,14	193.809	355,7	4,1%	29
		Amazor	ı		
Pastaza	2,83	25.864	518,0	6,9%	25
Morona					
Santiago	6,15	46.042	654,6	6,6%	23
Orellana	6,29	41.040	581,5	6,5%	24
Zamora	0.60	20 126	5201	E E0/	05
Sucumbias	0,00	52 704	404.4	6,8%	25
Napo	9,70	28.076	545 1	6.3%	23
ιναμυ	0,21		J4J,I	0,0 %	24
Galánagos	3.05	9 110	305.8	1 3%	20
Jaiapayus	0,00	3.113	000,0	1,070	23
Unfenced Areas	41,35	9.649	500,2	12,0%	26

* Children under 5 years per thousand reproductive-age women (15 to 49)

** 15-year-old people (and over) who cannot read or write (illiterate)

Source: INEC: Population and Housing Census 2010

There are 3 '810,548 houses in the country. 2 '439,362 houses are located in the urban areas, while the remaining 1.371,186 in rural ones. The average is 3.8 people and 1.02 families (no more than one family) per house. 71.3% of the houses are headed by men, while 28.7% by women. We can observe a detailed house-people ratio in the graph below:

House-people ratio in Ecuadorian houses



Source: INEC Census 2010

3-4 people is the house-person ratio average in most of the houses nationwide, contrasting the 4-6 in previous decades. The amount of family members and amount of houses in the most populous cities around the country can be observed in the following graph.

Average members	3,8	3,4	3,7	3,8	3,7
	Guayaquil	Quito	Cuenca	Santo Domingo	Machala
Amount of houses	598.858	471.717	89.613	79.429	64.851

Type of ownership is an important condition to consider, according to these four aspects:

- Private
- Rented
- Inherited
- · Granted by services

Distribution of the 4.654.054 houses according to the aspects mentioned above:

Type of house ownership



Source: INEC

Types of property and population vulnerability are closely interwoven. The housing distribution according to its type is shown in the graph below.

Type of property	%
House	70,56%
Apartment	11,68%
Ranch/Farm	5,28%
Hut	5,26%
Room rented in a house	4,66%
Hovel	1,22%
Thatched hut	0,88%
Others	0,47%

Source: Census 2010

House room usage and running water accessibility are two other key elements together with the type of house ownership and type of housing to be considered.

House room usage According to the areas

	Urban	Rural	Country
Exclusive use of room for cooking (kitchen)	82,80%	80,20%	81,90%
Exclusive use of room for bathing (Bathroom)	71,80%	39,30%	60,10%
Exclusive use of room for sleeping (bedroom)	94,30%	93,10%	93,90%
Water is purified	75,50%	50,60%	66,50%
Exclusive use for sanitary services (toilet)	86,40%	73,50%	81,80%

Source: Census 2010

The access to basic services also determines the population vulnerability. Water supply and waste disposal are two of the basic services less accessible in the rural areas. For clarification, the water quality values are not taken into account when referring to house water access.

Basic service coverage

	Urban	Rural	Country
House water supply	86,8%	45,9%	72,0%
House Electricity	96,1%	88,0%	93,2%
House Sewage disposal	71,0%	22,9%	53,6%
House Garbage collection	95,2%	44,9%	77,0%
House Telephone lines			33,4%

Source: INEC Census 2010

Referring to the interconnection type and communication media access of the population (2) (3), 85% of the population receives television signal. 76.3% of the population has access to cell phone services whereas 33.4% has fixed telephony services. Moreover, internet access is merely a 13% nationwide and only 26.3% owns a computer. As interesting information, 17.6% pay for some variant of cable TV services.

We can break down the information above into urban and rural services (2) (3). Only 1% of the rural population has internet connection as compared to the 16.7% in the urban areas. 85.8% has access to cell phone services in urban areas while its equivalent in the rural ones is limited to 68%. Fixed telephony services are mostly available in the urban regions, reaching a 50.4% which is highly contrasting to 13.2% in the remaining areas. Having a computer is also a contradictory aspect in both areas: 35.9% of the devices are found in urban areas as opposed to 8% in the rural ones.

Cell phones and internet users are grouped by age in the graphs below.

Internet users by age % related to age-group census 2010

	% (users)	Age range
	33,0%	5 a 15
higher internet	54,8%	16 a 24
usage	36,5%	25 a 34
	21,2%	35 a 44
	16,4%	45 a 54
	13,1%	55 a 64
	5,0%	65 a 74
	0,5%	75 o más

Cell phone users by age % related to age-group census 2010

	% (users)	Age range
	9,0%	5 a 15
	56,3%	16 a 24
higher cell	68,2%	25 a 34
phone usage	62,5%	35 a 44
	57,9%	45 a 54
	44,9%	55 a 64
	29,0%	65 a 74
	11,0%	75 o más

There are 25.129 regular educational centers based on Ministry of Education data. It is broken down by provinces in the graph below.

Provinces	Total	Provinces	Total
Azuay	1.035	Manabí	3.747
Bolívar	658	Morona Santiago	742
Cañar	462	Napo	368
Carchi	347	Orellana	491
Chimborazo	1.111	Pastaza	408

Cotopaxi	796	Pichincha	2.463
El Oro	770	Santa Elena	301
Esmeraldas	1.394	Santo Domingo	562
Galápagos	26	Sucumbios	636
Guayas	4.345	Tungurahua	569
Imbabura	591	Zamora Chinchipe	413
Loja	1.408	Zonas no delimitadas	91
Los Ríos	1.395	Total (nationwide)	25.129

Source: Ministry of Education

These educational centers can be regrouped according to their administrative and financial sources.

Education centers, according to their source of funding - Nationwide



Source: Ministry of Education

As complementary information, find below the number of teachers who currently develop activities in different places and according to different financial sources.

Nationwide teachers grouped by source of school funding.



Source: Ministry of Education

Most of the students can be found in the Coastal Region as shown in the graph below, which is divided by provinces.

Provinces	Total	Provinces	Total
Azuay	199.656	Manabí	398.462
Bolívar	56.251	Morona Santiago	55.891
Cañar	67.893	Napo	39.205
Carchi	44.061	Orellana	45.869

Provinces	Total	Provinces	Total
Chimborazo	128.087	Pastaza	32.520
Cotopaxi	117.195	Pichincha	686.853
El Oro	173.020	Santa Elena	83.972
Esmeraldas	195.811	Santo Domingo	111.706
Galápagos	6.900	Sucumbios	56.897
Guayas	990.422	Tungurahua	128.602
Imbabura	116.160	Zamora Chinchipe	32.567
Loja	128.654	Zonas no delimitadas	8.932
Los Ríos	232.075	Total	4.137.661

Source: Ministry of Education

With the aim of understanding the teachers' workload, the student-teacher ratio was analyzed based on the source of funding of the educational centers. The ratio for public, church-state, and municipal schools is 19-20 students per teacher whereas for private schools it is 14 students per teacher.

Schooling net rate is another aspect to consider. It is defined as the quotient between the number of people attending school at each level for the relevant school age. See the graph below based on this definition:



Schooling net rate Percentage

Source: Ministry of Education

The quotient between the population of a given age group attending an educational establishment and the population of that age group is known as attendance rate.In the case of the country, this rate has the following data:



School attendance rate by age

The illiteracy rate of the population over 15 years of age is 6.8%. Its gender distribution is graphed below.

Illiteracy by gender



Source: Ministry of Education

Bolivar 13.8%, Cotopaxi 13.6% and Chimborazo 13.5% are the cities facing the highest illiteracy rate nationwide. El Oro 4.1%, Pichincha 3.6% and Galapagos 1.3% have the lowest illiteracy rate in the country.

The next graph is based on a survey about "reasons to drop out of school" in students under 18 years from 2006 to 2010.

	dec-06	dec-10	
Financial resources	51,20%	40,90%	DECREASED
Work	14,90%	18,90%	INCREASED
Lack of interest	8,80%	12,50%	INCREASED
Sickness/handicapped	5,00%	7,70%	INCREASED
Housework	5,20%	7,30%	INCREASED
School failure	2,40%	3,40%	INCREASED
Lack of space at school	4,40%	3,30%	DECREASED
Pregnancy	0,70%	1,70%	INCREASED
Concluded their studies	1,50%	1,30%	DECREASED
Not allowed by the family	1,30%	1,00%	DECREASED
Others	4,60%	2,00%	DECREASED

Source: Ministry of Education

Although the lack of financial resources has decreased as a percentage from 2006 to 2010, it is still the main reason not to attend school. However, the increase in Housework, School failure and lack of interest are aspects to ponder. The main reasons to migrate are:



Aiming for a higher income is the main reason for emmigration. But this has a negative impact on the family structure and coexistence. This is a high risk factor impinging directly on disaster vulnerability.

The graph below indicates the percentage of emmigrated population as a percentage of the province's total population. The figures correspond to the province of origin and only those provinces with the highest emmigration percentages for 2010 are shown in the graph.

Main emmigrating population in Ecuador By province of origin

	% of migration By province
Cañar	5,97%
Azuay	3,86%
Pichincha	2,44%
Loja	2,42%
Morona Santiago	2,31%
Zamora Chinchipe	2,29%
El Oro	2,25%
Guayas	1,97%

3.2.1. Population projections (1)

It is of paramount importance to become acquainted with population data. It is the key for medium-term planning and programming. Therefore, the population indicators and information provided by ECLAC and CELADE for the five-year term (2010-2015) are included here.

Ecuador, Latin America and the Caribbean. Estimated rate for the five-year term 2010-2015

	2010 - 2015		
	Ecuador	Latin America and the Caribbean	
Infant mortality rate per thousand live births	17,6	18,6	
Gross Mortality rate per thousand inhabitants	5,4	6,0	
Global Fertility rate (children- women ratio)	2,4	2,1	

Gross Birth rate per thousand inhabitants	19,3	17,3
Life expectancyat birth (average years)	75,8	74,6
Annual growth rate per hundred inhabitants	1,1	1,0

Source: ECLAC/CELADE

The demographic growth indicators for Ecuador for the two five-year terms (2010-2015 and 2016-2020) provided by ECLAC/CELADE are shown in the tables below.

	2010/2015	2015/2020
Annual births	273	269
% of births to mothers aged 15-19 years	19,9	20
Gross Birth rate (per thousand)	19,3	18
Global Fertility rate	2,38	2,22
Average Fertility age	27,12	26,94

Mortality

	2010/2015	2015/2020
Annual deaths (in thousands)	76	84
% of deaths by	age	
0 to 14 years	10,1	7,6
15 to 64	37,5	35,8
65 and over	52,4	56,6
Gross Mortality rate (in thousands)	5,4	5,6

Life expectancy at birth			
Male and female 75,8 76,5			
Male	72,9	73,6	
Female	78,8	79,5	
IMR (infant mortality rate)	17,6	14,0	

Natural Growth

	2010/2015	2015/2020
Annual growth (in thousand people)	197	185
Natural growth rate (in thousands)	13,9	12,4

Migration

	2010/2015	2015/2020
Annual migration (in thousand people)	-42	-25
Migration rate (in thousands)	-3,0	-1,7

Total Growth

	2010/2015	2015/2020
Annual growth (in thousand people)	155	160
Migration rate (in thousands)	11,0	10,7

Based on a similar analysis, the population structure indicators by gender and age for the two five-year terms 2010-2010/2015-2020 according to ECLAC/ CELADE are:

Demographic indicators	2010/2015	2015/2020
% of the popula	% of the population	
0-14 years	28,2	26,1
15-64 years	64,3	65,1
65 and over	7,5	8,8
Dependency relation (in hundreds)	55,6	53,5
Population average age	27,1	28,7
Masculinity rate (in hundreds) ⁵	100,0	99,7
Aging rate (in hundreds) ⁶	26,7	33,6
Children-women ratio(in hundreds)	35,5	33,3
Percentage of women in their fertile years	51,8	51,7

3.3. Population and Economical Aspects

This is the evolution of poverty as a percentage for the Ecuadorian population according to data provided by INEC.



For December of 2011, the poverty line was at \$ 72.87 per month per capita, 28.6% of the population was under the poverty line.

Based on the results provided by INEC, households were divided up according to consumption and economic characteristics: 9.444 urban households in Quito, Guayaquil, Cuenca, Machala and Ambato were included in a survey carried out in December 2010. The households were divided into five strata, being 'A' the highest score and 'D' the lowest score. Out of a total 1000 points, 236 belong to housing characteristics, 171 to education, 170 to economic characteristics, 163 to goods, 161 to IT and communication, 99 to consumer habits. Stratification:

- A / High: from 845 to 1000
- B / Upper midle: from 696 to 845
- C+/ Middle: from 535 to 696
- C- / Lower middle: form 316 to 535
- D / Low: from 0 to 316

Distribution after the first poll:



The research was carried out in five cities. According to the strata, the average income in the investigated households is the following:

- Stratum A: \$2.685 average income
- Stratum B: \$1.602 average income
- Stratum C+: \$924 average income
- Stratum C-: \$528 average income
- Stratum D: \$298 average income

The average income consists of: incomes earned by occupation, bonds, stocks, investments, grants, leases, pensions, gifts, housing bonds, and bonds of human development (social assistance from the government), lotteries and remittances.

The characteristics of each level are detailed in the following table.

⁴⁶

⁵ Indicates the man-woman ratio percentage in a specific territory.
6 Indicates the ratio between the number of elderly people and the number of children and youngsters.

Stratum	Housing characteristic
A 1,9%	 Predominant materials of the floor: plank, parquet, floating boards Average: at least two private bathrooms with shower
B 11,2%	 Predominant materials of the floor in 46% of the houses: plank, parquet, floating boards Average: at least two private bathrooms with shower
C+ 22,8%	 Predominant materials of the floor: ceramics, tile, vinyl, stone Average: at least one private bathroom with shower
C- 49,3%	 Predominant materials of the floor: brick and cement Average: at least one private bathroom with shower
D 14,9%	 Predominant materials of the floor: brick and cement, wood (unified) Average: at least one private bathroom with shower in 31% of houses

Stratum	House facilities and belongings
A 1,9%	 All houses with conventional phone lines All houses with refrigerators Over 95% of the houses with kitchen(with oven), washing machine and stereo system The average house has two color television sets Over 80% of the houses haswo private cars
B 11,2%	 97% of the houses with conventional phone lines 99% of the houses with refrigerators Over 80% of the houses with kitchen(with oven), washing machine and stereo system The average house has two color television sets The average houses has one private car
C+ 22,8%	 83% of the houses with conventional phone lines 96% of the houses with one refrigerator Over 67% of the houses with kitchen(with oven), washing machine and stereo system The average house has two color television sets
C- 49,3%	 52% of the houses with conventional phone lines Over 84% of the houses with refrigerator and kitchen with oven Under 48% of the houses with washing machine and stereo system Average house has one color television sets
D 14,9%	 12% of the houses with conventional phone lines Under 43% of the houses with refrigerator and kitchen with oven Only 5% with washing machine 10% with stereo system Average house has one television set

Stratum	Access to IT and communication
A 1,9%	 99% of the houses have internet access Most of the houses have a PC and/or laptop/notebook There is an average of 4 cell phones in the house
B 11,2%	 81% of the houses have internet access and PC 50% of the houses have a laptop/notebook There is an average of 3 cell phones in the house
C+ 22,8%	 39% of the houses have internet access 62% of the houses have a PC 21% of the houses have a laptop/notebook There is an average of 3 cell phones in the house
C- 49,3%	 11% of the houses have a PC There is an average of 2 cell phones in the house
D 14.9%	There is an average of 1 cell phone in the house

Stratum	Consumer habits
A 1,9%	 People buy most of their clothes in boutiques, shopping malls, and/or local shops Houses haveinternet access 99% use private accounts, not office accounts 92% of the households have members registered in a social web page 76% have read books other than manuals and job reading during the last three months
B 11,2%	 People buy most of their clothes in boutiques, shopping malls, and/or local shops 98% of the houses haveinternet access 90% use private accounts, not office accounts 76% of the households have members registered in a social web page 69% has read books other than manuals and job reading during the last three months

Stratum	Consumer habits
C+ 22,8%	 38% of the people buy most of their clothes in boutiques, shopping malls, and/or local shops 90% of the houses have internes access 77% use private accounts, not office accounts 63% of the households have members registered in a social web page 46% has read books other than manuals and job reading during the last three months
C- 49,3%	 14% of the people buy most of their clothes in boutiques, shopping malls, and/or local shops 43% of the houses have internet access 25% use private accounts, not office accounts 19% of the households have members registered in a social web page 22% has read books other than manuals and job reading during the last three months
D 14,9%	 9% of the houses have internet access 9% has read books other than manuals and job reading during the last three months

Stratum	Education
A 1,9%	• The head of the household is a university graduate, most at post-graduate level
B 11,2%	• The head of the household is a university graduate
C+ 22,8%	The head of the household is a High School graduate
C- 49,3%	The head of the household is an Elementary School graduate
D 14,9%	The head of the household is an Elementary School graduate

Stratum	Economy
A 1,9%	 The head of the household has a profession: scientists, intellectuals, members of the executive power, legislative boards, civil cervants or officers in private companies 95% of the households are affiliated to or covered by ESSI, SSIAF or SSINP 75% of the households have private health insurance with/without hospitalization, international insurance, AUS, municipal insurance, provincial council and/or life insurance
B 11,2%	 26% The head of the household has a profession: scientists, intellectuals, members of the executive power, legislative boards, civil cervants or officers in private companies 92% of the households are affiliated to or covered by ESSI, SSIAF or SSINP 47% of the households haveprivate health insurance with/without hospitalization, international insurance, AUS, municipal insurance, provincial council and/or life insurance
C+ 22,8%	 The heads of the families are: service workers, traders, in machinery installation as operators and assemblers 77% of the households are affiliated to or covered by ESSI, SSIAF or SSINP 20% of the households haveprivate health insurance with/without hospitalization, international insurance, AUS, municipal insurance, provincial council and/or life insurance
C- 49,3%	 The heads of the families are: service workers, traders, in machinery installation as operators and assemblers and some are unemployed 48% of the households are affiliated to or covered by ESSI, SSIAF or SSINP 6% of the households have private health insurance with/without hospitalization, international insurance, AUS, municipal insurance, provincial council and/or life insurance
D 14,9%	 The heads of households are: unskilled workers, service workers, merchants, work in machinery installation as operators and assemblers 11% of the households are affiliated to or covered by ESSI, SSIAF or SSINP

In relation to the macro-economic indicators, it must be pointed out that according to the IMF in the documentthe "World Economy Perspectives" published in 2011, the growth of the world economy stabilized at around 4% until the end of 2012, one point less than in 2011. The GDP of the developed countries will keep on growing though at a rate of around 2%.

Data from the Ecuadorian Central Bank shows the comparative GDP between 2009 and 2012 to be:

In order to understand hpw the labour market has evolved data from 2009⁷ is provided.

Ecuadorian labour market development



There is slight drop in the unemployment rate leading to an increase in the full employment rate. Though unemployment rate still remains high, there is a downward trend.

Based on the Report HDR 2011 of United Nations Program for Development, Human Development is defined as "the freedom for people to live a long, healthy and creative life, to pursue goals valuable to them and to actively participate in the sustainable and equitable development of the planet we all share." Development Achievement is measured by means of the Human Development Index - HDI. It is defined as a compounded index that measures the average achievements attained by a country in three basic dimensions of human development that is: the enjoyment of a long and healthy life, access to education and a dignified standard of living. The four development categories according to HDI are: Very High, High, Average, and Low. Ecuador is in position 83 in the High categoryl out of 187 countries. Its value was 0.720 in 2011, slightly higher that the 0.718 in 2010.

7	Full employment means employees who either work at least
	the minimum legal working hours and they have salaries higher
	than the legal unified salary but do not want to work more hours.
	Or, they work less than 40 hours and they have salaries higher
	than the legal unified salary but do not want to work more hours.
	Unclassified employment means employees who cannot be
	included into either full employment or underemployment, due to
	lack of registration data

73 231.929 28 226.563 forecast) 5.012,00 2012 5,35 190 67'426.682 4.168,00 2011 26'928.1 3,50 57'978.116 318 56 2010 3,58 24'983. 4.081 .864 24'119.452 3.724,40 2009 0,36 52,021. GDP (thousands 2000 GDP (annual variation GDP per capita (current USD) GDP (thousands current USD) USD) rate)

For the year 2011 (2), the budget was targeted towards productive investment and capacity building, substantially decreasing the payment of external debt; in this period distribution in the main sectors was 6% for the energy sector, 5% for roads, 6% for health, 12% for education and 7% for the payment of external debt. Since 2005, the external debt to GDP ratio decreased from 29.2% to 15.0% in the 2011.

The growth rate in Ecuador scaled to the third place in Latin America and the Caribbean with a rate of 8.0%, being only surpassed by Panama (10.5%) and Argentina (9.0%), according to ECLAC.

The economically active population (EAP) in Ecuador has increased in 2011 as compared to 2010. The three-year term data provided by INEC is the following:

EAP Evolution

By age			
Age	2009	2010	2011
10-17	383.727	290.830	217.915
18-25	1.286.088	1.185.002	1.106.277
26 or over	5.015.297	5.059.408	5.323.010
TOTAL	6.685.112	6.535.240	6.647.202

The job-related population classification is:

- Rural population 5.392.713 inhabitants
 - Productive age population PAP: 82.08%
 - \circ ~ Economically active population EAP: 54.90% ~
 - \circ Economically inactive population EIP: 45.10%
- Urban population 9.090.786 inhabitants
 - Productive age population PAP: 83.70%
 - \circ ~ Economically active population EAP: 55.40%
 - Economically inactive population EIP: 44.60%

3.4. Territorial Organization

According to SENPLADES (2008), (Spanish acronyms for National Secretariat for Planning and Development) the best alternatives iare needed to develop solutions to environmental and socio-economic issues, taking into account the proposed models on decentralization, autonomy and territorial planning (4).

Based on these premises, zoning is proposed to facilitate suitable space organization management, integrated planning and balanced land use, depending on the potential and limitations of the resources available. The efficient care of rthe equirements and needs of the population are the basis for this process.

Guidelines for the establishment of zones:

- To establish zones combining neighboring provinces.
- To maintain the current political divisions (not dividing parishes, cantons, provinces).
- To link provinces with similar requirements.
- To consider Quito and Guayaquil as metropolitan districts.
- To consider the Galapagos Islands archipelago as a zone of special treatment.

On the basis of the proposed zoning, SENPLADES performed a 52-variable analysis to establish the association of provinces and to structure zones based on an identification of :

Territorial potential (1) (4) that should be regarded as elements or components of the area which represent comparative and competitive advantages for the development of a region, province, county or parish, facilitating the management of development institutions, enabling better use of the skills and capacities present and carrying out management based on the interests of each territory.

Territorial limitations (1) (4). Physical and natural conditions pertaining the capital that influence the development of agricultural production activities, including weather conditions, topography, and soil composition.

Territorial problems (1) (4). Anthropogenic, socionatural and natural hazards are included in this section. The former, together with vulnerabilities, can affect directly the human activities limiting the capacity to introduce a suitable landuse scheme.

Zones are established in the next graph according to the definitions mentioned above:

Zone	Structure
Zone 1	Esmeraldas, Carchi, Imbabura, Sucumbíos
Zone 2	Pichincha (except Quito canton), Napo and Orellana
Zone 3	Cotopaxi, Tungurahua, Chimborazo and Pastaza
Zone 4	Manabí and Santo Domingo de los Tsáchilas
Zone 5	Santa Elena, Guayas (except Guayaquil, Samborondón and Duran), Los Rios, Bolivar and Galapagos
Zone 6	Cañar, Azuay and Morona Santiago
Zone 7	El Oro, Loja and Zamora Chinchipe
Zone 8	Guayaquil, Samborondon and Duran
Zone 9	Quito Metropolitan District

Special management and attention should be paid to the Galapagos Archipelago since any kind of action taken there becomes an environmental condition modifier in the area. Ecotourism is its main source of income due to the international classification as protected area as well as its value for scientific studies.

Findings and descriptions for each area are summarized in the following tables (due to the information updating processes and definition of the zonal organization, areas 8 and 9 have been integrated into the analysis to areas 2 and 5):

	Territorial Strengthening (4)
Zone 1	 Most ethnic groups concentrated in the area Tourist development area (ecological and ethnoCultural) Textile industry Oil industry 25% of the area under protection and 25% with unprotected autochthonous vegetation Maritime ports 6% of the soil presents conditions for unlimited crop production 16% of the soil presents conditions for limited crop production 13% is suitable for livestock Five airports with 9 runways Road network allowing interconnection in the entire area Huge availability ofsurface water Representative subsectors: fisheries, aquaculture, forestry, biofuel (sugar cane and African palm)
Zone 2 & 9	 Huge migration zone due to Quito Almost 34% of the area is protected (zone with bigger area): highly-valued unprotected autochthonous vegetation 2.3% of the soil presents conditions for unlimited crop production 6.4% of the soil presents conditions for limited crop production 15.5% is suitable for livestock High electricity production Oil industry Mining Dense road network, but no homogeneous coverage It has the best potential forsurface water in the country Representative subsectors: fisheries, aquaculture, forestry, biofuel, processed vegetables, metalworks, tourism, transport, logistics

Image: Territorial Strengthening (4) • Larger territorial extension Important tourist activities • Scale manufacture (craftsmanship)

- . Important ethnic groups Mineral resources • 15.7% of the surface is protected area 62.2% of the surface covered by unprotected woods · 2.8% of the soil presents conditions for unlimited Zone 3 crop production 9.46% of the soil presents conditions for limited crop production 14.3% is suitable for livestock Hydropower production Huge surface water availability Representative subsectors: fisheries, aquaculture, forestry, biofuel, processed vegetables, metalworking, tourism, transportation, logistics Extensive coastline • 23 ports, most of them dedicated to fishing Relevant tourism, especially on beaches Important road infrastructure Future area for oil production • 2.5% of the land belongs to the system of protected areas (Manabí) 11.2% natural forest without protected status • 9.67% of the land can be used in agricultural activities without limitations Zone 4 33, 7% of the soil presents conditions for limited crop production 7% suitable for livestock production Few ethnic groups Scarce mineral resources Dry zone, mainly in Manabí Average hydrogeological Importance (groundwater) Representative sectors: fishing, aquaculture, biofuels, fruits, vegetables and tourism. It has the highest demographic concentration in the country . Receiving migration due to the presence of the city of Guayaquil High density of road network and highways Higher concentration of power plants Local oil production Minimum ethnic groups Zone 5 1.65% of the soil is under protection 24.79% of the soil is made up of unprotected forests & 8 Tourism focused on beach tourism High international trade flow High number of fishing ports 39.58% of the soil can be used for crops without limitation 30.26% of the soils have limitations on cultivation Representative sectors: fishing, aquaculture, biofuels, fruits, vegetables tourism, transport and logistics · Hand-crafting Tourism 14.2% of the surface is a protected area 48.18% with native forests, but unprotected area (especially in Morona Santiago) • 0.6% of the soil can be used for crops without limitation Zone 6 4.4% of the soils have limitations on cultivation • 22.2% of the area is suitable for livestock production Hydropower capacity 118 airstrips and airports (mostly in Morona Santiago)
 - Representative sectors: flowers, biofuels, metalworks, tourism, transport and logistics

Torritorial	Ctrong	thoning	1 /
remuoria	Sureny	ulening	14

- The highest quantity of mineral resources in the country
- More emphasis on tourism in Loja
- There are not many ethnic groups
- 5.7% of the territory is made up of protected areas
 54.4% are unprotected forests
- Zone 7 4.2% of the soil can be used in crops without limitation
 - 12.9% of the soils have limitations on cultivation
 - 13.4% of the area has the potential for livestock husbandry
 - Representative sectors: Fishing and aquaculture (El Oro), biofuels, fruits, vegetables and tourism

Territorial limitations (4)

Zone 1	 Hillsides with slopes greater than 70% (sub Andean areas), forming barriers for the development of productive activites, 27% of the surface area is in this condition Acid soils in approximately 45% of the surface Toxicity (PH level) occurs in 29% of soil (in Esmeraldas and Sucumbios) 6% are shallow soils 6% are soils of low fertility Rainfall rates above 3000mm are found in 55% of the regional territory(Esmeraldas and Sucumbios) Water deficit 1% of theNorthern Territory (Ibarra)
Zone 2 & 9	 Hillsides with slopes (sub Andean areas), forming barriers for the development of productive activites, 22% of the surface area is in this condition Acid soils cover approximately 55% of the surface Toxicity (PH level) occurs in 31% of the soil (mainly Orellana) 4% are soils of low fertility Excessive rainfall occurs in 34% of the territory (Orellana and subAndean zone of Pichincha) Water deficit in 1% of the territory (Guayllabamba)
Zone 3	 Hillsides with slopes greater than 70% (sub Andean areas), forming barriers for the development of productive activites, 10% of the surface area is in this condition Acid soils cover about 71% of the surface Toxicity (PH level) occurs in 49% of the soil (mainly in Pastaza) 9% are infertile soils Rainfall rates above 3,000mm are found in 13% of the territory (Esmeraldas and Sucumbios) Water deficit in in Riobamba, Ambato, Alausi and Guamote
Zone 4	 Hillsides with slopes steeper than 70% (sub Andean areas), forming barriers for the development of productive activites, 26.1% of the surface area is in this condition Acid soils in about 18.6% of the surface 31.% are shallow soils Rainfall rates above 3,000mm are found in 4% of the territory (Santo Domingo) Water deficit in 11.3% of the territory (Bahía de Caráquez)
Zone 5 & 8	 Hillsides with slopes forming barriers for the development of productive activites, 12% of the surface area is in this condition Acid soils in around 19% of the surface 3% are infertile soils Water deficit in 8.8% of the territory (Santa Elena &Puna Island)

Territorial limitations (4) Hillsides with slopes forming barriers for the development of productive activites, 27.3% of the surface area is in this condition Acid soils in around 45% of the surface . Zone 6 • Toxicity (PH level) occurs in 50% of the soil 7% are shallow soils 14% are soils with low fertility . • Excessive rainfall occurs in 25% of the regional territory · Hillsides with slopes forming barriers for the development of productive activites, 47.5% of the surface area is in this condition, Zone 7 • Acid soils in around 73% of the surface • Toxicity (PH level) occurs in 51% of the soil • 14% are infertile soils

Territorial problems – Anthropic hazards (4) (Natural hazards will be detailed in specific sections)

Zone 1	 The main issue is security, related to the northern border where violence and population displacements are present. Areas of influence caused by the fighting and violent conditions are identified. Hazards exposure associated with oil industry related infrastructure, such as spillages, sabotage, and civil disorder, among others. 5% of the surface area is affected by soil overuse, being the most affected area in the country, particularly the central - Northern Province of Esmeraldas.
Zone 2 & 9	 Concentration of oil infrastructure and product transportation systems, which exposes the area to spillages, sabotage, civil unrest, etc. Overuse of soil, especially in the mountains
Zone 3	 Exposure to hazards associated with the pipeline specifically Ambato and Latacunga Scattered sectors with misuse of soil, especially in the lower slopes of the mountains
Zone 4	 Overuse of soil scattered throughout the area Future exposure to hazards when the new refinery will be finished
Zone 5 & 8	 Exposure to hazards associated with pipeline Land use conflict is minimal, the affected area is smaller compared to other regions
Zone 6	• A representative extension of land is associated to incorrect landuse. It is the second affected Zone associated to this phenomenon
Zone 7	A remarkable portion of land affected by soil overuse mostly in the northern part of the area

3.5. Organization of the State

The Ecuadorian State is composed of the following powers:

- Legislature
- Judiciary
- Electoral branch
- Transparency and Social Control branch
- Executive

The Transparency and Social Control Power is made up of seven autonomous agencies:

- The Comptroller General of the State
- Superintendence of Banking and Insurance Insti-

tutions

- Superintendence of Companies
- Superintendence of Telecommunications
- Office of the Ombudsman
- Council of Citizens' Participation and Social Control
- Superintendence of People's and Solidarity Economy

The following organizational chart shows the structure of the Executive Power:



Social Development Coordinator Ministry
Social Registry
Ecuador Integrated System of Social Indicators
Interconnected Registry of Social Programs
National Secretariat for Migrants
Ministry Econ and Social Inclusion
Ministry of Public Health
Ministry of Educaction
Min. of Urban Development and Housing
Strategic Sectors Coordinator Ministry

Ministry of Telecommunications and Information Society
Ecuadorian Institute of Energy Efficiency and Renewable Energy
National Energy Council
National Energy Control Center
Guayaquil Electricity Comp
Coca Codo Sinclair
National Energy Corporation S.A.
Ministry of Energy and Renewable Energy
Ecuador Energy Corporation EP

Production, Employment and Competitiveness Coordinator Minsitry
National Secretariat of Higher Education
National Institute for Public Procurement
Tech Secretariat for Training and Professional Training
Ecuadorian Institute of Intellectual Property
Ministry of Foreign Affairs
Ministry of Agriculture, Livestock, Aquacul- ture and Fishing
Ministry of Transport and Public Works
Ministry of Tourism
Ministry of Industries and Productivity

Heritage Coordinator Ministry
Ecuador Railways
Covernment Council of the Special Galapagos Regime
Alfaro City
National Institute of Culture
Heritage ministry of Environment
Ministry of Culture
Ministry of Sports

Knowledge and Human Talent Coordinator Ministry National Secretariat of Higher Education, Science, Technology an innovation Ministry of Education Ecuadorian Institute of Intellectual Property Ecuadorian Institute of Education Loans and Scholarships Vice ministry of Public Service of the Ministry

vice ministry of Lobic dervice of the Phillis	пу
of Labor Relations	

Economic	Policy	Coordinator	Ministry
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Deposit	Insurance	Corp
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National Customs Service

- Bank of the Ecuadorian Institute of Social Security
- Ecuador Housing Bank
- National Development Bank
- National Financial Corporation
- State Bank
- Ministry of Finance
- Ecuador Central Bank
- Internal Revenues Service

Ministry of Security Coordination
National Secretariat of Risk Managment
Ministry of Defense
National Intelligence Secretariat
Ministry of the Interior
Ministry of Justice
Ministry of Foreign Affairs Comm & Integration
Ecuador Plan Secretariat
(National transit Agency) (part of MTOP, but coordinates with MICS)

Ministry of Policy Coordination and Autonomous Decentralized Goverments National Communication Secretariat National Secretariat of Managment Transparency Secretariat of Peoples, Social Movements and Citizen Partipation Ministry of the Interior Ministry of Justice, Human Rights and Cults Institute for Amazon Region Eco-development

(Graphs based on information in the coordinator ministries web pages)

3.5.1. Risk Management Committee

For the support and coordination of actions by the National Decentralized Risk Management System, the Risk Management Committee (RMC) is set out as its structure. It is independent of the geographical scope (cantonal, provincial or national) and of the Risk Management components (reduction, response, recovery) where actions are developed (10).

The Risk Management committees will have as permanent mechanisms:

- Plenary
- Technical Work Groups (MTT)

The Plenary (10) is the instance of inter-agency coordination to:

- a. Set the Agenda for Risk Reduction in its territory,
- b. Agree and follow-up on annual goals,
- c. Coordinate operations during emergencies and disasters.
- d. Guide the recovery phase,
- e. Make decisions on issues informed by the members, including recommendations for the declaration of the state of emergency.

According to the territorial level, the Risk Management Committee comprises:

coordinate the technical and administrative capacities of the executive branch and the private sector in a territory (cantonal, provincial, national) focused on specific topics, whether there are emergency situations or not. Each Technical work group will have a Coordinator according to the institutional responsibility provided for in this Manual" (10).

The groups are integrated based on management areas and components. If there are no representatives of the institutions listed above, they will comprise organizations that have these responsibilities in the respective territory (see annexes).

"Not all groups must necessarily operate on a permanent basis. The Plenary of each Risk Management Committee will decide on the activation of the groups that correspond to their agendas and needs. It may also create new working mechanisms if deemed necessary and the conditions to do so exist. It will also invite representatives of national or international bodies to these meetings".

"Moreover, before the imminence or occurrence of a particular adverse event, the President of the Risk Management Committee/Energy Operations Committee can activate the Work Groups and the corresponding mechanisms."

(10)

Plenary of the Plenary of the Plenary of the Risk Management National Risk **Canton Risk Province Risk** Committee or Management Management Management **Parish Mechanisms** Committee Committee Committee Coordination President of the President of the Republic (or his Province Governor Mayor Parish Board delegate) Secretariat/or Representatives of **Province Prefect** Parish Leader SGR Municipal companies National **Bisk Management** Delegates of Risk Secretariats Province Director of Municipal Unit Management committees (depending on the SGR Representative and networks competencies) Province Representatives of Coordinator Representative of the relevant Institutions/ Canton Leader Ministries Ecuadorian Assoc of Organizations Municipalities in the Parish Sub secretaries and Sector Public aid Parish aid organization Province Directors of Ministries organization head delegates State Entities Armed Forces highest Joint Armed Forces Armed Forces delegate rank official in the Command Chief delegate in the canton in the parish province National Police Police highest rank National Police National Police delegate official in the province commander delegate in the canton in the parish President of President of the the Ecuadorian Canton representative Local representatives of Province Federation of Association of of parish boards NGO subscribed to SGR Parish Boards Municipalities Other members Other members Other members required by the required by the required by the Other members required National Risk Province Risk Canton Risk by the Risk Management Committee Management Management Management Committee Committee Committee

It is worth noting that. according to the planning for the manual review, validations and reviews for the first quarter of 2013 were foreseen.

3.5.2. Diplomatic Relations (1)

These are the actions and instruments used by States to interact, communicate, reach common achievements, settle disputes, i.e. to maintain harmonic relations between the countries.

According to the information of the Ministry of Foreign Affairs of Ecuador has 95 embassies and consulates and a similar number of diplomatic representations of countries are in the national territory. 67% of these countries maintain international agreements on technological development, technical and economic cooperation, control of drugs smuggling, etc. with our country. 29% of them only have commercial relations with the country.

54

Technical work groups of the Risk Management Committee, which are "mechanisms to integrate and

4. Legal and regulatory framework for risk management in Ecuador

4.1. Description

Based on the analysis of the Secretariat of Risk Management (1), the main legal frameworks and regulations to consider are:

- The Constitution of the Republic of Ecuador
- The Public and State Security Act
- The Public and State Security Act Regulatory
 Decree
- The Organic Code for Territory Organization, Autonomies and Decentralization (COOTAD)
- The Organic Code of Planning and Public Finances (COPLAFIP)
- The National Development Plan for Good Living -2009 – 2013
- The National Integrated Security Plan

4.1.1. The Constitution of the Republic of Ecuador

In the Constitution, Risk Management has two defined approaches (1):

- As a component of the National Inclusion and Social Equity System
- As part of the National Decentralized Risk Management System and its ruling entity

Article No. 340 establishes the existence of a "National Inclusion and Social Equity System as the articulated and coordinated set of systems, institutions, policies, standards, programs and services that ensure the exercise, assurance, and enforcement of the rights recognized in the Constitution and the fulfillment of the development scheme objectives ..." ... "The system comprises education, health, social security, risk management, physical culture and sports, habitat and housing, culture, communication and information, leisure time, science and technology, population, human safety and transport." Here, risk management has the same importance as other fields such as education and it is an essential requirement for the operation of the System to achieve equity and inclusion (2).

Article No. 389 describes that the State " ...will protect individuals, communities and nature from the negative effects caused by natural or manmade disasters through risk prevention, disaster mitigation, restoration and enhancement of the social, economic and environmental conditions. This will be aimed at minimizing the condition of vulnerability," going from an earlier reactive vision toward a comprehensive vision of responsibility in order to reduce and, in the best cases, avoid the effects of disasters (2).

The same article mentions that "... the National Decentralized Risk Management System has risk management units from all public and private institutions at local, regional and national levels".

The system shall be led by the State by means of a technical agency with the following functions:

- 1. Risk identification
- 2. Adequate and timely information for Risk Management
- 3. Compulsory inclusion of Risk Management in public and private institutions.
- 4. Increase of citizen and institutional capacities for identification and risk management in their areas and competencies.
- 5. Articulation and coordination of institutions and actions for Risk Management
- 6. Ensured adequate and appropriate funding for the operation of the system.
- 7. Coordinated international cooperation focused on Risk Management

The characteristics of subsidiary decentralization, as a direct responsibility of the institutions in their geographic scope, are clearly described in Article No. 390. This article mentions that when risk management capabilities are insufficient, entities of greater territorial scope or technical and financial capacity ... will provide necessary support to their authority in the territory without removing them from their responsibility" (2). Paragraph 8 of Article No. 261 determines "the management of natural disasters" as part of the exclusive jurisdiction of the central State.

Other articles related to the role of risk management in the exercise, assurance, and enforcement of the rights recognized in the Constitution and the fulfillment of the development scheme objectives are: 10, 14, 72, 281, 313, 375, 395, 396, and 397.

4.1.2. Public and State Security Act and Regulatory Decree

Article No. 4 determines: "Public and State security shall be subject to the rights and guarantees set forth in the Constitution of the Republic, international human rights treaties." The principles that will guide it are (3): a. Comprehensive Security

- b. Complementarity
- c. Priority and opportunity, prioritizing on prevention
- d. Proportionality based on need, magnitude and transcendence
- e. Right and guarantees prevailing over norms
- f. Responsibility of the institution based on institutional missions, fields and competencies

Article No. 11, section d, determines that "...the prevention and the measures to counteract, reduce and mitigate natural and human-induced risks or to reduce vulnerability, correspond to public, private, national, regional and local entities. It will be led by the State through the National Secretariat of Risk Management".

Article No. 34, determines that when the Executive has declared a state of emergency. In case of natural disasters, "the planning, organization, execution and coordination of the areas of prevention, rescue, remediation, and aid will be led by the agency responsible for civil defense, under the supervision and control of the Ministry of Security Coordination... "It also establishes that "the agency responsible for civil defense will work with the decentralized autonomous governments and the civil society. It will also have the support of the Armed Forces..."

4.1.3. Public and State Security Act Regulation

Article No. 3 defines the Secretariat of Risk Management as the executing body of Risk Management in the country -with its roles as ruling and executing entity of the National Decentralized Risk Management System - and its competencies are focused on (4):

- a. Risks identification
- b. Generating and democratizing access and dissemination of information for Risk Management
- c. Verifying cross-cutting inclusion of Risk Management in public and private institutions
- d. Strengthening the capacity to identify risks according to action fields
- e. Managing financing for the operation of the National Decentralized Risk Management System and coordinating international co-operation
- f. Coordinating efforts and functions during prevention, mitigation, preparation, response, recovery and development.
- g. Designing education, training and dissemination programs
- h. Coordinating cooperation of humanitarian aid and information to handle emergency and/or disasters situations at national and international scale.

Title III regulates the performance of the National Decentralized Risk Management System (SNDGR) and SGR.

Article 16 states: "The normative provisions on risk management are mandatory and enforceable throughout the national territory" (4).

Article No. 17 establishes some definitions as follows: "...Risk is the probability of occurrence of an adverse event with economic, social or environmental consequences in a particular place and at a certain exposure time"; "a natural disaster is the probability for a territory or society of being affected by natural phenomena whose extension, intensity and duration produce negative consequences"; "an anthropic risk is that of human origin or is the result of human activities, including technological ones".

Article No. 18 enlists the competencies of the Secretariat of Risk Management as the ruling entity (4):

- a. To lead, coordinate and regulate the operation of the National Decentralized Risk Management System..
- b. To formulate policies, strategies, plans and standards of the National Decentralized System of Risk Management, under the supervision of the Coordinator Ministry of Security, for approval by the President of the Republic.
- c. To adopt, promote, and execute the necessary actions to ensure compliance with the policies,

strategies, plans and standards of the system.

- d. To design education, training and dissemination programs to strengthen the capacities of institutions and citizens for risk management.
- e. To ensure that the different levels and institutions of the system provide the necessary resources for appropriate and timely management.
- f. To strengthen response and aid agencies for emergency situations in the areas affected by a disaster, for the implementation of prevention and mitigation measures to minimize their impact on the population.
- g. To create interinstitutional cooperation agreements aimed at scientific research to identify risks, facilitate monitoring and surveillance of threats, for studying vulnerabilities.

Article 21 states that the SGR has a technical body with interinstitutional and intersector features for advice and support. This is the National Advisory Committee on Risk Management. Article 22 says that the Committee shall be comprised of (4):

- 1. The highest authority of the National Secretariat of Risk Management, that shall preside over;
- 2. The Coordinator Minister of Security or his/her delegate;
- 3. The Coordinator Minister of Social Development or his/her delegate;
- 4. The Coordinator Minister of Heritage or his/her delegate;
- 5. The Coordinator Minister of Strategic Sectors or his/her delegate;
- 6. The Coordinator Minister of Economic Policy or his/her delegate;
- 7. The Coordinator Minister of Production, Employment and Productivity or his delegate;
- 8. The Coordinator Minister of Policies and Decentralized Autonomous Government or his/ her delegate

The Presidency may summon other officials according to the needs presented and within the scope of responsibilities. The Advisory Committee will also have Technical Advisory Committees, composed of scientific institutions and specialists in risk reduction and response to emergencies.

According to Article 23, the functions of the Advisory Committee are (4):

- 1. To advise and support the SGR in the reform and development of policies, strategies, norms and national plans, in particular those related to risks and emergencies reduction.
- 2. Collaborate on the design of programs, projects or initiatives national for Risk Management.
- 3. Other required or assigned functions by the SGR.

Article 24 creates the emergency operations committees, which undertake the responsibility of Risk Management in their territory, which operate under the principle of subsidiary decentralization. The committees will be national, provincial and cantonal, which shall operate under the rules laid down by the SGR. It is important to indicate that the Management Committees of risks exist through a Resolution of the SGR (N° SGR - 367 - 2011) with the above functions, according to the Risk Management Committee Manual (1): "Once a state of emergency or disaster has been declares, the RMC is active immediately as Emergency Operations Committee (EOC), is declared in permanent session and assumes the functions set out for the States of orange or red alert" (p. 44 of the Risk Management Committee Manual)".

According to the Article 25 there must be coordination between the SGR and the Ministry of Education to incorporate Risk Management in the programs of basic, secondary and technical education.

To strengthen the dissemination and knowledge on RISK MANAGEMENT, Article 26 gives the directive to the SGR to design and implement training programs for authorities, community leaders, media and general population.

Article No. 27, "About the communication and dissemination" indicates that the SGR shall have a national strategy for social communication on risk management, such as support to the actions developed.

4.1.4. Organic Code of land use, autonomy and decentralization (COOTAD)

The principles that govern the authority of the autonomous decentralized governments, under Article 3, in the paragraph that defines the subsidiarity, states that " ...the central government does not exercise powers that can be implemented efficiently by government levels closer to the population and will only deal with those that are appropriate, or that by their nature may be of interest or involvement of the national assembly or a territory". It also points out that "the activities and powers can be temporary taken over by another level of government in the case of proven deficiencies, omission, natural disasters or stagnation in the management... "(5).

On the powers of the Governor, Article 37, paragraph m, points out that in case of serious emergency, which may be caused by natural disasters, urgent and transient measures must be requested.

Article 54, paragraph o, mentions that one of the functions of the municipal autonomous decentralized government is: "to regulate and control constructions in the cantonal constituency, with special attention to the control rules of risk and disaster prevention", as this is one of the key elements for the disaster risk reduction. This is also referred to in Article 84, paragraph n, but in relation to the municipal autonomous district governments.

On the exercise of Risk Management, article 140 says, "... all threats of natural or anthropogenic origin that affect the canton will be managed concurrently and in articulation with the policies and plans issued by the responsible national agency, in accordance with the Constitution and the law". "The municipal autonomous decentralized government must adopt

technical standards for seismic risk management and prevention in order to protect the people, communities and environment". "The management of prevention, protection, aid and firefighting services, which according to the Constitution correspond to the municipal autonomous decentralized governments, shall be carried out observing the law that regulates the matter ... "

Article 466, related to the powers in land-use planning, determines that "the municipal and metropolitan governments exclusively control the use and occupation of the land in the territory of canton... "landuse planning is considered a key element in Disaster Risk Reduction.

4.1.5. Organic Code of Planning and Public Finances (COPLAFIP)

On public investment and instruments, Article No. 64 refers to the incorporation of **environmental and risk management approaches in the design and implementation of public investment** programs and projects, which will promote favorable management actions of vulnerability as well asanthropic and natural risks" (6).

4.1.6. Other instruments and regulations

Tools have been developed for the regulatory response in case of disasters, including:

- a. Risk Management Committee Manual. The c ommittee is the intersector and inter-institutional structure for Risk Management.
- b. Regulations for the Implementation of Standards of emergency humanitarian aid for food, cooking, home and cleaning. This policy is the national indicator for compliance with Sphere international standards.
- c. Guide for International Cooperation. Guidelines to regulate the reception of international aid if required by the country.

4.2. Conclusions and recommendations

- It is advisable to define the concept of 'disaster' in the framework of the commonly accepted definitions to facilitate compliance with the different legal norms. It is recommended to extend the definition and scope of 'natural disaster' depending on the origin of the risk factors, the impact area and local capacities. This will allow establishing better institutional competencies.
- It is increasingly urgent to issue a risk management law in Ecuador.
- It is necessary to implement the legal frameworks of different government levels by a unified terminology, local approaches linked to national goals and standardized indicators to measure local and national progress.
- It is necessary to monitor the exercise of the approach based on 'rights' of both human beings and the environment, in risk management actions

5. Strategic Framework for Risk Management in Ecuador

5.1. National Plan for the Development of the Good Living 2009-2013

Objective No. 4 "To guarantee the Rights of Nature and promote a healthy and sustainable environment" encompasses Risk Management through policy No. 4.6, which states the need of "reducing social and environmental vulnerability of the effects caused by natural and anthropic processes that generate risks" (1) Within policy 4.6, key actions are mentioned (1):

- a. Incorporate the risk management into planning, territorial organization, ecological zone division, investment and environmental management.
- b. Implement differentiated timely response programs to decrease the vulnerability of the people to various threats.
- c. Encourage comprehensive, sustainable and efficient management actions for land and watersheds that promote conservation and restoration, emphasizing ancestral and appropriate technologies according to the reality of the communities.
- d. Implement a research and early warning monitoring system in communities that are exposed to different threats.
- e. Develop specific models for the insurance sector (catastrophic models), which combine risks and financial parameters of the insurance and reinsurance sector; to recreate historical events and make an estimate of future losses.
- f. Analyze the vulnerability and the contribution to the adaptation of current and future strategic infrastructure to climate change.

Item 6.10, sustainability, conservation, natural heritage awareness and community tourism promotion, states that the political project has foreseen "... a transition from the extracting, dependent and non-organized model into a moderate and sustainable model, using in an intelligent way the available spaces, assuring the food sovereignty, taking into consideration the growth of the population, protecting the environment, assessing risks for natural events, to be able to adopt precautionary and mitigation measures , democratizing the planning and the decision making to all the citizenship "

Item No.8 about "Territorial National Strategy", within point No. 8.6 "Guarantee the sustainability of the natural heritage through a rational and responsible use of the renewable and non-renewable natural resources, " mentions the need of applying the "Management of river basins and hydric resources" (8.6.2) in which it is required "... to strengthen the culture of the proper use of the water among the society and prevent risks caused by floods and droughts" risk reduction" mentions that "... on these natural events, we encounter settlements of communities. infrastructure and services that have not taken into consideration their exposure to a threat; generating a high vulnerability level of the territory and exposing the country to disasters of different magnitude. Nevertheless, many of those disasters could be avoided if some measures were taken such as a proper territorial organization, investment planning, a culture of prevention, strengthening of skills of different players and an approach prioritizing the mitigation of existing threats. However, emergencies happen in a large or small number around the world. In Ecuador, a proper and efficient training program of response system should be developed to face different magnitude events, because only an adequate management of the emergency will bring about a fast recovery without a significant social and economic impact on the country. It is worth highlighting the importance to incorporate, as a cross cutting indicator, the risks involved in the public work planning and execution processes, in order to reduce the vulnerability for the population and infrastructures"

5.2. Security Agenda and Integrated National Security Plan

One of the "fields of the integrated security approach" in the Plan is "Environmental and Risk Management," considered as a cross-cutting component, focused on the Rights of Nature, Food Sovereignty, Risk Reduction, Response and Recovery (2).

The National Plan for Integrated security contains 6 objectives, 14 Policies and 69 strategies, of which No. 4 includes the variable of Risk management including 2 policies and 9 strategies. The statement of objective No.4 is "to reduce the vulnerability of people and nature to the negative effects of natural or anthropic events" (2).

The Policy for the "Prevention and tackling of natural or anthropic disasters" sets as a strategy to:

- 1. Implement orientation and awareness programs regarding risk management within the educational, institutional and community sectors.
- 2. Generate fourth level specialization programs in risk management.
- 3. Implement the national early warning system.
- 4. Incorporate climate change effects into planning and risk management.
- 5. Develop a culture within the citizenship and institutions of Risk management.
- 6. Encourage the articulation of technical and scientific institutions, present in the national territory, in the analysis of threats.
- 7. Gather the public and private development institutions to reduce vulnerabilities.
- 8. Coordinate recovery actions, as a result of disasters or emergencies on the national territory.

Item No. 8.6.4 "Comprehensive management and

The Policy to "decrease the negative effects caused by environmental threats" contains the following strategy (2):

Foster the effective control of environmental crimes

The following policies, from the National Secretariat of Risk management, related to the policies and strategies of the National Integrated Security Plan, are established in the corresponding agenda (2):

- a. Consolidate the Risk Management Decentralized National System to make political and technical decisions related to prevention, mitigation, preparedness, generation of early warning, response, rehabilitation, reconstruction and recovery.
- b. Reduce the vulnerability as a national priority to help reduce poverty and social exclusion through the identification, awareness, information and follow-up of risks.
- c. Encourage and boost the social construction trough the educational sector and other social players so that they can become supervisors involved in the change of Risk management.

5.3. Conclusions and Recommendations

- The RM (Risk management) planning should have the objectives, policies and strategies of the National Good Living Plan as a common foundation.
- The current reviewing of the Development National Plan should take into consideration the recommendations mentioned above.

6. Risk conditions in the country

6.1. Disaster Historical Analysis

In Ecuador the highest impact disasters have been related to hydro-meteorological phenomenon, earthquake, volcanic eruptions and landslides; however, other causes such as outbreaks and technological incidents, cannot be ignored. A special case is car accidents, in which there is a high level of morbidity and mortality, but due to its conditions, it is treated as a high priority case of public health.

According to investigations developed by the IGEPN (1), the main earthquakes in Ecuador since Hispanic times, based on information available, are the following:

Provinces	Years
Azuay	1856, 1887, 1893, 1901
Bolívar	1942
Carchi	1834, 1868, 1923, 1926, 1955, 1987
Chimborazo	1645, 1674, 1689, 1786, 1797, 1911, 1961
Cotopaxi	1687, 1689, 1736, 1757, 1800, 1859, 1914, 1944, 1976, 1996
El Oro	1913, 1928 , 1953, 1970
Esmeraldas	1906, 1942, 1944, 1958, 1976
Guayas	1901, 1906, 1942, 1980
Imbabura	1854, 1859, 1868, 1942, 1955, 1987, 2000
Loja	1749, 1904, 1913, 1928, 1946, 1953, 1970
Los Ríos	1901, 1942
Manabí	1896, 1898, 1942, 1990, 1998
Morona Santiago	1971, 1995
Napo	1987, 2005
Pichincha	1587, 1755, 1768, 1859, 1914, 1915, 1922, 1923, 1929, 1938, 1955, 1976, 1987, 1990
Sucumbíos(*)	1987
Tungurahua	1645, 1687, 1689, 1868, 1949
Zamora Chinchipe	1971, 1995

BIG EARTHQUAKES

Some volcanic eruptions have occurred and modified to a large extent the occupation and distribution of the territory. During this period the main registered events are (1):

Eruption Processes

Volcano	Years
Reventador	1889, 1944, 1958, 1960, 1994, 2002
Cotopaxi	1742, 1743, 1744, 1766, 1768, 1851, 1853,1856, 1877, 1880, 1885, 1903, 1906
Guagua Pichincha	1575, 1582, 1742, 1998 -1999
La Cumbre	1825, 1968, 1978, 1988, 1991, 1995, 2005
Sangay	1903, 1976, 1941, 1980,
Sierra Negra	1943, 1953, 1979, 2005
Tungurahua	1773, 1886, 1916, 1917, 1918, 1999 - 2012

Volcano	Years
Wolf	1800, 1948,
Alcedo	1954
Cerro Azul	1959, 1968
Cayambe	1785

Since 1970, and according to the information provided by Desinventar⁸ 1970-2010, related to impacts associated to hydro-meteorological phenomenon, the highest loss of lives is related to El Niño events during the years 1983, 1987 and 1992-1993. On the other hand, the event of 1997, listed as an extreme event, brought about a very small number of victims. "It's possible that the Ecuadorian society and institutions have learned from the previous events, and the public and institutional prevention measures brought about a significant reduction of the negative impact on human lives" (INAMHI)(1992)(2).

During El Niño in 1997-1998, losses of houses, farming, vital infrastructure, tourism and trade, were registered according to the data from ECLAC (1999), included in the PAHO Chronicle of Disasters. The losses amounted toUSD 2.869.3 Millions, equivalent to 15% of the Ecuadorian GDP in 1997; of which 783 Million (27%) were direct damages and 2.086.1 Million were indirect damages in productive sectors and infrastructure. It is important to highlight that there is not an estimate of the costs generated by the recovering processes in the midterm.

From this analysis, it can be determined, that the higher number of losses was in the coastal region, where there is a high concentration of population; additionally, most of the time, these losses are related to hydro-meteorological phenomena.

From a total number of 6.260 records for the period (1970-2010), the cases related to car accidents and other kind of events, which require individual and special treatment, are excluded. The following table details the number of events for the time frame.

Number of records per event type in the "Desinventar 2010" Database

Event Type	N°	Event Type	N°
Floods	1407	Escape	41
Landslide	1050	Plague	28
Fire	985	Hailstorm	27
Rain	565	Thunderstorm	17
Outbreak	220	Heat Wave	16
Droughts	131	Hurricane-force Winds	15
Forest Fire	110	Subsidence	11
Explosion	105	Ice Wave	11
Contamination	98	Biological	11
Surge	93	Panic	7
Volcanic Activity	87	Avalanche	6
Storm	77	Lahars	5
Gale	72	Settlements	4
Earthquake	71	Tornado	2
Overflow	66	Sedimentation	2
Torrential Flood	64	Snowstorm	2
Structural Collapse	60	Liquefaction	2
Downpour	55	Change in the Coastal Line	1
		Total	5523

In the reports from OSSO Corporation, for 1970-2007, the size of impacts has been determined. To carry out this qualification "... the most robust variables from the inventory, were chosen (Deaths and Destroyed Houses), which were defined as such because most of the records give a quantitative data and others that, though not as robust, are part of the effects of disasters in the country (affected houses and hectares). For each of the variables, percentiles were calculated, and it was determined that the percentile 97 is a stabilization point of the different curves. In Ecuador, the percentile 97 correspond to 20 Deaths, 60 Houses Destroyed, 301 Houses Affected and 60.000 hectare of either farming or forest that were affected..." (OSSO Corporation, 2008), 67 records shows values that are gualified as an Extreme Impact Event. In the following table, the classification of the event is detailed.

Amount of Records according to event type from the "Desinventar 1970-2007" database

	N°	%	Deaths	%	Destroyed Houses	%	Affected Houses	%
Extreme	11	0,27%	903	23%	2279	20%	22063	54%
Bigger	56	1,39%	747	19%	4294	37%	7138	17%
Small	3958	98,34%	2269	58%	4966	43%	11844	29%
TOTALS	4025	100%	3919	100%	11539	100%	41045	100%

8 This section is taken from the report:Extreme, large and lower impact disaster losses in Ecuador, 1970-2007, carried out by Corporación OSSO', This work was supported by the European Community and the Andean Community, Later on, these information was updated and delivered to "Desinventar" in 2010. 4,025 records were examined, out of 22 provinces. Since 2008, two more new provinces were added. Therefore, the total records for 2010 increased to 6.260.

According to the information available, we clearly see an increasing number of events during the time frame under analysis, and it could be caused by:

1. Sub-recording of events.

2. Increased vulnerability.

- 3. Human Settlements in areas of risk, therefore generating a greater exposure to threats.
- 4. Poor management of river basins and hillsides.

The above-mentioned increase is shown in the chart below.

No. of annual events 1000 800 600 N° Events 400 200 \cap 982 984 986 988 990 992 994 996 966 970 976 004 980 67 97 97

Source (Desinventar)

A clear increase in the number of floods and landslides is also shown, in relationship to others events, due to the increasing population in areas of risk, slopeside settlements, sedimentation of river basins, expansion of the farming border and poor sewage management.



Source (Desinventar)

Despite the increasing events within the last years, the amount of deceased and missing people decreased. It is well known that the emergency response capacity in the country has been strengthened (Pre-hospital Care, Evacuation, Rescue, Health care capacity); this is a key element, but it's necessary to take into account some other factors such as the intensity and recurrence of events. In the following table this ratio can be observed.

Ratio of deaths and missing people during disasters / by year



Source (Desinventar)

Deaths and missing people by event (1970-2010)



It is estimated that the impact of the small magnitude events has generated a loss higher than the extreme and major events.

The ill and injured from the events, are taken into account in the analysis because they affect the health care infrastructure and force to implement emergency protocols; the importance of this factor is based on the direct and indirect loss associated to productivity, besides the required economic investment for the recovery process of sick/injured people.

TheSick/Injured people diagram and table are shown below.

Sick/Injured people in events by year



Source (Desinventar)

Injured / Sick people by event (1970-2010)

Kind of Event	Injured/ Sick	Kind of Event	Injured/ Sick
Biologic	1	Rains	264
Hailstorm	1	Gale	300
Surge	1	1 Structural Collapse	
Tornado	2	Flood	264
Storm	8	Heat Wave	300
Overflow	13	Earthquake	382
Plague	15	Landslide	493
Panic	27	Fire	953
Avalanche	28	Explosion	1.062
Alluvium	28	Contamination	2.814
Escape	31	Outbreak	84.600
Forest Fire	41		

Out of the total of injured/Sick, deceased or missing people, the injured/sick people account for 95% whereas deceased and missing people reach 5%, but these numbers will not always remain the same in case of intensive events with a higher level of mortality. It is important to develop preparedness strategies that strengthen the structure of the pre-hospital care based on the demand in case of emergency or disaster.



Percent ratio between deceased, missing, injured and sick people

Source (Desinventar)

According to the manual of the Risk management Committee, a person can be defined as affected , when the person: "has suffered the loss of basic community services and needs social assistance;" it has also been defined as the porson who "has lost his/her dwelling or goods and requires social and economic assistance and needs a temporary job to guarantee his/her wellbeing and subsistence." In the next graph of the number of affected people, it can be seen that a high number of people were affected during the years 1987 and 1997-1998, when earthquake and floods occurred (El Niño Event).

Affected people by Year



Source (Desinventar)

Though not present in all events, damages on houses are a clear indicator of disasters. In the next picture, you can see the relationship between the damage and the type of event, the higher values are linked to hydrometeorological phenomenon.

Damage of House by Kind of Event



Source (Desinventar)

Damaged of houses by year



Source (Desinventar)

Data from the Situational Room of the SGR, show that the provinces with the higher number of events during the period 2010-2012, are Guayas and Loja; the events are linked to hydro-meteorological phenomena, with a clear peak in year 2012 (Data to July 2012).

No. of events by province (2010-2012)



Source: SGR



No. of Events by Year

6.2. Threats

6.2.1. Extreme Hydro-meteorological Events-Floods

6.2.1.1. Description

Según la Organización Meteorológica Mundial – OMM According to the World Meteorological Organization – WMO and UNESCO (1974)(1) a Flood is defined as a "water level increase above the normal flow" understanding as "Normal flow" the surface of the water that does not cause any damage, negative impacts or any kind of loss; to complement this definition, the National Center for Disaster Prevention CENAPRED of Mexico (2011), defines a flood as the event, caused by rainfall, waves, storm tides, or failure of any hydraulic structure, that results in an increased level of the river or sea-water free areas, generating a penetration of water in places where water was not present and generally causing damages on population, agriculture, livestock and infrastructure".

For the Federal Emergency Management Administration- FEMA (2012)(2), the following items can be identified as risks factors and flood causes:

- 1. Seasonal rainfall
- 2. Highly Intense short-lasting rainfall, especially in high river basins.
- 3. Global climate phenomenon
- 4. Dam ruptures (Natural or Manmade)
- 5. Large amounts of underground water.
- 6. Landslides, avalanches and lahars
- 7. Sea penetration caused by wave action, storms or tsunamis.
- 8. Glaciar melting

There are different kinds of floods:

- a. Slow (Alluvial or Plain)
- b. Sudden

Floods bring about a sensitive deterioration in the standard of living of the affected population, with material damage in the productive sectors and infrastructure. It is important to acknowledge that floods, in the medium-term, leave a favorable balance with the fertilization of the flooded ground, which makes the soil more productive and avoids the use of chemical fertilizers but this, in turn, promotes the occupation of zones in high flood ridk areas.

6.2.1.2. Measures to control Overflows

To solve the conflicts caused by floods, it would be good to take into consideration two kinds of measures:

- Preventive Measures. Try to regulate the use of floodplains in order to take the most advantage from them in a suitable manner; among the actions are: rules for the use of flood areas, flood forecasting system and the execution of hydraulic works to mitigate flood damage.
- **Corrective Measures.** These are applied to protect the urban and agricultural developments located in floodplains; and include fluvial regulation works such as reservoirs, marginal dikes, rectification and canalization of cannals, relocation of threatened facilities and implementation of drainage works.

Among the actions that can be developed to control Overflows are:

1. Structural Measures

They encompass high-magnitude infrastructural work, considerable investment and long terms of execution, including Regulation Dams, Marginal Dikes, Interbasin projects, improvement and protection of cannals and basins.

Reservoir

The storage of water in the upper course of the drainage basin is the most direct way, even though not necessarily the cheapest one to reduce floods on the lower part of the basin. The main purpose of the reservoir is to store water during the extreme condition flow in the river and discharge it when the critical conditions have passed. The selection between building small reservoirs in the headwaters and big reservoirs in the main course of the river has been controversial, and currently it is accepted that the small reservoirs are more a supplement to, rather than a substitute for big reservoirs.

In general, reservoirs are a good solution, but thry imply significant investment and require a long time time for the design and construction processes.

Side levys

It represents the oldest, most common and quite often the cheapest way to be protected against floods. It is based on two lateral edges (similar to small earth dams) in both sides of the river, intended to keep it in the natural conditions.

The biggest danger in the side levy system is that it provides complete protection until certain magnitude of the flow and then no protection is provided for higher flow levels, which can give a false sense of protection and the effects could be worse than a flood.

Interbasin

The most direct and possibly the most effective way to defeat a situation that gives rise to a flood; is to redirect the water from the riverbed. By doing that in a planned way it could be effective and the means to control water flow may be relatively economical. Some of the requirements to adopt that measure are: the area into which the water is redirected should be uninhabited or protected (it could be protected by secondary levys) to prevent the expansion of the water in different directions; drainage should be reasonably easy, so that the water can return to the river in the case of a flood and it should have good protection and control in carrying out the water redirection works.

Riverbed Improvement

This method contributes to decrease levels through the improvement of the load capacity of the riverbed. It can be carried out through the following actions: Decreasing the roughness of the riverbed, widening and deepening of the riverbed; shortening the riverbed, making the hydraulic gradient bigger, and through the control of the sediment transport.

Most of the time, these are expensive and not permanent solutions (in some of the cases with a high environmental impact), because it is hard to maintain the new riverbed due to the dynamic variations that occur in it. This solution is used almost exclusively when a suitable depth for fluvial transport is needed.

Watershed Protection

Even though it does not involve the development of engineering works, it constitutes a very efficient and non-expensive way of reducing the magnitude of the floods. The protection of the catchment areas is carried out by avoiding the indiscriminate depredation of natural forests and encouraging the reforestation on those areas which have lost the vegetal cover of the soil. Vegetation contributes to keep the water, decreasing in a significant way the magnitude of the flow of the flood, and it additionally protects the soil from erosion by avoiding the drag and deposit of large amounts of material on the lower areas causing sedimentation of the riverbed.

2. Non-structural Measures

Most of these measures are emergency solutions and can be part of the actions needed when floods have already occurred. They could have a temporary and limited effect for being part of an administrativetechnique system that requires time to be implemented. Some of these methods are:

- The pumping of the water stagnated in the floodplains
- Reordering the urban and rural space, aimed at facilitating temporary human settlements in nonaffected areas and cattle movement to pastures located in higher ground.
- Provide insurance and compensation to farmers for agricultural losses.
- Clean the riverbed
- Fumigation of areas that favor the spread of disease-carrying insects, etc.

These actions should be taken because the damage of the flood has already taken place, and it is an obligation to protect human lives. It will be good to mention within these measures, the importance of flood forecasting or the implementation of an early warning system (EWS) that reports on the approaching flood in order to be able to take preventive measures as needed.

6.2.1.3. Situation in Ecuador

The flood phenomenon in Ecuador is a complex issue of meteorological, oceanographic and hydrological incidence, for instance, the sea currents from the eastern pacific, the weakening of the trade winds, higher evaporation due to the high temperatures and the orographic effect of the Andes, bringing as a result, intense and persistent rainfall across the national coastline. In the hydrological aspect, it is a problem of fluvial mechanics, involving the overflowing of rivers, collection of rain water and the tidal influence (5).

In Ecuador, floods are recurrent, especially in the lower basins of the coast, basins of the Amazonian region and in some basins of the Andean region.

The main factors for the occurrence of floods in the country are:

- 1. Seasonal precipitation. Due to the high level of sedimentation on the lower areas of the basins, abundant rains are not needed for flood to occur in certain sites; this phenomenon worsens because of the occupation of river beds for agricultural production as well as the development of human settlements.
- 2. El Niño phenomenon. This is one of the main factors for floods in the country. It is considered a worldwide cyclic climate event of regional impact, which generates droughts or heavy rainfall.
- 3. Limited carry capacity of drainage systems in cities. The drainage systems built in the populated areas, were planned according to the precipitation historical records. However, due to climate change, there have been extreme precipitation increases within short periods of time, generating a large amount of water that was an impossible load to be carried by the installed drainage systems. On some other occasions, floods occur because of the low carrying capacity instead of the amount of rainfall. This phenomenon is linked to unplanned urban growth or a fast and aggressive expansion of the cities.
- 4. Damming of rivers. Due to poor management of hillsides, some landslides have occurred, bringing as a result the damming of some rivers causing floods in nearby areas.
- 5. Breakdown or Overflowing of dams and damming. It is true that in Ecuador, breakdown of artificial or built dams has never happened in the past, but we have had dam breakdowns of those due to landslides. Other floods have occurred during the rainy season, because, despite the controlled venting of the dam, the input flow is higher than the output flow due to heavyrainfall in the upper basins and the lack of models of decision making scenarios for the venting process.
- 6. Effects associated to volcanoes. Floods and high density flow events have occurred, associated to eruptive processes (this will be discussed in the next section).
- 7. Sea Penetration. These events are associated to risks factors such as tsunamis, large waves and tides; Their impact is increased because of human settlements located across the national coastal belt (the topic will be explained in the corresponding section).

Vulnerability in the areas with likelihood to floods and overflow is produced by different factors, including, the settlement of human groups on floodplains, the increasing agricultural work in high risks areas, the undersizing of the drainage network, the wrong layout of the roads thus creating artificial damming and affecting the proper drainage of rain water, foothill soil erosion from the uncontrolled logging of forest areas dragging as a consequence solids into the river, dumping of garbage and debris into the rivers without any consideration for the consequences, and destruction of the protection infrastructure in place to avoid overflowing.

In our country, the poor strata are the most severely affected with a further worsening of their living

conditions. Regarding food and nutrition, harvests can be lost and sowing delayed resulting consequently into food shortages.

Floods, no matter their origin, bring about secondary effects such as problems of health care, transport, mobility, trade, education, industry, fishing, public infrastructure, etc. thus increasing the costs of services, and rising the direct and indirect costs of the impact and recovery processes.

During El Niño event and Southern Oscillation-ENSO (Phenomenon Known as El Niño), of 1997 and 1998(3), the INAMHI carried out a hydrological survey, taking into account (INAMHI, 1999):

- Comparison between events El Niño 72-73 and 82-83
- Analysis of the normal average monthly flow and the average monthly flow 82-83 and 97-98
- Cause and Effect.
- Return period.
- Damages caused and areas flooded by province.
- Areas affected by flood and waterlogging in the coast, highland and rainforest.

The research was developed according to the effects of extreme precipitation in the riverbed of: Esmeraldas, Jama, Chone, Portoviejo, Jipijapa, Guayas, Zapotal, Taura, Cañar, Balao, Jubones, Arenillas, Puyango, Napo and Pastaza rivers. A total of 20.325.86 Km2 was defined as affected area. The analysis produced the following results, 5.974.37 Km2 flooded due to the overflow of rivers in the coast, highlands and rainforest, and 14.351.49 Km2 due to waterlogging in the coast and highlands.

To compare, floods that occurred in the year 82-83 in the Ecuadorian coast, a report from ECLAC states that areas in the coast were subjected to strong tides, that in many of the cases matched the overflow of some rivers. The total affected surface was of about 15% of the national territory; and had a direct or indirect impactin about 1 million of people. The exceptional point here was the high values of annual precipitation, of over 4.000 millimeters, with a recurrence period of 500 years. The total amount of damages was estimated to be at around USD 641 million. From that amount, USD 534 million (83%) were direct damages to the infrastructure and production, and the remaining USD 107 million (17%) were direct effects represented by unrealized revenues or non-processed products by the secondary sectors.

On the other hand, due to the irregular rain distribution across the national geography, the inter-annual cycles also showa large variations, causing extended drought periods and low river water levels, which is very common in Ecuador.

According to the National Secretariat of Water – SENAGUA, the biggest issue in Manabí and Guayas provinces, are the disasters caused by floods and/ or drought; for that reason the Secretariat started multipurpose projects, mainly aimed at building dams to control floods during the rainy seasons and to provide water to the population during periods of drought.

In parallel to the building of some projects, an early warning and hydrologic forecast system will be implemented to predict floods and/or droughts in a fast and timely fashion within the areas of incidence of the project; in coordination with INAMHI's national monitoring system.

6.2.1.4. Recommendations

- The INAMHI as governing body in the monitoring process of the hydro-meteorological activities in the country and responsible for the basic network of information, shall instruct and rule the research, design and construction of complementary networks for different purposes and exploitation, such as the Early Warning System to control floods.
- It is very important to collect immediately the information associated to previous impacts of floods to improve the hazard maps.
- The topic of risks associated to the water should be treated from a systemic point of view, with a wide participation of the public and private sectors and the community.
- Since floods are a complex issue with meteorological, oceanographic, hydrological and socioeconomic incidence, they should be holistically analyzed and treated with a massive interdisciplinary and inter-institutional involvement.
- The country has several experiences regarding the treatment and control of overflow, as well as in the implementation of structural solutions (Docks, Bypass, Etc.), and non-structural solutions in some hydrographic basins. All these experiences should be taken into consideration whensubmitting new programs and actions within the field.
- Support INAMHI in the implementation of the Hydro-meteorological Basic Network to further improve the existing network, and allow a better monitoring and delivery of decision-making information.
- With the support of international organizations, there are some Hydrological Forecasts of Extreme Event projects that were implemented; but once completed, those projects were not sustainable because of the lack of strategies and support.
- Implementation of systems that facilitate the forecasts and warning generation (e.g. Delft-FEWS-type Systems to do the follow-up of overflowing). The systems should be developed with the capacity to be adapted to the need of any hydrographic basin, including apps for hydric resources, drought prevention, hydrologic forecasts and real-time control.
- There is a need of establishing policies, guidelines and directives to update the research work and propose new research lines.
- The initiatives on the watersheds should be developed within the policies defined by SENPLADES, about deconcentration of activities, coordination between the local entities and massive participation of the beneficiary population.

- It is convenient to further increase the knowledge about the flood causes and effects, delving into the knowledge and analysis of the socioeconomic and hydric issues, specially the damages avoided.
- Gather institutional efforts to develop research studies, elaborate math and research models in the field of extreme hydrological phenomena and encourage the development of human skill and techniques in this area.
- Generate decision making knowledge about the management of hydric resources, dams and early warning systems, based on the premise that structural measures are not the only way to control floods or droughts.
- Increase the human and technical capacity to develop new projects and researches.
- Integrate the efforts of the institution to develop studies and researches on issues of common interest without duplicating efforts.
- Strengthen policies, directives and cooperation mechanisms between INAMHI-SGR to update information and further research floods and low water levels in Ecuador.
- Share experiences, studies, models and capacities in the region, related to floods and low water levels in Ecuador.
- Hold meetings, forums, workshops among the countries of the region, to analyze methodologies applicable to the knowledge of floods and low water levels.
- Undertake actions to decrease or interfere in the underlying drivers that cause floods and low water levels. E.g. the management of mountainsides, control of rainwater in urban centers, etc.
- Provide support to the project carried out by SENAGUA.
- For the management of geographic information, we recommend to implement the Spatial Data Infrastructure – SDI mechanism within the National Information System- SIN- framework. The SDI mechanisms are: transparency, interoperability, efficiency applied in an automatic way to meet the institutional requirements needed for the planning, response and decision making.
- Encourage the integrated studies on hydrographic basin, precipitations on high and low basins and floods, as key element for risk management planning, taking the hydrographic basin as planning structure.

6.2.2. Extreme Hydro-meteorological events - Droughts

6.2.2.1. Description

Droughts can be defined as a transitory anomaly in precipitations, with some water but under the statistic requirements of a specific geographic area (3). The amount of water is not enough to cover the biotic needs of an ecosystem.

The main cause of every drought is the lack of rain or precipitation, this phenomenon is named meteorological drought and if it persists then it becomes a hydrological drought, which has as a main characteristic the inequity between the amount of water available and the natural water demands; also there is the agricultural drought in which there is a deficit to cover the agricultural production demands. By analyzing them as natural phenomena, droughts have been present in recurrent way and in some dates in specific cycles, in many areas around the globe (3). There is a theory in which the origin of the drought is questioned, either is caused by natural origins or if floods are totally related to human activities.

Heavy droughts have strong impact on socioeconomic development. Apart from being a main cause for desertification, it has an effect on human activities. It is important to acknowledge that man made desertification⁹ has become one of the biggest environmental issues nowadays and it is no stranger to Ecuador. This phenomenon mainly affects arid, semi-arid and sub-humid dry areas, and it results from different factors, including the climate changes and mainly the human activities (2).

Many of the human crises have had droughts as a trigger as long as proper strategies were not applied in mid or long term. The later can even happen in countries with a high socioeconomic development.

Among the effects of drought are:

- Production of food and fiber, main objective of agriculture, can be affected in considerable proportions due to the inadequate distribution of rainfall, generating direct and indirect losses (1).
- 2. Loss of livelihood of small farmers, forcing them to sell their productive assets and means of livelihood (3).
- 3. Increasing vulnerability of the population because of lack of food security. (3)
- 4. Increasing diarrheal diseases and decreasing sanitary conditions.
- 5. Forest growth decrease. (3)
- 6. Presence of secondary effects such as forest fires.
- 7. Overload in house duties, especially women and housekeepers.
- 8. Lack of water in urban centers.
- 9. Macroeconomic impact on the country (3).

This phenomenon is linked to the landuse, in which underlying socioeconomic factors, such as poverty and inequitable resource distribution intervene as well as environmental issues such as inappropriate land use systems and agricultural methods.

Damages and negative effects caused by low water level result in the stagnation of several activities (Industry, Trade, Bank, Urban Transportation, Agriculture, etc.) and economic losses.

6.2.2.2. Situation in Ecuador

- Rain distribution in Ecuador is very irregular, geographically speaking; inter-annuals cycles also have a great variation, bringing as a result prolongued drought periods.
- There is a proposal to design a new meteorological station network, through which, it will be possible to collect all information related to the drought periods. The main goal is to have hydrometeorological information and develop a trend to know more about this phenomenon and study mitigation alternatives.
- Some studies have been carried out, that allows to analyze the behavior and availability of humidity in different areas across the country; among them; "Hydric balance. Determination of drought and precipitation indicators in different locations in Ecuador" (2002) and "Determination of Area Vulnerable to desertification in Ecuador" (2007).
- With the purpose of supporting the development of the country, many sectors especially the agricultural, energy, sanitation, and some other; designed and built hydrotechnical structures that allow to collect water from rivers and generate hydroelectricity, water to irrigation and drinkable water; sometimes those structures are about to collapse due to the low water level periods.
- E.g. the energy crisis from the first quarter of 1993, resulted in losses of USD 70 million. Something similar happened in 1995, when losses were estimated at USD 500 million. Following eight days of rationing, by mid October 1997, 24.5 million were lost" (5). In the last years, at the end of 2007 and beginning of 2008, there was a low water level situation that affected the country. While trying to address the electrical deficit some environmental effects came up, due to the use and implementation of a thermal power station, which has high operating costs and is highly pollutant due to the burning of fossil fuels.
- There are some initiatives that have been executed , such as "2006 Emergency Support for the agricultural rehabilitation of small farmers affected by ice storms and floods in the provinces located in the Inter-Andean Corridor in Ecuador", executed in coordination with the Ministry of Agriculture and Livestock. The treated areas were exclusively prioritized according to the impact of the ice storms and floods on the small farmers of marginal organizations, who harvest their strategic products so as to achieve a relative level of food security. The project was not continued and currently is in a stand-by stage.
- In Ecuador, we have had desertification processes that require special attention.
- The Monitoring Meteorological Stations have been selected and a Basic Network of Stations has been designed to achieve a better and clearer understanding of hydric conditions in the different regions of Ecuador, prone to desertification.
- There are research studies on the drought situation in Ecuador, and there are evendrought-related theme maps.
 - There are national instruments available and developed with the support of international entities.
- Dissemination of weather news reports and

⁹ Man-made desertification: Is an ecological degradation process, which affects fertile and productive soil potential. This term is usually mistaken by the term desertification. On the other hand, desertification is a region's natural evolutionary process to morphological, climatic and environmental conditions which are known as desert.

climate-related warnings, training sessions and workshop-seminars, addressed to farmers of the Andean region, in which meteorological aspects and the ways to decrease the effects of droughts are explained in layman's terms.

- A drought-related data bank has been setup (FAO archive to build the drought map- Emergency Support Project for the agricultural rehabilitation of small farmers affected by ice storms and floods in the provinces located in the Inter-Andean Corridor in Ecuador)
- Develop strategic alliances with farmers, authorities and local, province or national organizations; beneficiaries received technical information that will keep them totally informed about the origin and development of potential atmospheric adverse events (Meteorological reports, weather newsletter, climate warnings, etc.). This activity was reinforced with field activities with the farmers. Currently this information is not delivered anymore.
- There is no proposal to institutionalize drought monitoring and prevention in Ecuador.
- There is only a few trained people who can be part of activities, such as monitoring, assessment, etc.
- The national instruments to complement drought monitoring, have not been developed.

6.2.2.3. Recommendations

(This section should be read jointly with those that are related to floods and climate)

- Desertification is an environmental and socioeconomic issue that requires special attention, nationally prioritized through intersectorial teams.
- Having as a foundation the researches and experiences developed, prepare a proposal for the monitoring and prevention of droughts in Ecuador, and as part of a national threat monitoring system.
- Monitoring results, including the creation of medium-term scenarios, will provide information and will be a tool for action planning and impact assessment.
- The relationship between INAMHI and MAGAP should be strengthened, allowing support for prevention activities in connection with frosts and drought effects.
- Develop protocols in order to inform the population in a timely manner regarding the warning and forecast bulletins prepared. Information must reach the ATD (Technical Area Office) to enable timely dissemination.
- The project 'Emergency support for agricultural rehabilitation of small farmers affected by frost and drought in the Inter Andean provinces of Ecuador' must continue in order to consolidate its results. MAGAP is responsible of establishing plans and strategies for this purpose.
- Climate events are becoming more unpredictable; in addition to their practical experience, farmers should also have climate information to help them prevent the negative effects of frost and drought.
 - INAMHI should be strengthened in its ability to operate and maintain weather stations and issue

forecasts on a 24-hour basis; this information should be disseminated through a network (e.g. community radio) to prevent the effects related to frost and droughts; FAO recommend this in 2006.

- The above points can be strengthened through partnerships with local bodies (municipalities, parish councils and other bodies) as already secured in Azuay and Chimborazo; in several provinces these partnerships are being started.
- Agrarian Councils can be organized, similar to those operating in Carchi Province. Their purpose is to coordinate work with communities and MAGAP technical departments. This is a good model to follow to make contact with farmers.

6.2.3. Seismic and volcanic activity in Ecuador

6.2.3.1. Volcanic Risk (1)

One consequence of the interaction between Nazca and South American plates is the presence of an active volcanic chain (or volcanic arc) in the center north Andes, characterized by more than 80 volcanic systems (Figure 1) of Plio Quaternary Age (less than 2 million years). Among volcanoes that make up the Ecuadorian arc, at least 25 have shown very large eruptions during the last 10,000 years (Holocene, less than 10,000 years); of these, 8 volcanoes recorded recurring eruptions in historical times (after the Spanish conquest in 1534 AD). All these, without mentioning Galapagos Islands volcanoes, one of the most active volcanic centers in the world.

Volcanic eruptions also pose a great threat for Ecuador, due to the high population density of the Ecuadorian Andean valley. Indeed, most of the populations of the North Central Sierra are settled within 25 km of an active volcano in the Inter-Andean Valley, in areas already affected in the past by volcanic eruptions (e.g. Quito, Valle Los de Chillos, Latacunga, Salcedo, Cayambe, Otavalo, Ibarra, Ambato, Riobamba, Baños). In addition, there is the fact that the poor rural populations in social disadvantage which are not very resilient and more vulnerable are located in areas of high impact because of volcanic ash (i.e. Tungurahua, Cotopaxi, Chimborazo), which directly affects their sole source of income: agriculture and livestock.

This is clearly seen with the significant eruptive activity (Volcanic Explosive Index VEI \ge 3) and recurrence shown by Guagua Pichincha (1660 AD), Cotopaxi (1533, 1742-44, 1768 and 1877, Hall et al., 2008; Andrade et al., 2005) and Tungurahua (1640, 1773, 1886, 1916 – 1918; 1999 to this date, Hall et al., 1999; Le Pennec et al., 2005;. Samaniego et al., 2003) historically. These eruptions were characterized by a highly explosive eruptive activity with pyroclastic flows that descended along the flanks of volcanoes, a wide dispersion of ash and, in the case of Cotopaxi, the generation of significant flows of mud and debris as per historical reports (Wolf, 1878; Sodiro, 1877); compiled by Egred, 2001

The eruption of Cotopaxi in 1877 was particularly

important as mudflows affected Los Chillos and Latacunga Valleys causing significant casualties (1,000 victims) and a serious economic crisis. The social and economic implications of a large eruption of Cotopaxi would be catastrophic today, due to the current high population density in these areas and also because they are an important centers of economic development.

It is obvious that starting a decade ago, Ecuador has experienced a resurgence of eruptive activity with the eruptions of Guagua Pichincha (1999-2000), Tungurahua (1999-2012) and Reventador (2002 to 2012). These eruptions have had a significant regional impact like ash reaching Quito related to the eruptions of Pichincha and Reventador as well as a very serious local impact to the communities living around the Tungurahua volcano.



Figure 1. Map of volcanoes with historic Holocene and Quaternary history in continental Ecuador Source: Prepared by IG-EPN

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6.2.3.2. Seismic Risk (1)

Ecuador is a country of high seismic and volcanic risk, as evidenced by the 70,000 earthquake victims during the post conquest historical period.

Off the coast of Ecuador in the subduction zone of the Nazca plate under the South American plate, we have experienced the biggest earthquakes in the history of the country (Figures 2 and 3).

The major effects caused by earthquakes, have been registered in Central and Northern Highland areas, directly related to the earthquakes of moderate magnitude, M 5 - M 7.5, located in the contact zone between the South American plate and the North Andean Block, and the type of construction that has dominated the Sierra, this is the sun dried brick (adobe), which is one of the weakest materials to withstand seismic forces.



Figure 2.Map with seismic (1541 - 1986) and instrumental (1987-2008) history. Source: Prepared by IG-EPN



Catalogue of Events Without Aftershocks February 16 - 2011

Figure 3. Map of important seismic activity registered by instruments in Ecuador since 1900 Source: Preparation IG-EPN

A high population density and urban development pressures make the country highly vulnerable to earthquakes. Unacceptable loss of human lives and slowdown in the emerging national development have accompanied the disasters caused by large historical earthquakes in Ecuador, for example, Ambato in 1698, Latacunga in 1757, Riobamba in 1797, Ibarra in 1868 and again in 1949, and Northeast Ambato in 1987. On the coast and associated with the subduction process, there have also been large earthquakes with significant regional impacts such as those of: Manabí 1906, Esmeraldas - South West of Colombia, 1942, Manabí - Guayas 1953, El Oro – Guayas 1958, Esmeraldas 1970, Loja 1979 and south western Colombia and the northern part of Esmeraldas in 1979. Human and economic losses caused by these big earthquakes and other minor ones of local scale, have strongly influenced the country growth and the sustainability of its development. Such is the case of the earthquake in the northeast (1987), which not only caused the death of at least 1,000 people, but also economic losses of about U.S. \$ 1 billion in property damages, especially the trans-Ecuadorian pipeline breakdown.

Analyzing the past 20 years, we find that after the 1987 earthquake the events were not serious but highly destructive and ruined more restricted areas which also caused significant local impact. These are: the southeast event, known as the 1995 Cutucú

earthquake; the 1996 event in Pujilí and the last one in Bahia de Caraquez 1998. The twenty-first century, so far, has been abnormally quiet as the seismic intensity is concerned, although 14 years have passed since the last event of destructive characteristics (Bahía de Caraquez). The last earthquake of 7.3 magnitude in August 12, 2010 despite its magnitude did not cause major damage, because of its highly unusual feature of having being located at a depth of over 230 km at the hypocentral shear zone of the Nazca plate.

6.2.3.3. Recommendations

To analyze minute by minute the level of activity of seismic and volcanic sources and to issue early warnings on the one hand and on the other, provide permanent public information about the characteristics and condition of the threats; it is necessary to have reliable seismic and volcanic monitoring of national coverage by geophysical, geodetic and geochemical instrumentation of visual and remote observation and with continuous transmission of data in real time, 24 hours a day, 7 days a week, and a processing and analysis center of scientific data and dissemination of warnings and other relevant information. This is a task of high technical complexity and high logistics demand.

Some of the problems that have been identified in the case of Ecuadorian society responses to address seismic and volcanic phenomena are:

- High exposure to the impact of earthquakes and volcanic eruptions, high vulnerability of the State and society to these events and poor responsiveness of the National Decentralized Risk Management System (SNDGR) due to limitations of early warning systems and immediate notice.
- Difficulties for optimal 24/7 operation of the seismic and volcanic monitoring networks, and limited automation of analysis and information processes.
- Limited capacity for rapid response of the National Decentralized Risk Management System before possible effects of earthquakes in the territory, including the potential for tsunami generation in the absence of immediate information on location and size of earthquakes, their mechanisms of generation and their capacity to cause damages.
- Poor access of the National Decentralized Risk Management System to information on the realtime monitoring of active volcanoes and difficulty in understanding the meaning of the activity recorded and the early warnings issued.
- Poor development and implementation of regulations for earthquake-resistant construction because of the limited knowledge of the potentiality of generation and impact of earthquakes in the country, and limited dissemination of seismic hazard maps.
- Difficulty of the National Decentralized Risk Management System to assimilate the significance and size of volcanic risk allowing urban development in areas of high vulnerability, regardless of the risk. Little knowledge of volcanic hazards in areas of recent urban development but with high population density.

6.2.4. Tsunamis

6.2.4.1. Situation in Ecuador (1) (3)

The current and past seismic situation, as well as the very dynamic geomorphology, suggests that a strong earthquake can generate a tsunami with its already known consequences. However, it is important to highlight that the Ecuadorian coast has a very active geodynamic context, similar to other shores in the Pacific. This leads to the analysis of a tsunami threat that considers the distance from which the event can occur in relation to the Ecuadorian coast. And for this analysis, threats of distant, regional and close origin are considered. The last two can cause the greatest impact in the Ecuadorian coastal region as they are generated very close to the territory.

A statistical analysis of seismicity between 1955 and 1995 shows that events of greater intensity occur more frequently in the western Pacific area. In this area, large tsunamis are generated, which are defined as a major threat to Ecuador due to the "directivity" acquired once the tsunamis are generated (INOCAR 2011) (2).

Another area which is considered a major threat to the Ecuadorian coast is the Central American region and the coasts of South America, mainly the Chilean coast. The events that are generated in both the north and the south may have an energy distribution that affects island and inland coasts. According to the available information, this region has the highest seismic activity after Japan (Lomnitz, 1970).

It is known that tsunamis of local origin are the most dangerous to the coasts in any part of the world, because of the time and height of arriving waves. They can take between 10 to 30 minutes after the earthquake occurred (for Ecuador) and reach up to 30 meters in the worst-case scenarios, depending on the geodynamic framework in the coastline bordering the ocean. Based on the analysis of the magnitude of the events, it has been determined that earthquakes in the Continental Shelf can be of a magnitude greater than those of the interior and with enough energy to generate tsunamis. For example, the earthquake on January 31, 1906 of 8.7 in magnitude on the Richter scale, which caused a tsunami in front of the province of Esmeraldas.

Due to the afore mentioned, in 1976 the Oceanographic Institute included in its institutional projects the study of tsunamis. Since then, has also become a part of the Tsunami Warning System as part of the global network of tide gauges. For this, the State has appointed this Institute as official representative for the Pacific Tsunami Warning System (PTWS). It is the Focal Point and National Contact for the reception of information, warnings, alarms or cancellation messages from the Pacific Tsunami Warning Center (PTWC), located in Hawaii.

Since 1989, studies have been conducted to determine the threat of local tsunamis that may arise in the Ecuadorian coast. Supported by the United Nations, from 1989 to 1996, an assessment of the expected heights and/or impacts by tsunamis along the mainland coast, was conducted. The first study was performed in 1989 in Santa Helena, Salinas and Libertad (currently Santa Elena province). For 1992, the study was conducted in Esmeraldas, which resulted in flood maps for the entire province. In 1993, wave heights in the entire Manabí province were determined. In 1996 the studies were supplemented with work carried out in El Oro province. This information about the threat resulted in the development of risk maps of the entire coastal profile, made by the Civil Defense.

Since 1996, the methodology for determining the threat was implemented, validated, and improved using numerical models to reproduce tsunamis physical process. These models have been positively tested in most countries, so INOCAR has applied this methodology in its current studies. The models require inputs such as fine bathymetry and topography, as well as seismic sources studies for a better approximation of the results.

Regarding monitoring of the threat, since 2007, INOCAR has implemented the National Center for Tsunami Warning, which permanently observes the occurrence of earthquakes in the Pacific Ocean on a 24/7 basis. Its purpose is to keep the Coastal communities and authorities at various levels informed on the occurrence of tsunami events in the world. This monitoring was strengthened with the acquisition, by SGR, of buoys that are monitored by INOCAR. One of them is installed, since October, 2011 off the coast of Manta, around 100 km off the coastline, in a reef of 1615 m and it is already part of the monitoring network of PTWS. The second is a backup point when maintenance to other buoys is required. A network of tide gauges is maintained and enhanced to obtain in real-time information. There are also very fine detection devices, located at great depths, to determine the water column deformation from open sea.

Another objective of the National Center for Tsunami Warning is to transfer information about tsunamis to the community, through written media and other means. Therefore, INOCAR plans activities aimed at improving knowledge about tsunamis in mainland and island coastal populations.

6.2.4.2. Recommendations

- Conduct a national study on tsunami sources, which would cover the information and knowledge gap at technical level.
- Complete the studies on the effects of tsunamis of distant origin in the Ecuadorian mainland coast.
- The local threat has been extensively studied for several years and it is still institutionally relevant and important for SGR. However, the risk to the different coastal areas must be determined taking into consideration the vulnerability of growing populations along the coast.
- To promote the densification of bathymetric and topographic data in order to improve the quality

of the output of the models and achieve a better approximation of the physical information of tsunamis.

- To conduct studies to find the local effects that tsunami waves generate in the different water bodies of the Ecuadorian coast, whether they are bays, coast lagoons or others based on the occurrence of past events.
- To promote the use of real-time information from tide gauges in order to calibrate the models used to determine probable heights and times of wave arrival.
- It is advisable to strengthen institutional capacities through human resources, to allow for the development of new projects and activities aimed at improving the knowledge about tsunamis.
- To seek knowledge transfer from international entities, whose technological development has advanced much more than the national development.

6.2.5. Mass movements (landslides)

6.2.5.1. Description

In 2007, the former Ecuadorian Geological service, along with other Geological Services of the Andean region, carried out the Andean Multinational Project. It included the Group of Standards for Mass Movements-GEMMA (2007) (2). It defined 'mass movements' as any downhill movement of a mass of rock, debris or earth, due to gravity (Cruden, 1994). David Varnes (1958) introduced the types of hill movements in the "Landslides- Analysis and Control", using the type of material (rock, debris, earth) and the type of movements (drops, overturns, lateral dispersion, flows).

According to Sass (Ed. 2007) (4) landslide science is a new scientific discipline that requires interdisciplinary research that includes:

- Water Sciences: meteorology, hydrology, hydraulics, etc.
- Earth sciences: geology, geomorphology, seismology, volcanology, geodesy, etc.
- Cultural Heritage and Environment: Protection of the cultural and environmental heritage.
- Engineering Sciences: Civil Engineering, forestry, mining, etc.
- Social Sciences: politics, administration, risk management, recovery, etc.

The following chart sets out the relationship among sciences in the study of landslides.



Figure 3: landslide science as an integrated discipline, based on Progress in Landslide Science, Sassa, ed. 2007.

According to Popescu (1994) (3), the principal factors for landslides are:

Ground Conditions

- Weak and plastic material
- Sensitive Material
- Collapsible Material
- Altered Material
- Fractured Material
- Material with fissured seals
- Unfavorable orientation of the seals (schistosity, cleavage)
- Unfavorable orientation for discontinuities (flaws, inconsistencies, sedimentary contacts)
- Contrast of permeability and effects of groundwater
- Contrast of rigidity (material rigid, dense on the plastic material)

Geomorphological Processes

- Tectonic lifting
- Volcanic lifting
- Glacial regression
- Fluvial erosion on the foot of the hillside
- Erosion by the waves on the foot of the hillside
- Glacial Erosion on hillsides
- Erosion of lateral margins
- Underground Erosion (dissolution, caverns)
- Vegetation removal (by erosion, drought or fire)

Physical processes

- Heavy rainfall
- Rapid melting of snow
- High and prolonged rainfall
- Rapid reduction after floods, high tides or rupture of natural dams
- Earthquakes
- Volcanic eruptions
- Rupture of crater lake
- Thawing of the 'permafrost'
- Freezing and thawing of the ground
- Shrinking and swelling of expansive soils

Manmade Processes

- Excavations at the foot of the slope or hillside
- Overload in the crest and the slope
- Location of reservoirs
- Irrigation
- Faulty maintenance of the drainage system
- Water leaks from services (water, sewage, storm water)
- Removal of vegetation
- Mining and quarrying
- · Creation of very loose waste landfills
- Artificial vibration

For Cruden and Varnes (1996) (1), there are several types of mass movement.

- Slides (rotational, translational, on wedge, complex and compound)
- Rock falls
- Rocks overturn
- Lateral dispersion
- Creep
- Flows (debris, rocks, dry objects, mud, dirt)

6.2.5.2. Situation in Ecuador

Ecuador is subject to a series of geological threats (volcanism, seismicity and mass movements), because of its location in the so-called Pacific Ring of Fire, which has generated areas prone to earth movements. Therefore, fatalities have occurred and populations and infrastructure have been destroyed, negatively affecting the social and economic development of the country.

Additionally, anthropic activities can cause mass movements, particularly when big infrastructure works take place without taking into consideration the physical and mechanical properties of the soil and subsoil, affecting or even destroying it. Consequently, the State has to invest large sums of money in their reconstruction or rehabilitation, which may be more costly than a new construction in a safer place.

In the past few years, there has been great investment of economic resources in the rehabilitation and reconstruction works of large-scale infrastructure destroyed by mass movements. For example, the landslide that occurred in Quito - Baeza - Tena road in June, 2001 produced 26 fatalities, a rupture of the pipeline, oil spillage, and road obstruction and therefore affected activities in the region, causing considerable losses to the Ecuadorian State. The effects could be reduced if there were a map of susceptibility and danger due to mass movements of the country, thereby facilitating the implementation of risk reduction programs, early warning systems and contingency plans.

The following table provides a summary of the main situations that occurred in Ecuador during the past two centuries, related to mass movements that caused life or material losses.

Secretariat of Risk Management
DATE	TYPE OF PHENOMENON	PLACE AFFECTED	CONSEQUENCES
1640	Landslide	Cacha, Riobamba Canton, Chimborazo province	Disappearance of Cacha: approximately 5,000 fatalities
1918	Tungurahua volcano eruption	Baños and other nearby towns	Mudflows that devastated some sites, destroyed houses and bridges and killed animals
1987	Earthquake	Amazon - Pichincha - Imbabura	Reduction of 60% of export earnings (damage in Transecuaoriano pipeline), close of tracks by landslides, isolation of populations
1993	La Josefina landslide	Paute River	50 Deaths and \$147 million in direct damage
2001	Huangu Ravine landslide	Papallacta – Baeza Road	26 fatalities, pipeline fracture, oil spillage, obstruction of the highway and environmental damage

Source: FlorentDemoraes and Robert D'Ercole, 2001, Chart of risks and capacities in Ecuador, COOPI, OXFAM, SIISE

According to the geological, mining and metallurgical research available, some of the main limitations that still exist include:

- Lack of effective mechanisms to allow people to obtain the maximum benefit of geoscience.
- The information does not always reach the institutions/persons that need it.
- Decision-makers have limitations in the understanding of the information received and in their knowledge of tools and media for application, or they are simply unaware of the existence of the information.

Another factor to be considered is organized and planned urban growth. In order to do this, information on geological threats and mass movements must be timely and essential to ensure proper land use in the construction of infrastructure and works and for the population.

Between 2002 and 2008, INIGEMM was part of and worked in the Multinational Andean Project: Geoscience for Andean Communities WFP: GCA. This is a cooperation project among the Canadian International Development Agency, the Geological Service of Canada and the Geological Service of Argentina, Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela. This project began in June 2002 and ended in December 2008. The eight participating countries recognized the need to work on the investigation and mitigation of natural threats, in accordance with the conclusion at the UN/ISDR and the Summit of the Americas in Quebec City. From 2004 onwards, complying with the mandates of 'Project GCA', a pilot project was established in Reinaldo Espinosa's housing development in Loja. A detailed geological, geotechnical and socio-economic investigation was carried out in the community involved. It was complemented with the drilling and installation of monitoring systems, using inclinometer, piezometer, differential GPS, extensometer and cracks measurement. The monitoring and control was carried out in 2005 - 2008 by technicians of the National Geological Service - currently INIGEMMin collaboration with students from the Technical University of Loja.

Additionally, susceptibility was assessed by mass movement processes of Loja - Zamora and Loja-Saraguro and Cuenca – Loja roads.

In the Southern Zone, which comprises Loja province, in the border with Peru, further investigation was conducted due to the geographical location and in order to carry out joint projects with technicians from the Geological Institute of Mining and Metallurgy of Peru – INGEMMET. With this it was possible to produce geoscientific information that will benefit both countries, since this area is subject to multiple mass movement processes, which has a negative impact on the socio-economic development of the southern region. The binational Ecuador-Peru Geological Map was produced at 1:500 scale, between 3 and 6°S as well as a mass movement processes inventory map in Loja, Zamora Chinchipe and El Oro provinces.

In 2006 – 2007, a research study was conducted on mass movement processes in Yuquin, Pimampiro canton, Imbabura province. The result is a map of susceptibilities to mass movement processes and a socio- economic diagnostic of the community involved.

In 2011 the map of susceptibility to threats by mass movement processes of Chunchi canton, Chimborazo province was created.

At the beginning of 2012, INIGEMM began with the investment project "Zoning of susceptibility and risks/ threats by mass movement processes at 1:50,000 scale, phase I", which covers the whole national territory in the 23 provinces, except for the Galapagos Islands. But Phase I focused on the most vulnerable areas (populated areas, public and strategic infrastructure projects) in Chimborazo, El Oro and Imbabura provinces. Currently this project is running in two pilot areas (Zaruma and Riobamba) to obtain a map of susceptibility/threat by mass movements, which will be made and evaluated with standard methodologies in the investigation of this phenomenon.

INIGEMM has an inventory of mass movement processes of the national territory on a 1:1,000,000 scale, with written press information compiled and provided by the National Polytechnic School and from the research conducted by the institution until 2009. The inventory map contains the georeferencing of approximately 2,700 mass movements, classified by type of process. There is also a preliminary map of zoning of susceptibility to the geological threat, in particular of the mass movements in the Ecuadorian territory on 1:1 '000,000 scale, which is currently being methodologically validated.

The results of the investigations are detailed in the 150 technical reports in the Geological Mining and Environmental Information Center CIGMA of INIGEMM. They are available to general public and were given to the stakeholders for the application and implementation of conclusions and recommendations. The information generated will be a basis for the National Risk Management Secretariat for the design and implementation of appropriate risk management systems in high risk and vulnerability areas.

6.2.5.3. Recommendations

- To discuss the mass movement theme (landslides) from a systematic point of view and a multidisciplinary participation of several public and private sectors
- Feed INIGEMM data base. When feeding of the Systematization Project has been concluded, the results in the regions of the country will be calibrated.
- Implementation of monitoring and control system in real time regarding active landslide in Ecuador.
- It is necessary to establish policies, guidelines and instructions to update studies made and propose new researches on landslides.
- Use the final product of the research of the Project 'Zoning of susceptibility and dangers / threats due to landslides at a scale of 1:50.000', for Risk Management and Zoning.
- Increase the technical and human capacities of INIGEMM for the development of projects and studies.
- Integrate the efforts made by institutions to develop studies and research on themes of common interest to avoid duplication of efforts.
- Strengthen cooperation policies, guidelines and mechanisms among INAMHI-SGR-IGM-IEE-IG to update and research mass movements (landslides) in Ecuador.
- Share experiences, studies, models and capabilities in the region related with mass movements (landslides).
- At level of countries of the region, hold meetings, forums, workshops in order to analyze methodologies applicable to the landslide knowledge.
- Improve the hydro meteorological station network, both conventional and automatic, in order to have meteorology and hydrologic information available which is applicable to the case of mass movements (landslides).
- Perform actions to reduce or intervene in underlying factors causing mass movements (landslides) namely manipulation of slopes, control of rain in urban centers etc.
- For the management of geographical information, it is recommended to use the mechanisms of Infrastructure of Spatial Data (Infraestructura

de DatosEspaciales - SDI in the frame of the National Information System (SistemaNacional de Información – SIN). SDI mechanisms are: transparency, interoperability, efficiency and opportunity automatically used to respond to necessary institutional demands for planning response and decision making.

6.2.6. Waves and tides

Currently at global and regional level, coastal countries are making great efforts to implement and strengthen ocean observation, considering that alterations can occur in the climate regime with extreme events. This affects people and causes material damage, becoming an obstacle to sustainable development of countries.

Ocean processes, which normally occur in the coastline, are of vital importance for people's development. The permanent incidence or sudden arrival of waves changes the coastline in thousands of years or, in extreme cases, in a few months and even days.

On the other hand, Ecuador has a great biodiversity of marine and coastal resources, with a coastline zone densely populated and exposed to multiple threats such as swells, coastal erosion and sedimentation processes, which occur at any time of the year.

INOCAR and education institutions, such as ESPOL, have carried out research in different points in the Ecuadorian coast, in order to determine the dominant regime of waves in the Ecuadorian shore, as well as to identify frequent heights and periods. Furthermore, studies of the sediment movement have been conducted in several coast areas in order to determine areas of greater erosion on the coast and to determine a base line. For these studies, there are instruments to obtain information from waves in specific sites with a maximum depth of 25 meters, which is ideal for coastal buildings. However, to have a better knowledge of waves with greater spatial coverage, it is necessary to acquire new equipment to obtain information of greater spatial and temporal resolution.

There is currently a limitation in obtaining information from the coastal-marine area. INOCAR does not have equipment for permanent measurements due to the great investment required for constant monitoring and maintenance of the equipment. This equipment can be funded if there is sponsorship from private or public entities that require specific studies on wave action, in order to build or create shore structures.

INOCAR, sponsored by SENESCYT, is updating its monitoring equipment. It is now purchasing two buoys for wave measurement. This, along with the implementation of a model of shallow waters, will improve the spatial and temporal information of waves in Ecuador.

6.2.6.1. Recommendations

 Strengthen capabilities of personnel working on the topic of waves, on data analysis, on numeric modeling, sponsoring fourth level studies or internships.

- Strengthen and validate the data base with INOCAR information and similar institutions in order to determine quality, density and usefulness with available data.
- Strengthen the use of models to make forecasts, promote development of local models.
- Determine zones of potential danger due to surges in the Ecuadorian coast and islands.
- More frequent studies of sediment transportation in the coastal sector; with the purpose of determining the more efficiently the dynamic sedimentary balance of the Ecuadorian coasts.
- Increase the density of the information collected in local areas in order to make a better characterization of a given area.
- Sponsor technology transfer from abroad to the GAD in order to analyze the predominant regime of waves in the Ecuadorian coast

6.2.7. El Niño - Southern Oscillation (ENSO)

6.2.7.1. Description

El Niño-Southern Oscillation (ENSO) is an adapted ocean-atmospheric phenomenon which consists of the interaction of the surface waters of the tropical Pacific Ocean with the surrounding atmosphere. ENSO is related to climatic disturbances in many parts of the world. Especially the west coast of South America that is clearly affected by signs of this ocean-atmospheric phenomenon.

Its ocean component, related to the behavior of the surface temperatures of the tropical Pacific Ocean, causes the occurrence of two events: El Niño, which appears with warm anomalies, and La Niña, which appears as cold anomalies of ocean temperature. The atmospheric component, measured quantitatively by the index of Southern Oscillation, which is a reflection of the relative change between the atmospheric pressure at sea level between western sectors (surroundings of Darwin, Australia) and the east-central area of the Pacific Ocean (surroundings of Tahiti island).

Currently, there are several investigations about the formation and development of El Niño; the most well-known are the following.

Wyrtki Theory (1979)

El Niño is a reaction of the equatorial Pacific Ocean to the prolonged increase of the drag force of the winds. "Strong southeast trade winds blow for more than 18 months, carrying an accumulation of hot water in the western Pacific, a raise in sea level and a decline of the thermocline. As soon as the winds weaken, the accumulated water tends to flow back into the Pacific, causing a rise in sealevel and the decline of the thermocline along the South American coasts. The arrival of warm water along the coasts marks the beginning of El Niño".

Barston (1994)

Declares that at the moment there is not an entirely satisfactory explanation for this event. The results obtained by different teams of researchers indicate that the origin of the phenomenon is very complex. Satellite observations give an overall view of the ocean basin, interpreting the spatial and temporal scales that characterize El Niño.

Comparative analyses of past El Niño events show that they are not completely similar, although they have common characteristics. Rasmusson and Carpenter analyzed six events after 1945, split the events into several phases, thus creating a canonical or standard event, without forgetting that this is only an approximate simulation. A typical event begins early in the year, evolves during the spring (Northern Hemisphere) up to a maximum phase reached in the following boreal winter and ends after 10 to 15 months with exceptionally high temperatures throughout South America.

Stages of an ocean – atmospheric anomaly

Preconditioning phase. It occurs at the end of the boreal summer of the previous year; the sea surface temperature in the eastern portion of the Pacific basin is weaker than normal and trade winds are stronger.

Initial phase. At the end of the year an initiation phase of the process is set. Positive anomalies of sea surface temperature appear along the South American coasts to the south of 10° south latitude and around the dateline (180° longitude), trade winds decrease from September-October west of 180° longitude, the gradient of the thermocline begins to decrease.

Maximum phase. In the following spring, a strip of hot water extends from the Colombian coast along the equator up to approximately 140° west longitude, as well as along the coasts of Ecuador and Peru, where anomalies reach 2° to 3°C and reach their maximum height in April, May or June. At the same time, the sea level rises in the coast, both north and south of the equator and the thermocline declines.

Transition phase. At the end of the summer, coast anomalies tend to disappear, while the warm water strip spreads all over the Pacific. In the west, trade winds are reversed, blowing towards the east.

Stage of maturity. In January, the warm event starts a mature phase which is the maximum extension of temperature anomaly in the sea surface. A second maximum anomaly is observed along the South American coasts and corresponds to the absence of seasonal cooling that usually occurs during the boreal summer (northern hemisphere).

Indexes for monitoring of El Niño event

To systematize ENSO monitoring, the international scientific community divided the basin of the tropical Pacific in four regions: Niño 1.2 (80°W-90°W and 10°S), Niño 3 (90°W - 150°W and 5°N - 5°S), Niño 3.4 (120°W - 170°W and 5°N - 5°S) and Niño 4 (150°W - 160°E and 5°N - 5°S).

Several indexes have been developed to describe an ENSO, as oceanic index that considers the sea surface temperature; an atmospheric index that considers the Index of Southern Oscillation and other multivariable indexes as the multivariate ENSO index (MEI). It is calculated from the Analysis of Principal Components of six variables spatially averaged over the tropical Pacific (atmospheric pressure at sea level, zonal and meridional components of the wind, sea surface temperature, surface temperature of the air and cloud cover); MEI was developed by Wolter and Timlin.

One of the most used indexes in South America is the Oceanic Niño Index (ONI), used by the National Oceanic and Atmospheric Administration of the United States (NOAA), which is based on deviations from the average sea-surface temperature in El Niño Region 3.4, of \pm 0.5°C, calculated from an average of three months and based on a methodology of reconstruction developed by Smith et. al.

6.2.7.2. Situation in Ecuador

El Niño Southern Oscillation is one of the main climatic phenomena affecting the country, which has an occurrence cycle of 3, 5 and 7 years, generating alterations primarily by increases in precipitation (El Niño phase) as by precipitation deficits (La Niña phase).

This phenomenon directly impacts the Coastal and Insular Regions of Ecuador, causing floods in the lower coastal areas, penetration of the sea in the coastline areas due to sea-level rise, landslides in areas by the foot of the Eastern Mountain Range and flash floods of rivers.

According to a study conducted by INAMHI and consistent with the international scientific technical criteria, it was found that the events described as 'extremely strong', correspond to years 1982-1983 and 1997-1998.

El Niño(1997-1998) showed the vulnerability and weakness of the country in hydro-meteorological risks related to it, causing losses in the agriculture and fishing productive sectors, according to the assessment made by the Development Andean Corporation (CAF, 2000). There was significant damage to the infrastructure of the transport sector, due to the deterioration and destruction of roads and bridges. Economic losses reached \$2,882 million, which accounted for about 15% of the Gross Domestic Product (CAF, 2000).

Considering the lessons learned during El Niño Southern Oscillation (ENSO) occurred between 1997 and 1998, INAMHI has strengthened its capabilities for detecting, monitoring and foreseeing the event.

The INAMHI is part of the National Study Group

of El Niño phenomenon - ENFEN, made up of other technical entities such as the Oceanographic Institute of the National Armed Forces - INOCAR, the National Fishing Institute - INP and institutions related to risk management and universities. ENFEN meets periodically to assess the ocean-atmospheric conditions to detect, assess, monitor and issue information and forecast bulletins before a likely El Niño event to Risk Management agencies and government entities for decision-making and preventive purposes. Regionally, ENFEN is part of the Permanent Commission of the South Pacific - CPPS, of Peru, Chile and Ecuador, which develops the Project of Phenomenon Regional Study - ERFEN, generating a monthly international bulletin "Climate Alert that assesses and monitors El Niño phenomenon on the west coast of South America", with information generated by its members.

INAMHI works closely with the International Research Center for El Niño - CIIFEN, which aims to reduce its negative impacts.

In the last decade, INAMHI has implemented global and regional numerical models of weather forecast with time horizon three months later. This helps the study and understanding of El Niño phenomenon, resulting in objective elements to advise decisionmakers, generating a new vision of risk management in disasters with a preventive and mitigation approach. INAMHI and other national and international agencies have carried out some studies and assessments on El Niño phenomenon, highlighting its consequences and proposals for follow-up and monitoring these anomalies. These studies and assessments resulted in products and maps on the subject:

- "Ecuador at the intersection of several climatic influences. A strategic location for the study of El Niño phenomenon". (1998).INAMHI-IRD.
- 2. "Final Report 1997-1998 El Niño Weather Assessment". (1998). INAMHI.
- 3. "Map of threats, Vulnerability and Capacities in Ecuador". (2001).
- 4. INAMHI-ORSTON. Influence of El Niño on Hydro rainfall schemes of Ecuador. (1997).

6.2.7.3. Recommendations

- To support INAMHI in the implementation of a basic monitoring network of the upper atmosphere, through radio probes that will allow Ecuador to have information for research and understanding of the regional dynamics of El Niño phenomenon.
- To strengthen the Basic Hydro meteorological Network for better monitoring and delivery of information for decision-making.
- To manage human talent training at Master's level in the field of meteorology, numerical modeling and risk management.
- To develop research projects on monitoring indexes for detection and monitoring of El Niño phenomenon by the South American coasts.
- To strengthen policies, guidelines and mechanisms for cooperation between INAMHI and SGR to increase technical capacities and climate prediction.
- To share experiences, studies, models and capacities in the region, related to El Niño phenomenon.
- To maintain and strengthen meetings, forums, workshops among the countries of the region in order to analyze methodologies applicable to El Niño.

6.2.8. Ecuador Epidemiological Situation in disasters

Ecuador reports endemic diseases that have caused emergencies and that could potentially cause disasters, some of them are:

6.2.8.1. Dengue fever

Dengue is an endemic disease in the Americas region with epidemic cycles; it continues to be a significant public health problem. It is strongly seasonal, especially in winter months (rainfall and temperatures $> 28^{\circ}$ C in the coastal region). Its persistence has been associated with social and environmental determinants, such as population growth, migration, uncontrolled or unplanned urbanization and great patches of poverty in cities.

Environmental determinants are more directly related to the persistence of dengue. The lack of basic services is one of the main problems, particularly the chronic deficit in water supply, serious problems in environmental management of wastewater and inappropriate waste collection, as well as the inappropriate conduct regardless to the use and disposal of non-biodegradable materials, condition that increase in disaster situations, mainly in floods at climatic zones that induce growth of the vector and others. Four serotypes of dengue virus were identified. Between 2007 and 2010 virus 1 prevailed, including the Galapagos Islands; in 2010, although there were very few cases, virus 2 and 4 were identified (National Institute of Hygiene and Tropical Medicine). During the recent floods of 2012 dengue cases and fatalities increased by a significant percentage.

During the last winter season, in 2012 in the Ecuadorian coast, up to epidemiological week 33, 15,275 cases occurred, compared to the 5,439 cases of classic dengue fever the year before; 266 of severe dengue; 23 died related to the 6 cases of 2011. There is a significant increase in cases and deaths, which indicates that dengue continues to be a public health problem in the current conditions of vulnerability, which expands in the winter season.

In the 27th Pan American Sanitary Conference in 2007, the problems due the increasing dengue fever outbreaks and the complexity of the epidemiological situation for prevention and control were identified. In the Conference, dengue was considered a problem that goes beyond the health sector and the assistants focused on the search for public policies to control the social determinants and environmental conditions of transmission and the strengthening of national strategies for integrated management for prevention and control (EGI-dengue).

6.2.8.2. Malaria

The trend for malaria is in rapid decline since 2003, due to a strengthened control program and a modernized management of the disease. In the year 2006, there were 8,957 cases of malaria, a figure that was reduced by 2010 to 1,888 cases with an incidence rate of 0.14 /1000, the lowest among the countries that share the Amazon basin. There was a predominance of Plasmodiumvivax (1,630 cases), Plasmodiumfalciparum (258 cases), the latter are restricted to Esmeraldas, Guayas and Cañar. To continue the current trend, Ecuador is well on its way to the elimination of malaria in its territory. (Malaria surveillance system in Ecuador).

6.2.8.3. Yellow Fever

No recorded cases since 2002 (Yearbook of the MSP). The coverage of immunization against yellow fever remains high in Ecuador.

6.2.8.4. Measles

Durante 2011 se reportó internacionalmente una During 2011, an epidemic of measles was internationally reported, which produced a review of the program of measles immunization, actions that demanded mobility of resources, people and logistics.

Until week 49 of 2011 (49/2011) there were 189 confirmed cases at national level (Pichincha 26, Guayas 10, Cotopaxi 9, Chimborazo 3, Tungurahua 126 and in Pastaza 9). Thus the peak of the outbreak in Ecuador coincided with the evolution of the epidemic curve in Tungurahua.

Until September 12, 2012, there were 329 identified cases throughout the country (260 in 2011 and 69 in 2012). The Tungurahua province has accumulated a total of 164 cases. The other cases are distributed as follows: 49 cases in Pichincha province, 37 in Guayas, 30 in Pastaza, 12 in Cotopaxi, 28 in Morona Santiago, 4 in Chimborazo, 3 in Santo Domingo and

1 case in Manabí. The last confirmed case occurred at epidemiological week 28, in Pichincha, 7 months of age, with eruption initiation date on July 12, 2012.

The lessons learned from the measles epidemic are:

Recent cases of measles in the country occurred in 1996, which made it difficult for health staff and the population to identify cases of measles.

Administrative coverage is not sufficient to identify susceptible pockets. They must be complemented by stratification tools by communities and coverage monitoring.

High vaccination coverage is not achieved only by vaccinating according to the demand in health services. It requires extramural tactics to capture "unvaccinated" population, such as floating and mobile population affected by the measles outbreak.

It is necessary to work with local leaders and intercultural officials of health to achieve effective access to these communities, knowing their realities, language and traditions.

Positive Serology Cases and measles relation by provinces. Ecuador. September 12th, 2012

	Cases 2011			Cases			
Province	Cases with positive serology	Confirmed by relation	Total 2011	Cases with positive serology	Confirmed by relation	Total 2012	
Guayas	19	4	23	14	0	14	
Morona Santiago	0	0	0	27	1	28	
Pichincha	28	6	34	12	2	15	
Tungurahua	49	114	163	1	0	1	
Cotopaxi	10	0	10	2	0	2	
Pastaza	9	16	25	5	0	5	
Sto. Domingo	1	0	1	2	1	3	
Manabí	0	0	0	1	0	1	
Chimborazo	4	0	4	0	0	0	
General Total	120	140	260	64	4	69	

Source: MSP-PAI: Data Base of the provinces (information obtained with final classification)

6.3. Priority setting and threat identification based on the potential impact and recurrence

In order for technical scientific bodies of the country know the main hazards (intensive, emergent and recurring) that according to their monitoring systems and prediction models could cause a greater impact on the Ecuadorian population, infrastructure, lifelines, livelihoods, etc., the following methodology was applied:

1. Description of the main hazards and potential

impacts presented by institutions.

- 2. Identification of the main descriptors of such hazards.
- 3. Explanation of the scope of threats.
- 4. Identification of major vulnerabilities associated with indicated hazards
- 5. Recognition of the threats that may pose a greater impact if they happen simultaneously (synergy)

The products obtained with no specific priorities are:

6.3.1. Associated with volcanic dangers

6.3.1.1. Anomalies in the behavior of volcances

No volcano is specified. The main descriptor is the lack of preparation in communities and institutions of the system. Work is to be performed based on the population, using methodologies and processes known as Social Volcanology.

6.3.1.2. Start of eruptive process in Cotopaxi volcano

Main critical points are:

- Presence of pseudoscientific scenarios developed by organizations with little or no technical ability, without liability or legal jurisdiction.
- Lack of coordination and preparedness processes.

6.3.2. Associated with extreme hydro meteorological phenomenon

6.3.2.1.Floods

Floods are not associated with a specific place. Main critical and descriptive points:

 Reduction and / or loss of productivity; even if a higher impact is foreseen at rural level (agriculture

and livestock), impacts in productive processes of second and third level should be also considered.

- Damages to public infrastructure. Recovery processes are not in accordance with population demand and recurrence of events.
- Early warning systems should be implemented at all levels in the territory (national, zonal, provincial, local and community). Improved monitoring of weather variables.

6.3.2.2. Heavy Rainfall/torrential nature

They are specially associated to areas with slopes in both therural and urban sector. Its main critical points and descriptors listed are:

- Soil and slope erosion that will cause loss of production and protection.
- Landslides and mudslides, caused by decreasing soil absorption capacity and water saturation.
- Loss of crops and protective vegetation.
- In the 'foothills' there is abundant material (flows) in the alluvial plains
- Sudden floods in the upper watersheds and slow floods in the lower ones.

6.3.2.3. Droughts

Damage in regions that cover one or several provinces. Critical points and descriptors to be considered are:

- Vulnerable population in food insecurity situation.
- Low agricultural production and price increase.
- Migration of population mainly to urban centers.
- Presence and increase of forest fires.
- Wind erosion of soils especially in slopes creating instability.
- Due to permeation phenomena, there was washing or erosion of the surface layer.

6.3.3. Associated with climate alteration / climatic processes

6.3.3.1. El Niño Event and Southern Oscillation

Event of regional scope and impact at national level. Main descriptors and critical points to be considered are:

- Sudden Floods in the upper watersheds and slow floods in the lower ones.
- Water shortage in the sierra (highland).
- Damages to coastal infrastructure.
- Landslides and mudslides, caused by heavy rainfall and super saturation of water in the soil.
- Reduction of fishing production.
- Risk-exposed population due to settlements in risk zones.
- Assessment of institutional capacities for monitoring and notification to be performed as well as scientific research that allow prioritizing mitigation actions to be implemented.
- More specialized studies on agro climatic risks in flood zones.
- Design dissemination and awareness strategies through information technology, communication and social networking.

6.3.3.2. Water erosion

It can be observed specially in the High Andean Zone. Main descriptors and critical points are:

- Loss of soil required for agro productivity, causing wastelands to appear.
- Reduction of productivity and food safety in minor producers (self-consumption production).
- Migration of population mainly to urban centers.
- Event of slow development but of great impact.
- Increase of sediments in catchment basins reducing its carrying capacity and posing a risk for flooding.

- Change in the physical aspect of the soil and alluvial landscape with potential risk for towns near the catchment basins
- Limited scientific research on these phenomena.

6.3.3.3. Retreat of glaciers

The descriptors and critical points are:

- Change in flow of catchment basins.
- Loss or reduction of water sources
- Change in land use and the type of production.
- Intense erosion processes.
- Increase in temperature.

6.3.4. Associated with events of geological origin

6.3.4.1. Large-scale landslides / surface displacements

They can be observed on the mountain sides, especially in the highland region. The main critical points and descriptors are:

- Landsliding surface masses that can cause damming of rivers.
- Public and strategic infrastructure loss.
- Human life loss.
- Population isolation and transportation restrictions to commerce.
- Temporary displacement of populations.
- People unaware of landslides dynamics; a communication strategy is required for awareness building.
- Limited ability for operations and early warning by the technical scientific agencies.
- Further studies at the coastal region.
- Perform mapping based on landscape units.

6.3.4.2. Earthquakes of more than 5 degrees of magnitude (Richter)

Mainly in the large urban centers of the central–northern highlands, and the central-southern coastal area. Critical points and descriptors considered:

- Lack of means dor data collection.
- Impact on critical infrastructure and loss of function of social and government structures.
- Potential damage to facilities of scientific technical institutions.
- Landslides as side effects. Landslides trigger.
- A strategy for socialization of information is required.
- It is necessary to extend the study to coastal seismicity level.
- Lack of additional studies related to the characteristics of the bedrock, soil relief and water table that enable to supplement the information on seismic hazards.

6.3.4.3. Active geological faults

Focalized events that can happen anywhere. Descriptors and critical points are:

• Subsidence or displacement of topsoil.

- Water filtration.
- Displacement of soil and rock masses.
- Damages to homes and public infrastructure.
- Geological maps require upgrade (if carried out, they should be made at a scale of 1:50,000).

6.3.4.4. Tsunamis originated nearby / tsunamigenic seism

Consider damages to coast region, mainly Esmeraldas and Manabí provinces. Main critical points and descriptors are:

- Earthquake in the ocean near the coastal region.
- Damage to coastal infrastructure due to a tsunami and possibly to an earthquake.
- Depending on the earthquake, cities located near the mountains or the Highlands can be affected.
- Impact on the coastal economy and tourism.
- Loss of communication; it might be necessary to transmit emergency information but systems could collapse.
- Several communities and localities are unprepared.
- Suboptimal levels of institutional coordination.
- Studies of tsunamis caused by landslides and submerged islands in Galapagos are needed.

6.3.5. Associated with oceanic dynamics

6.3.5.1. Coastal erosion due to swell

They can occur throughout the Ecuadorian coastline. The descriptors and critical points are:

- Damage to public and private infrastructure in coastal region.
- Changes to the coastline profile.
- Impact on production processes.
- Migration of population and development of unplanned settlements.

6.3.6. Associated with anthropic processes

6.3.6.1. Deforestation

All national territory can be affected. Critical points and descriptors:

- Soil degradation and groundwater contamination due to flower crops.
- Population centers affected by mining.
- Loss of topsoil protection on slopes and increased risk of landslides.
- Pollution of catchment basins.

6.3.6.2. Pollution of Surface waters

There can be damages in all catchment basins. Main descriptors and critical points are:

- Damages on water collection points for human consumption.
- Increased risk of diseases in communities exposed to contaminated water.
- Exposure to pollutants from livestock, fisheries and agriculture.
- Lack of knowledge about the hydrological dynamics to enable decision making.

- Need to improve and expand the hydrological investigations nationwide.
- Limited information from hydrogeological maps for decision making by the authorities.

6.3.6.3. Other technological risks that should be considered

A special monitoring and control should be made on:

- Construction of swimming pools and water reservoirs that can be related to landslides, pollution and changes in biotic and abiotic micas of catchment basins.
- Construction of roads that depending on the fulfillment of technical requirements, can be associated with sliding, and altered structure of slopes.
- Intensive production agriculture models that cause soil erosion and groundwater pollution.
- Production and transportation of hazardous chemicals, especially those used in mining.
- Mining production.
- Transportation of oil (using polyducts, oil pipelines and vehicles).

6.3.7. Other threats

According to the Ecuadorian Spatial Institute there are threats to the planet of external origin, such as electromagnetic solar storms; there are warnings from international organizations regarding their potential effects:

- Damages to power grid.
- Collapse of telecommunications systems.
- Increase in average temperature.
- Restrictions on international transportation.
- Changes in the operation of electronic equipment.

6.3.8. Identification of joint threats or secondary effects

As part of this process, situations that might appear jointly and cause greater impact on populations were identified. These might be:

- a. Heavy rainfall and landslides of great magnitude.
- b. Floods and heavy rainfall.
- c. Tsunami of near origin and earthquake affecting cities (greater than 5 degrees).
- d. Tsunami and erosion due to waves.
- e. Water erosion and droughts.
- f. Floods and landslides.

It is important to review the historic context and how more than one event has happened simultaneously, namely:

- 1698 Ambato: seism with landslides
- 1757 Riobamba: earthquake with landslides
- 1949 Pelileo: earthquake with landslides

1998 – Manabí: Floods (due to El Niño) and seisms 1998 – Esmeraldas: Floods, landslides and technological threats (oil derivates leak)

6.3.9. Main vulnerabilities identified and

associated to selected threats

In the process performed, the representatives of the technical scientific bodies identified the following institutional and population vulnerabilities:

- Lack of commitment from parties related with Risk Management (authorities, entities, institutions and population).
- Lack of processes for territorial planning in which risk is included as a variable.
- Not enough funds or budget available for an adequate Risk Management.
- Infrastructure is improvised and highly exposed to menaces.
- Lessons learned from community work in early warning have not been socialized (Tungurahua lookouts).
- Little participation of private Enterprise as social responsibility and risk generator.
- Community is not adequately prepared for disasters.
- Underlying factors as poverty still prevail and are not yet associated as key elements in Risk Management.
- Political sector is not adequately trained on Risk Management; in general, their actions are oriented to reactive processes once disasters have occurred.
- Poor coordination among public institutions.
- Public institutions are not yet able to attend the population demand required for Risk Management.
- Responsibilities of the institutions are not clearly defined for Risk Management.
- The data on existing information issued by technical scientific institutions are not shared.
- The role of volunteers is not clearly defined in cases of emergencies.
- There are problems for retention of technical personnel with salaries in accordance with responsibilities.
- Competence for mass control and movement is duplicated and there is not a unified methodology.

6.3.10. Conditions for an adequate operation of a coordinated system of technical scientific institutions

The representatives of institutions and entities have considered that the key elements for the system's correct operation, are:

- To review the legal framework that clearly defines institutional responsibilities and if necessary, create a system or committee.
- To work with the community in order to transfer knowledge to end users of the information.
- To keep on using high technology and integrate it between agencies and institutions bridging the gap existing between scientific knowledge and technology available.
- To disseminate clear policies on the transfer and handling of scientific information; models of dissemination of studies and scientific information developed should be included
- Standardization of information and presentation

of products.

- To rely on its own infrastructure with adequate requirements and integrators of the institutions.
- Organization of an integrated plan with longterm results, clear and realistic objectives, with sustainability schemes and state funding.
- Defined competencies and responsibilities, avoiding duplication of effort. Unified Protocols.
- Direct relationship with universities, allowing the development of science and applied research.
- Technical systems without political interference in management levels composed of staff with high professional training and experience
- Direct contact with decision makers.
- The actions and products must be multidisciplinary (geology, structural, environmental, etc.)
- Clear understanding of the local environment and recovery of ancestral knowledge.
- Impacts and risk scenarios generated in a participatory manner, with systems approach and based on consensus.

6.4. Ecuador's vulnerability

6.4.1. Global diagnosis of current situation

Until recently, knowledge of natural hazards (earthquakes, floods, landslides or volcanic eruptions) has become the country's most important matter for addressing risk reduction issues. The effort to understand the functioning of the territory, its dynamics, development and the vulnerabilities associated with these aspects is recent. A better understanding of the dynamics of vulnerabilities and its relation with threats will allow making better decisions for the care and use of the elements that are essential for the proper functioning of each territory.

The particularities of the development in each territorial context have determined different exposure levels of the population, goods and services to hazards of natural origin (Map N°1) and anthropogenic ones. In fact, many of the man-made hazards can be seen as developmental defects. Thus, vulnerability is not only "the susceptibility to damage", but also a lack of capacity to address adverse events. As such, it can be imagined that an element is not only vulnerable to external threats, but is also vulnerable for the inability to recover from an event or because of its limited ways to assimilate external adversity or ways to return to a normal situation. As such, it is focused on the vulnerabilities due to gaps and weaknesses that territorial and social organizations have regarding the risk management processes" (National risk Management Secretariat, 2011:65)¹⁰.

Along the same lines, high levels of vulnerability are related to the disordered growth of urbanization in

¹⁰ This vision of essentiality of the territory is one of the ways of discussing vulnerability without stemming necessarily from threats. The knowledge of the territory and its strategic elements for its development guarantee specific actions in which specific mitigation, protection and risk prevention actions are required

the territory in the last 70 years, focused on the cities of Quito and Guayaquil (see map No. 2). The same situation is seen in many cantons of the Highland where the density often exceeds 100 inhabitants per km2, particularly in the central part, where the indigenous population is a majority, and in the west of the country, where the population is concentrated near cities or along major economic corridors, as is the case of the sub-Andean region or in the upper basin of the Guayas River, where high densities and migration are linked to export crops (D'Ercole and Trujillo, 2003). This growing pattern has increased the threats and vulnerabilities in several locations and has not overcome the inequalities in the population.

The index of unsatisfied basic needs (NBI for its Spanish acronym) evidences fragile social conditions in socioeconomic terms, access to services, financial resilience, etc.; consequently, in areas with higher rates of NBI there is greater susceptibility to suffer the impacts of a disaster, as in the cantons Colimes, Palenque, San Lorenzo, Muisne, slewing ring, Zapotillo, Olmedo, Arajuno, Loreto, Urbina Jado, Eloy Alfaro, Cotacachi, Buena Fe, Colt and Guamote.

In the cantons with high levels of rural conditions, the average rate of people with unsatisfied basic needs is almost 50,9% a quite different situation from that observed in urban areas (map N° 3). For D'Ercole and Trujillo (2003:49), "it is evident the difference among the cantons in Esmeraldas Province and the canton where Esmeraldas city is located. Other examples are the cantons where Tulcán, Ibarra, Quito, Ambato, Riobamba, Cuenca, Machala, Loja, Guayaquil, Milagro, Manta, Portoviejo y Babahoyo are located, which are in better conditions as compared with the other cantons of their provinces. (...). Rural cantons that are less vulnerable are mainly those of the Coast that have certain economic dynamism because of their agro exportactivities, mainly in El Oro Province.



Map No. 1 Exposure of population when faced to threats

Preparation Team Project for estimation of Canton Vulnerability, 2012





Preparation Team of the Project to Estimate Canton Vulnerability 2012



Map No. 3. Vulnerability due to poverty

Preparation Team of the Project for Estimation of Canton Vulnerability 2012

Certain zones with low levels of poverty show important administrative, legislative and budget capacities; they start to have an influence in the design and/or implementation of action for the reduction of threats and/or recovery when a disaster occurs, as is the case of Quito and Guayaquil, but the conditions of Colimes, Palenque, San Lorenzo, Muisne, Olmedo, Arajuno, Loreto, Puerto Quito, Urbina Jado, Eloy Alfaro, Cotacachi, Buena Fe, among other cantons is disturbing because of their high level of poverty they add low institutional capacities¹¹.

Overall, the population growth, their property and its location in areas exposed to various events or the environmental deterioration of the territory have become determining factors in the increased risk in many places, where it can be observed a rise in the levels of susceptibility to adversed events such as floods and fires; changes can be observed in the behavior of the losses that reflect the transformation and accumulation of risks.

6.4.2. Tests to estimate of vulnerability

Risk Management of the country has focused on emergencies management and the protection of property and potential areas before events (mitigation, mainly). This approach is turning towards integrated risk management, bringing it closer to development management and building mechanisms and capacities in the governing body and in the National Decentralized System as a whole¹².

The responsibilities for managing risks assumed by the autonomous decentralized governments (GAD) and other entities of the system require qualified personnel and resources of various kinds, which include development of information, methodologies, technical standards and regulations, aimed at bridging the current gap of Risk Management capabilities.

One of the biggest gaps that autonomous decentralized governments (GAD) face is the lack of appropriate instruments to guide and harmonize development management and land management, where Risk Management operates transversely. This gave rise to the project to "Estimate of vulnerabilities and disaster risk reduction at municipal level in Ecuador", a methodology developed in a joint effort with universities, municipalities, the United Nations Development Program (UNDP) and the Secretariat of Risk Management (SGR) of Ecuador with DIPECHO VI and VII funding, on the line labeled 'Estimate of vulnerability at municipal level in Ecuador', during the period 2010-2011, focused on small and mediumsized cantons.

With this tool that allows authorities of municipal autonomous decentralized governments (GAD) to adjust their plans for development and land management, in response to the guidelines of SENPLADES, as well as to make decisions on the reduction of disaster risks. This tool analyzes the physical-structural vulnerabilities of the buildings, water supplies and road networks, the socio-economic vulnerability of the canton and the political-legal and institutional vulnerability.

With this tool, it is possible to define four phases of implementation:

I. Generation and first test of methodology in 13 pilot cantons in 2010-2011

To test the tool, a pilot ran in 13 cantons of the country (Latacunga, Rumiñahui, Salcedo, Baños, Guano, Penipe, Machala, Zaruma, Santa Elena, Salitre, Babahoyo, Milagro and Santa Elena). The implementation had a positive balance, resulting in a preliminary mapping of vulnerabilities, a basic statistical analysis and a guide of recommendations related to the management of local information that should be considered in future deployments.

This methodology is designed to be used by municipal teams with the information that they already have. It is valid as preliminary diagnosis of the local land as opposed to the vulnerabilities mentioned above and will serve as a tool for decision-making of local authorities. Its strength is the profitability of the time spent in gathering new information, focusing on the information already available in most locations.

The methodology deals with different types of vulnerability (see table below) and relates them to the most common threats in the territory (volcanic eruptions, landslides, floods and earthquakes).

Vulnerability	Principle
Socioeconomic Vulnerability Analysis	It includes analysis of the socio-economic profile of the most vulnerable population. For this vulnerability, information from the National Institute of Statistics and Census, Population, and Housing (INEC) and social indicators generated by SIISE3 were used.
Political Vulnerability Analysis	It refers to the level of autonomy that a community has for decision-making in several aspects of social life and the possibility of formulating and implementing strategies or actions that help keep risks within acceptable levels.
Legal Vulnerability	It refers to all regulatory bodies that rule risk management and the degree of implementation of its regulations at national and local levels. This information is linked to ordinances, regulations, and agreements of local wills in the municipality.
Institutional Vulnerability	It refers to the degree of cohesion or barriers in local inter-agency relations, the forms in which the municipalities, within their perception and organizational structure, maintain internal risk management activities as related to their daily activities and the progress of risk management at project level and concrete actions.

¹¹ This local reality extends to the area where the national institutional vulnerability is shown in the insufficient articulation of planning instruments and public management.

¹² Local weaknesses and capacities allow us to understand the best ways for intervention within a context of prevention and development.

 II. Application of the methodology through a University Network in 21 cantons of Ecuador (August 2011 - December 2012)

The SGR and UNDP are implementing the methodology in other 21 cantons in the framework of DIPECHO VII with the project 'Estimate of vulnerabilities at Municipal Level in Ecuador', with the purpose of settling this instrument as a national standard.

The procedure for the implementation of a methodology is based on the following diagram:

Diagram No. 1 Implementation of the current methodology

Elaboration: Draft team to "Estimate Canton Vulnerability", 2012



The criteria with which the cantons were chosen were: synergy with other DIPECHO projects, exposure levels of the territories to natural threats, high levels of urban density, and political willingness to implement the project.

For its deployment, an academic network was formed with 7 public universities representing each region, to support the cantons. Each university has formed a team of professors and students from senior years (students writing their dissertations and interns) to work with up to four cantons allocated.

The distribution of universities and cantons by area is listed below:

PLANNING ZONE	UNIVERSITY	GROUP
Zone 1	Universidad Técnica del Norte	Esmeraldas (Esmeraldas), Ibarra, San Pedro de Huaca (Carchi)
Zone 2	Escuela Politécnica del Ejército (ESPE)	Orellana (Orellana), Rumiñahui (Pichincha), Quijos (Napo), Patate (Tungurahua)
Zone 3	Escuela Politécnica del Chimborazo (ESPOCH)	Pallatanga Cumandá (Chimborazo), Latacunga (Cotopaxi)
Zone 4	Escuela Politécnica del Litoral (ESPOL)	Chone, Manta (Manabí)
Zone 5	Universidad Estatal de Bolívar	Group 1: San Miguel de Bolívar, Guaranda (Bolívar)
	ESPOL	Group 2: Bucay (Guayas), Santa Elena (Santa Elena).
Zone 6	Universidad de Cuenca	Paute (Azuay), Cuenca (Azuay), La Troncal (Cañar).
Zone 7	Universidad Nacional de Loja	Zaruma, Yantzaza, Loja

Elaboration: Draft team to "Estimate Canton Vulnerability", 2012

III. Strengthening of vulnerability analysis and methodology improvement

The first diagnosis showed some weakness in regard to the comprehensive vision and analysis of the territory and the issue of vulnerability. The analysis focused on the management of the information and does not achieve an understanding of the territory dynamics as a system. It became clear that there is a need to go beyond understanding forms of exposure of territorial elements to threats and to achieve a stronger reading of the territory.

Consequently, reading worked at two scales: one at the level of the entire canton and one at the level of the canton head (urban area), as an approach for understanding each space and observing the interrelation and dependence between scales. Within each territory, some of the aspects that have been considered were:

- a. Demographic and socioeconomic situation: a few key questions rose: What is the vulnerable population (or population geographically dependent)? Where is most of the population in the territory? What is the livelihood of the population of the canton? Where are the poor populations located and where are they defined?
- b. Land Use: refers to the occupation of the territory and its functionality.
- c. Essential elements: seek to highlight the structural (rivers, populated centers) and strategic elements of the canton for its operation (roads, equipment, institutions) at cantonal and urban level. Many elements can be out of administrative boundaries, but they

are important if the operation of the territory relies on them.

d. Major milestones or events of the canton and its identity: refers to events or historical milestones that are part of the collective memory of the canton. It can be disasters or past events, great social upheavals or some other event that is part of the identity of the territory.

The analysis of these issues provides a preliminary overview of how the territory is structured and the evolution of its vulnerability. It is complemented with information about elements or resources for emergency management, relevant stakeholders involved in the canton and the population dynamics.

The reading of how the territory is structured helps identify:

- a. The main development factors in the canton are: projects, investments for economic (companies or other sources of employment, tourism, development, industrial areas) and social development (service infrastructure, bridges, water networks, heritage elements, among others).
- b. The essential elements: correspond to a visual diagram that shows the spatial distribution of goods and services that characterize the territory and that make it function as a system and that contribute to the operation of other systems on the next scale.
- c. The main natural and manmade risk factors at canton and urban level. This aims to highlight the factors that cause discomfort, setbacks or limitations in the development of the canton, and the consequences for its social wellbeing. For example, there are conflicts around projects or existing spaces, insecurity, pollution, land invasions, road accidents and traffic, as well as areas where there is recurrence of disasters, events, or a latent natural threat.
- d. The elements for emergency management: This approach highlights the main elements or territorial resources essential for the management of an emergency, evacuation and recovery of livelihoods.
- e. The distribution of the human population: Refers to the dynamics of the population in the territory, which shows if the canton increases or decreases and where there is demographic concentration in terms of space and activity.
- f. The main intervention stakeholders: Definition of a map of stakeholders and their location. And an additional diagram on the importance, roles and relations that exists among them (diagram of stakeholders).
- A vulnerability analysis is carried out for the essential elements. It is aimed at understanding

their vulnerability based on two criteria:

- a. Vulnerability related to the degree of exposure of the essential elements to threats such as floods, earthquakes, volcanic eruptions, landslides and other threats, depending on the particular case of each canton. The level of information on the essential element determines how to deepen the analysis. One of the important points of this information is the analysis of the consequences or at least an estimate of them.
- b. Vulnerability related to dependence of strategic elements: This analysis responds to the logic of systems and shows the dependency essential elements have on other elements of the territory and that have a global impact on the functioning of the urban and canton territory

After this stage, the institutional-political-legal vulnerability is analyzed. It should be noted that these vulnerabilities are closely related, since usually, weaknesses at institutional level influence the political and legal vulnerabilities and vice versa, depending on the perspective of the analysis. The criteria used are:

- a. The relation of public policies with risk management actions. It is necessary to contrast the document information with specific institutional and social practices to observe the degree of congruence between the existing regulations, ordinances, and actions.
- b. The generation of externalities among stakeholders. This is to show the effects among the actions by stakeholders, and the levels of coordination or lack of it, in terms of risk generation.
- c. The availability and efficiency in the use of risk management resources (capacity). It is analyzed if the relevant stakeholders of the canton related with planning, territorial control and risk management have the human and material resources to fulfill their functions and if these are aimed at reducing risks..
- d. The stakeholders' perceptions regarding the existence and management of risk. Perception is an important factor that should be considered in terms of risks. Additionally, many stakeholders in the canton have experience and lessons learned in terms of risks.
- e. The effort of accountability, dissemination and monitoring of compliance with risk management standards (national and local.

This diagram shows the performance of the approach:

l st vulnerability reading	TERRITORY STRUCTURE	 Demographic and socioeconomic profiles Use of the land Essencial elements of the territory The major milestones or events of the canton and its identity
2nd vulnerability reading	TERRITORY THEME APPROACHES	 The elements od development of the canton The main problems of the canton The elements for emergency managment Human mobility The main intervention stakeholders
3rd vulnerability reading	The Vulnerability Of the essential Elements	 The vulnerability by exposure The vulnerability by dependency
		• The vulnerability related to the actions (public
4th vulnerability reading	The Institutional Vulnerability - Political - Legal	 policy) The vulnerability related to the conflict The vulnerability related to the available resources (capacity) The vulnerability related to the perception in terms of risks managment The vulnerability related to the existence and application of rules and regulations
4th vulnerability reading	THE INSTITUTIONAL VULNERABILITY - POLITICAL - LEGAL	 policy) The vulnerability related to the conflict The vulnerability related to the available resources (capacity) The vulnerability related to the perception in terms of risks managment The vulnerability related to the existence and application of rules and regulations

IV. Strategies implementation for canton vulnerability reduction

It is expected that vulnerability studies will be used in each municipality as a useful tool for risk reduction. With this in mind workshops will be held with the authorities of GAD, SGR and AME.

6.4.3. Other relevant aspects of the project

- Organization of the academic network that leads the work with the cantons (Army Polytechnic School, Loja National University, Technical University of the North, Polytechnic School of Coastal, Cuenca University, Bolivar State University and Chimborazo Polytechnic School).
- Organize a team of experts for each vulnerability, to train college teams and support them in the process.
- Incorporation of Ecuadorian Consortium for Advanced Internet Development (CEDIA, Consorcio Ecuatoriano para el Desarrollo de Internet Avanzado) project, which provided a platform for virtual communication, dissemination of results and management of spatial data.
- Approach of academy to municipalities.

6.4.4. Needs and recommendations

The main concern in the effort to build risk management capacity lies on sustainability. Among identified sustainability strategies we have:

- To build and strengthen the national academic network for the research of vulnerability with the active participation of SGR and SENESCYT. It is recommended to establish a project to boost research, improve opportunities for reflection and teaching well capacity as as generating research topics of the territory with due agreement among actors.
- To support vulnerability as a theme in academia, research capabilities should be strengthened and the approach from the social sciences in each of the universities should be improved.
- The methodological tool used requires significant technical support; thus, it is necessary to review it to reach the goal of being a standard tool for easy implementation at local level.
- Active participation of local actors that are familiar with the territory is necessary

to identify and analyze vulnerability of a town, territory and institution.

- Vulnerability is expressed in different forms aside from maps and statistical analysis and requires further research by academic and knowledgeable actors.
- The support of local and national information management focused on risk analysis and vulnerability is necessary as a mechanism that helps to improve the data for vulnerability and risk analysis at canton level.
- Integration of variables for vulnerability assessment in land management programs of municipalities. This task is managed by the Association of Municipalities of Ecuador (AME Asociación de Municipalidades Del Ecuador) to link the necessary variables in order that information and vulnerability analysis considered for risk reduction can be generated annually.
- Improvement of socio economic, population and institutional vulnerability indicators with entities as the National Institute of Statistics and Census (INEC Instituto Nacional de Estadísticas y Censos).
- Approval of other instruments on the subject of vulnerabilities handled by other actors such as the International Center for the Research of El Niño phenomenon (CIIFEN Centro Internacional para la investigación del fenómeno de El Niño) and the Ecuadorian Spatial Institute (Instituto Espacial Ecuatoriano) (formerly Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos - CLIRSEN). The purpose is to reach

consensus on one analysis methodology for the country, complementing the different criteria and standardizing theoretical - methodological approaches.

• Guidelines for vulnerability reduction strategies that enable a steady reduction of the different cantonal vulnerabilities.

It is expected that these actions can contribute to the:

- Creation of an academic research network on vulnerability in the country that supports the issues of vulnerability and risks.
- Improvement and expansion of vulnerability studies and methodology.
- Inclusion of vulnerability indicators in information generating institutions like INEC.
- Strengthening of municipalities in the management of information and vulnerability tools to normally perform these studies and assessments.
- Approval of approaches and criteria for vulnerability analysis in national and local institutions that handle this subject.
- Sustainability through an academic reflection on the theme of vulnerability and risk.

6.5. Institutional capacities / vulnerabilities

In order to identify institutional capacities in participatory workshops, scenarios of affectations and institutional constraints were used as working tools. In the attachments the scenarios used are detailed.

6.5.1. Ecuadorian Spatial Institute (Instituto Espacial Ecuatoriano) / Surveying by remote sensing (1)

6.5.1.1. Descriptive

The remote sensing survey of the country is performed by the Ecuadorian Spatial Institute under the Ministry of Defense (created by Presidential Decree 1246 of July 19, 2012). This body perform actions related to scientific research and undertakes the responsibilities and projects developed by the Center for Integrated Natural Resources Remote Sensing (Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos – CLIRSEN - CLIRSEN (2).

In general, IEE coordinates with SENPLADES the project for geo information generation to manage the territory at national level at a scale of 1: 25.000, taking the cantons as territorial frames. The process is facing some delays.

The Institute maintains relationships with technical and scientific institutions [public and private), research centers and universities, satellite operators, scientific organizations for technical assistance, etc.; this has allowed the development of quality products. CLIRSEN is appointed as focal point for the International Charter for Space on behalf of Ecuador, which was triggered by forest fires; the institution currently has agreements with INAMHI, IMGEMM, INEC, and MIDUVI.

The information is provided to GAD and SGR after it has been analyzed in the field and at the office

6.5.1.2. Main actions

Training Center in Remote Sensing (Centro de entrenamiento en percepción remota – CENPER)

CENPER provides training and technology transfer services to technical, civilian, military and the general public for training and specialization in Geomatics technology, as professional and technological academic support in the country. Its main objective is to increase knowledge on remote sensing and geographic information systems through an annual training program, covering the requirements of current and potential customers. There is a branch of the training center in Guayaquil.

CENPER has been recognized by the Regional Centre for Education in Space Science and Technology for Latin America and the Caribbean (Centro Regional para Educación en Ciencia y Tecnología Espacial para Ameríca Latina y El Caribe - CRECTELAC) as an affiliated Regional sub center for training - 'Node Ecuador', sponsored by the UN. Its main responsibilities include the coordination, implementation and monitoring of academic activities.

Activation of The international Charter "Space and Major Disasters"

In case a disaster hits Ecuador, the SGR will ask the Federal Emergency System of Argentina (Sistema Federal de Emergencias de Argentina) to activate the International Charter 'Space and Major Disasters'. IEE, as the focal point, it is responsible for receiving raw satellite images that the Charter has decided to use for the processing and delivery of products.

Geoinformation Generation Project for territory management at national level

The purpose is to provide GAD authorities, base mapping at 1:25,000 scale, with geomorphological information, soil, climate, land use and natural coverage, infrastructure and social, cultural and economic services, natural hazards and risk analysis. All this information will be standardized and structured in a 'geodatabase' for the formulation of development plans and land planning.

Risk Assessment

The goal is to help reduce the impacts of a disaster, estimating the level of risk at canton level through knowledge of natural or socio-natural hazards and factors of physical, social and economic vulnerability (there are areas with reports not yet updated).

The development of the studies is supported by the following instruments.

a. Methodological Guide for Risk Analysis

It helps to understand the relationship between the generation of geoinformation, at a scale of 1:25,000, vulnerability and threats. Its guidelines are based on studies and publications made by SENPLADES-CISP-European Commission 'Risk management in land planning processes'; COOP-IRD-Oxfam: 'Threats, vulnerabilities, capabilities and risk in Ecuador', National Institute of Civil Defense and National Prevention Direction of Peru (Instituto Nacional de Defensa Civil y Dirección Nacional de Prevención del Perú): Basic Manual for estimating risk ('Manual básico para la estimación del Riesgo'); PREDECAN summarized in several documents; SENPLADES 'Technical Guidelines for Inclusion of Risk Management in Development Plans and Zoning 'Lineamientos Técnicos para la Inclusión de la Gestión del Riesgo en los Planes de Desarrollo y Ordenamiento Territorial (PDOT), Complementary Guide, consultancy of Juana Marino; SENPLADES' Guide of contents and process for the formulation of development plans and cantonal zoning 'Guía de contenidos y procesos para la formulación de planes cantonales de desarrollo y ordenamiento territorial', in addition to other documents prepared by CLIRSEN.

b. Procedure Manuals

Its purpose is to define procedures for calculating the physical, social and economic vulnerability, when facing flooding, landslides, earthquakes and water erosion (in principle) threats as part of risk analysis at canton level, using inputs of the geoinformation generation project. It is noteworthy that the indicators for each variable are based on data and information available.

c. Quality Control Manual

With the increasingly urgent need to have updated, reliable and georeferenced territorial data, the quality of thematic information constitutes a vitally important aspect to identify and spatialize natural hazards and socio natural factors influencing the vulnerability and the risks to which several sectors of the country are exposed. On this basis, the quality control of products developed for risk analysis intends to follow the philosophy of ISO 19100.

d. Protocol for the representation of geographical elements

The purpose of the protocol is to facilitate interoperability and to use the same language in the representation of geographical elements, namely points, lines or polygons.

The main product of the studies is the technical memory, which includes maps of natural or socionatural hazards of physical, social, economic and risk vulnerability. The information is structured in a geodatabase, with its metadata.

As a support for risk management associated with floods the information is analyzed indicating:

- Threats due to river flooding (overflow) and rain (flooding)
- · Vulnerability: Social factors such as number of

inhabitants, population density, and basic social services. Physical factors such as roads, housing, education and health facilities. Economic factors such as agricultural production activities

- For MAGAP: risk estimation, integrated vulnerability/threat analysis. The estimate is made at a scale of 1:25.000 and at canton level.
- The input used for the studies are high resolution orthophotos (years 2000, 2010, 2011) and radar images.

The information obtained corresponds to a base line that can be used in:

- The identification of critical sites based on natural hazards and their relation to social and economic processes taking place in the canton territories.
- The synthesis of information for decision-making related with disaster risk reduction based on the definition of priorities and search of strategies and lines of action.
- As the information is standardized, homogenized and structured under a 'geodatabase', updating of the thematic information and interoperability between systems and theme products is easier.

Another specific support was given to INOCAR for satellite imagery in areas prone to tsunamis.

During a disaster it is possible to have direct and specific support of the Institute for both response and coordination support; there are 200 people that can do this.

6.5.1.3. Recommendations/ Requirements

- The facilities of the Institute are vulnerable to an earthquake.
- Complete geoinformation for land management. It is suggested to prioritize intervened areas (anthropogenic) and move on to protected areas and others, considering the volcanic variable. This information will be publicly accessible.
- Standardize the information in the short term as it is impossible to do it during an emergency.
- Work in an integrated manner among technical / scientific institutions based on the information provided by the Spatial Institute.
- Prioritize prevention and land management.
- Increase budget for the different departments of the National Decentralized System for Risk Management for planning and risk management.
- Strengthen the National System of Situation Rooms, establish protocols and working agreements.
- Improve access and use of information by entities of the National Decentralized System of Risk Management.
- Develop contingency plans; for the continuity of the different services available, there is backup information at SENPLADES.
- Improve operational capacity and backup key information for emergency and disaster management, and keep information ready for immediate access in different facilities in case the main office is affected.
 - Optimize product delivery times and compatibility

among systems.

• Standardize the methodologies of the institutions on data collection, map and chart building.

6.5.2. Geophysical Institute of the National Polytechnic School

6.5.2.1. Descriptive

The Geophysical Institute of the National Polytechnic School (Instituto Geofísico de la Escuela Politécnica Nacional IGEPN) is the main research center for the diagnosis of volcanic and seismic hazards in Ecuador, as well as monitoring their activities and disseminating scientific information to State authorities and the public. It was created by the Council of the National Polytechnic Schools through a resolution issued on February 7, 1983. This institute is one of 19 academic departments of the National Polytechnic School.

With Executive Decree 2593 on January 13, 2003, the Ecuadorian government put the Department of Geophysics / Geophysical Institute (IGEPN) in charge of carrying out the diagnosis and monitoring of seismic and volcanic hazards throughout the national territory, as well as producing public information from such events.

6.5.2.2. Main Actions

National Seismology and Volcanology Service

The National Seismology and Volcanology Service (Servicio Nacional de Sismología y Vulcanología (SENASV)) of IGEPN is formed by several processes designed to provide the country the following services:

- 1. Instrumental observation networks for seismic and volcanic monitoring.
- 2. Processing and analysis of the data generated in the different networks.
- 3. Dissemination of the results of this process, as well as seismic and volcanic alert.
- 4. Maintenance and operation of the National Seismic and Volcanic Data Base called National Data Center

The modernization of SENASV has been funded by SENESCYT through a multiannual research program approved in 2008. This project entitled 'Strengthening of the Geophysical Institute: expansion and modernization of the National Service of Seismology and Volcanology' has among its main objectives the modernization and expansion of monitoring networks.

SENASV's specific objectives are:

- 1. To keep a continuous operation, 24 hours a day, 365 days a year (24 /7).
- 2. To develop the technical capacity and promote the development of technological tools and their implementation.
- 3. To process and analyze the data from

instrumental monitoring networks and regurlarly report nationwide the seismic and volcanic activity.

- 4. To issue early warnings as well as special or regular reports on the seismic and volcanic activity or associated phenomenas: landslides, lahars, ash clouds, tsunamis, etc.
- 5. To transmit early warnings; also provide information and advice to local institutions and national, sectional and local authorities.
- 6. Permanent action regarding ongoing concerns and requirements of the press and the general population; raise awareness in the population and authorities on the impact of seismic and volcanic phenomena and facilitate the inclusion of the concept and actions to prevent these natural phenomena.
- 7. To maintain a full seismic and volcanic data set easily accessible to researchers.

IGEPN has the following technological capacity to carry out these tasks:

a. National Seismograph Network (Red Nacional de Sismógrafos RENSIG)

This network is used in permanent seismic monitoring (24h - 365 days) of seismic and volcanic activity of the country. It allows the calculation of hypo centrals, magnitudes, focal mechanisms, etc. It is comprised of:

- 53 digital broadband stations.
- 2 digital broadband stations and accelerographic sensors that are part of the worldwide network of seismographs. (IRIS: Incorporated Research Institution for Seismology).
- 9 multiparametric digital stations.
- 4 digital broadband stations (30 sec.) south of Ecuador (Arenillas, Yantzaza, Playas and Catamayo).
- 3 digital broadband stations and infrasound in Riobamba and Macas.
- 3 digital broadband stations in Yaguarcocha, and Urcuqui Imbabura volcano.
- 17 analog stations of short-period (1 Hz).
- 5 stations with five seconds sensors.

b. National Network of Accelerographs (Red Nacional de Acelerógrafos RENAC)

Used in ongoing monitoring (24/7) of strong earth motions that cause damages to structures. The accelerations measured also allow the estimation of seismic intensities in a short time to optimize the response of the National Risk Management System consisting of:

- 42 accelerographic stations installed in the national territory and 40 additional ones to be installed until the end of 2012
- 17 accelerographers in Quito
- c. Volcano Observatories Network (Red de

Observatorios Vulcanológicos (ROVIG)

Active volcanoes are observed through various technologies including seismographs, barometers infra acoustic sensors, GPS inclinometers, EDM, volcanic gas detectors, AFM sensors that detect the passage of lahars or pyroclastic flows. The level of instrumentation dedicated to each volcano is in direct relation to the threat posed to the population settled near the volcanoes.

- Three observatories for monitoring; 1 (Tungurahua, Cotopaxi and Guagua Pichincha). They have seismic monitoring with more than 4 stations, infrasound sensors (this is not the case of the Guagua Pichincha), flank deformation, geochemical monitoring of fluids and monitoring of mudflows and / or lahars, as well as pyroclastic flows (this is not the case of the Guagua Pichincha)
- Seven observatories for monitoring; 2 (Reventador, Cayambe, Antisana, Cuicocha, Chimborazo, Imbabura and Sangay). These observatories have seismic monitoring with more than one station for flank deformation (inclinometry, EDM and GPS) and geochemical monitoring of occasional fluids.
- Six observatories for monitoring, 3 (Pululahua, Ninahuilca, Cerro Negro, Chachimbiro, Soche and Quilotoa). They have seismic monitoring with one station and occasional measures of other parameters.
- Galapagos Network. The seismic network in the Galapagos Islands is programmed to be installed this year and fulfills two aspects: monitoring of active volcanoes and seismicity control.

d. National Geodesy Network (Red Nacional de Geodesia (RENGEO))

Is formed by geodesic GPS of double frequency and high resolution destined to the monitoring of flank deformation of volcanoes and of the continental crust. It is formed by:

- 3 GPS in Balao (Esmeraldas), Chispas (Manabí) and Punta Prieta (Manabí).
- 9 GPS located in the coastal provinces at the north of the country.
- 5 GPS stations through an agreement with the Environment Ministry.
- 21 GPS with the strengthening Project of the Geophysical Institute funded by SENACYT. (17 stations installed).
- 8 GPS with other projects.

e. National Network of Data Transmission and Repeaters (Red Nacional de Transmisión de Datos y Repetidoras (REPET))

REPET is the real time foundation for surveillance with the different monitoring networks as it allows immediate access to the information collected in different stations by the Processing Center for Information and Seismic and Volcanic warning system. This network consists of subnetworks according to the technology used for transmission as follows:

- Analog transmission with 48 links and 47 repeater points throughout the country.
- Digital transmission with 26 links and 9 repeater points.
- Satellite Transmission that minimizes effects caused by weather conditions, topography and the use of repeaters with four stations, two of which correspond to infrasound information, one station collects seismic data and the base station. At the end of 2012 the satellite network with 17 nodes and two receiving points will be completed.
- Microwave transmission. It has a backbone data transmission in the central highland region capable of sending data through nine nodes and seven links.
- Communication Network (voice): it has a network with digital voice coverage with three repeater stations in the central and northern highland region which, in late 2012 will cover Pichincha, Imbabura, Esmeraldas, Manabí and Tungurahua provinces. There will be two base stations and 12 portable radios.

f. National Base of Seismic and Volcanic Data

According to current computing standards, seismic and volcanic data should always be available to the scientific community to conduct research in the field of earthquakes and volcances. Moreover, the same information should be used by the various state agencies involved with public safety and national development for land management, design of infrastructure works, regular updating of earthquake resistant regulations, etc. In addition, it should be available to professionals and students that need them for their corresponding academic requirements or professional practice.

From a technological stand point, the National Database consists of hardware and software and data communication systems:

- Equipment for data acquisition: 14 servers for data acquisition in real time for different types of stations: seismic, accustic, accelerographic, GPS, inclinometers, gas detectors, mudflows and video cameras.
- Data, information and backup storage System: annually for up to 1 and 2 TB of data which will be expanded to 6 TB per year. Currently storage capacity is higher than 36 TB, of which 50% is already used up.
- Equipment for server applications and services.
- Data Analysis equipment.
- Equipment for staff use.

- Printer and Scanner Equipment.
- Communications equipment (networking).

From a data perspective, the National Database is already shaped by the historical background which includes the historic seismic catalog (based on the Archive of the Indies and all available information from 1541), in addition to the information of observatories and global networks since the early twentieth century until 1990.

Since 1990, the earthquake catalog consists of observations made with the RENSIG, implemented and managed by the Geophysical Institute. A portion of the seismic catalog is freely available on the website of the institution.

g. Center for Processing, Information and Volcanic and Seismic Warnings (Centro de Procesamiento, Información y Alerta Sísmica y Volcánica (TERRA))

The seismic, volcanic and crust deformation information is received, processed, interpreted and disseminated to the National Decentralized Risk Management System in the Processing, Information and Early Warning Volcanic and Seismic Center (TERRA); it operates 24/7 and its main objective is to provide effective and timely warnings of seismic and volcanic activity in Ecuador and in the zone of influence of its territory. These advices are generated using state-of-art tools (software and specialized equipment) and protocols of monitoring centers worldwide, previously coordinated with strategic users.

For the dissemination of information there is permanent and duplicated communication network formed by the digital voice network, landline, mobile phone, fax, email and website.

The center operates 24 hours, 7 days a week with a group of analysts with experience and the ability to process and interpret information and make decisions in the event of an anomaly. This team is supported by a scientific in charge that is available 24 hours a day, during 14 calendar days.

6.5.2.3. Recommendations / Requirements

- There is a clear imbalance between actual risk and perceived risk that decision makers and the general public have. With no real sizing of this risk, the development of the country and the security of the population are based on false assumptions related to the perception that the threat does not exist or that the potential impact is minimal, or false assurances from religious or traditional beliefs, so it is necessary to implement the strategies needed for the perception to be as consistent as possible with the real risk, especially among decision makers on security, development and / or the preparation and response to these natural hazards.
- Erroneous perception of safety based on the

alleged earthquake resistance of state and private infrastructure and buildings; in reality these have mostly been built with little or no earthquake resistance considerations.

- Prioritize the design of mechanisms that enable the country to develop a high level of scientific understanding in fields earthquakes and volcanic eruptions.
- Strengthen the dissemination models as Social Vulcanology that allows democratization of information.
- Keep a modern, permanent and uninterrupted surveillance on the sources of seismic and volcanic generation.
- Generate adequate information for decision making which is always urgent and difficult, addressed at policymakers in the territory before the imminence or the catastrophic impact of these phenomena.
- Provide tools to enable decision makers to raise their perception of the real risk to lead the formulation of policies and implementation of strategies to mitigate these natural risks.
- It is necessary to have some sort of modern and automatic seismic and volcanic information service with state of the art technology and at national level with controls that will ensure 24/7 operation with a very high level of trust, since safety and even lives depend on this.
- Greater support of the Armed Forces and National Police is required regarding the use of areas for installation of communication systems and repeaters.
- At the moment there is available a study on stable zones that in case of landslides can become a useful tool.
- In case personnel are affected, there are not enough human resources to replace affected staff and with the experience needed for analysis and decision making.
- In case of tsunamis, there are national and international support systems, so that monitoring can continue only if the earthquake is not close enough and has not harmed the IGEPN's main office.
- High vulnerability of IGEPN facilities regarding earthquakes or events that may structurally affec the building.

6.5.3. National Institute of Meteorology and Hydrology (Instituto Nacional de Meteorología y Hidrología – INAMHI)

6.5.3.1. Description, responsibilities and products

The National Institute of Meteorology and Hydrology – INAMHI- is an institution with technical and managerial Independence with national and international representation that is attached to the Secretariat of Risk Management and with jurisdiction and responsibility in the whole country. It was organized in 1961 with the responsibility for establishing, operating and maintaining the Network of Hydrometereological Stations providing basic information and hydrometeorology services and products needed for the development of the country.

Its responsibility and powers are focused on:

- Improvement of the quality and coverage of information, which is generated through the network of hydro meteorological stations.
- Maintaning the climatological and hydrological data base updated.
- Easy access of all users to technical information and services.
- Enabling and improving warning reports of adverse weather phenomena, ensuring these reache the public.
- Provide quality products related to weather, climate and environment.
- Inform the public about the socio-economic benefits of better understanding climate issues and the distribution of water resources.

To fulfill the responsibilities and delivery of products it is necessary to keep a national and intern ational coordination level and inter institutional work; direct communications are maintained nationally with INOCAR, INEE, MAE, MAGAP, DGAC, SGR, IGEPN, universities and research centers; and internationally with ERFEN CIIFEN and, with the World Meteorological Organization - WMO, with the Water Center for Arid and Semi Arid Zones in Latin America and Caribbean (Centro del Agua para Zonas áridas y semi arids de America Latina y el Caribe CAZALAC).

The following are among the institutional products available:

- Weather and flow prediction in reservoirs.
- Hydrological studies.
- Climate Studies.
- Hydrogeological studies.
- Monitoring of glaciers.
- Environmental studies, in relation to the MAE and GAD.
- Early warning systems for local flooding.
- Thematic maps relating to climate, hydrology, frost and drought.

6.5.3.2. Actions in the Short and Medium Terms

- Monitoring of glacier dynamics through micrometeorological modeling will be maintained. The results of this work is important for various ministries and secretariats.
- In order to improve the institutional capacities in the human resources area, contact has been made with the PROMETHEUS project to obtain information and make it accessible to professionals.
- Based on an environmental and health focus approach, a predictability model for dengue is being developed which will enable the establishment of strategies for controlling spread and epidemiological barriers.
- Participation in the KLEVER project, of Latin

American scope, regarding investment in capacities for DRM.

- Update of monthly rainfall maps based on the parameters of the WMO.
- Three research projects are being developed with SENESCYT to strengthen capabilities of the institute

6.5.3.3. Institutional capacities / vulnerabilities

The facilities and networks of the institute are exposed to events and are susceptible to physical and functional damage during a disaster. There is no contingency plan or a plan for continuity of operations. However, a Risk Management unit and institutional committee have been created. The risk matrixes for necessary short term plans have been created. There are backup processes in Guayaquil, capable of generating forecasting models. There is also mobile exploration equipment available, mobile laboratories and technical staff who can be sent to specific areas during an event.

There is a network of automatic information and manual stations supported by satellite equipment. There are 500 weather and hydrological stations throughout the country. SENAGUA transferred its set of workstations to the institution. After having analyzed them and assessed their status, it will be determined how they will be integrated into the existing networks. It is necessary to have a record of all the (public and private) weather stations existing in the country to improve the level of information.

Updated maps on temperature and precipitation distribution could be provided so the decisionmaking bodies can respond to emergencies and make projections for recovery and reduction processes.

During El Niño Southern Oscillation - ENOS (known as El Niño), between 1997 and 1998, INAMHI conducted a hydrological assessment; this is currently being strengthened.

Community early warning systems for landslides and floods are being established with the help of the Autonomous Decentralized Governments, specifically with Cumandá, Napo and Quito.

In order to design strategies, scenarios related to weather and disease transmission are being created along with the Ministry of Health/ Ministry of the Environment.

Training on meteorological and weather processes is important for decision-makers.

6.5.4. National Institute of Geological, Mining, Metallurgical Research -INIGEMM

6.5.4.1. Description, competencies and products

The National Institute of Geological, Mining, and Metallurgy Research was created based on Official Register 517 of January 29, 2009. It establishes as its preceding institutions: the National Service of Geology and Mines - SNGM, the Directorate General of Geology and Mines - DGGM, the Ecuadorian Institute of Mining - INEMIN, the Geologic-Mining-Metallurgy Research and Development Corporation - CODIGEMM, the National Directorate of Geology - DINAGE and the National Geology Service – SGN. This institute is part of the Ministry of Non-renewable Natural Resources. Its competencies are:

- To generate, systematize, focus and manage geological information throughout the national territory to promote sustainable development of mineral resources and to prevent the effect of geological and manmade threats, supporting territorial management (Mining Act, Article 10).
- Generation of georeferenced and reliable geoscientific information of geological threats (mass movements).
- Technical assistance to SGR and Autonomous Decentralized Governments in studies and assessment of mass movements in all the country.
- Studies and assessment of unstable areas in different parts of the country.

INIGEMM is the official institution of mass movement research at national level. It has an experienced technical group and applies clear and validated methodologies for national intervention. Its main links are SGR, Autonomous Decentralized Governments, the Ecuadorian Spatial Institute and it receives international support from the South African Government and the NGO Geologists of the World. It is negotiating to receive help from Canada, Italy and Norway. The relationship with the IGEPN is limited to the transfer of information. It has a cooperation agreement with the National Polytechnic School.

There are 10 investment projects, the major ones include:

- Hydrogeological Research in mining areas.
- Implementation and assessment of a system for monitoring landslides in real time.
- Implementation of investment projects related to the zoning of susceptibility and dangers of mass movement processes, 1:50,000 scale, at national level (start in three provinces), 2012-2015.
- Research methodologies for the zoning of susceptibility and dangers of mass movements, at a scale of 1:50,000.
- Technical Assistance in zoning of susceptibility to mass movements in Chunchi canton, 2011.
- Research in the dynamics of landslides in Chimborazo (there are areas susceptible to landslides of up to 3 km).
- A map is being put together at a scale of 1:50000 for mining areas. It is in the process of research and mapping update.

Projects have been developed with international cooperation institutions and universities, whose

specific geological components have been under the responsibility of the institute.

Extreme events of precipitation and hydrological deficit are within the scope of INIGEMM's research; because if there are hydraulic dams, landslides increase when there are low levels.

Some of the products the Institute provides are:

- Preliminary maps zoning susceptibility to mass movements at national level.
- National geology mapping.
- Publication of the 'Multinational Andean Project 2007/ assessment guide of threats'.
- Methodology for zoning of geological threats discussed and validated with national and international experts.

6.5.4.2. Actions in the Short and Medium Terms

One of the main actions to improve threat monitoring, is the determination of methodological variables to be applied in studies and research for standardization and regulation of products and research conducted in or outside the institution.

Ongoing training in geological threats, as well as the processes of dissemination and transfer of capacities to Autonomous Decentralized Governments, SGR, Ministry of Health, is another important point that helps development. Dissemination has also been achieved at community level. It should be emphasized that, supported by international cooperation, methodologies have been developed to transfer knowledge of studies and research results to the communities.

The positioning of the institution, as well as its recognition by public and private entities as the leading institution in geology and mass movement is a priority. INIGEMM has to validate (public or private) studies related to mass movements, as well as actions related to this topic, in order to avoid duplication of functions and loss of resources.

6.5.4.3. Institutional capacities/ vulnerabilities

- The analysis, assessment and studies are performed by national and international staff with experience and expertise in geological threats. There is a direct relationship with international geology services for updating methodologies and technological innovations regarding geological threats.
- There is a database of 2,700 mass movements inventoried at national level. Several of them are monitored with special technologies. For example, with differential GPS and scanner of 125 thousand points per second with coordinates x, y, z. It is necessary to strengthen studies in the coastline and, in particular, in relation to tsunamis.
- There is trained and experienced staff in the

implementation of a methodology for working with communities. This allows dissemination of the findings and situations associated with mass movements, with a focus on risk reduction and, if necessary, on response. The institute can advise on the development of Risk Management plans related to landslides.

- There is no relation with the National System of Situation Rooms of the SGR; relations are only maintained with some Autonomous Decentralized Governments. The institution has expertise for realtime monitoring; however, there is a lack of input, resources and personnel to maintain a national monitoring system. There are early warning systems for slow landslides in certain locations, but they do not exist for shallow landslides.
- The country lacks technicians specialized on mass movements; there is no university training at third or fourth level of education specialized on the topic. The lack of technicians results in a need for training for local or province technicians for the development of specific actions, in particular related to monitoring.
- Agreements exist with the NGO 'Geologists of the World,' which is working in Chimborazo.
- There is no contingency plan in case of damages to the institution or schemes for continuity of services.
- There is a high risk of functionality reduction in the case of the institution being affected by an event or incident.

6.5.5. Oceanographic Institute of the Navy - INOCAR

6.5.5.1. Description, skills and products

The Oceanographic Institute of the Navy ofEcuador (INOCAR) was created on February 2, 1932 as a Hydrographic Service, during Alfredo Baquerizo Moreno's government, and was raised to the category of Oceanographic Institute on July 18, 1972, by Executive Decree 642. Its main responsibilities were navigational safety, oceanographic research, compilation and creation of the national nautical chart, representation in international organizations working on hydro-oceanographic research. At the moment, it directly depends of the Ministry of National Defense. If there is an event of oceanic origin, INOCAR is a key constituent of the warning system established as part of the National Decentralized System of Risk

Management, facilitating advice and information actions.

Their skills related to Risk Management processes are:

- Permanent monitoring of threats (tsunami, El Niño, storms, swells, etc.) that generate risks in the coastline.
- Support in aid actions in the coastline.

INOCAR is a technical entity that supports the National Decentralized System of Risk Management in the identification, monitoring and warning issuing of oceanographic threats that affect the Ecuadorian coast.

Any risk management information generated is sent to the SGR. Its dissemination takes place once it is authorized by this Secretariat. There is also a direct relation with IGEPN, in particular for monitoring earthquakes on the coastline or at sea.

The main tasks and objectives of INOCAR (Oceanographic Institute of the Navy) are:

- Monitoring, diagnosing and advice to the people in charge of making decisions regarding oceanic and atmospheric events in order to take preventive actions and also for decision making for managing of natural disasters.
- Promote the development of scientific research with the objective of contributing with governmental organizations or private companies in the study of the sea and take advantages of its resources.
- Know and apply modern technologies that will improve our scientific level, and boost a solid and efficient development of the activities and means of maritime power.
- Coordinate and collaborate, along with other public organizations, in the elaboration, update and implementation of reduction and contingency plans when facing natural disaster emergencies in the maritime-coastal area.
- Optimize operational processes, control and assessment of Oceanographic and Hydrographic activities and also provide navigation support in order to guarantee the safety of the navigation at sea, cannals and navigable routes of the country.
- Develop activities of scientific research that will contribute to naval operations and support national development and the country's sovereignty.
- Study and implementation of different support alternatives for the work of INOCAR with National and International institutions.
- Coordinate and advice the government organizations, particularly the Ministry of Foreign Affairs, about aspects regarding sovereignty and maritime interests.
- Widely disseminate the work and research carried out by INOCAR that will benefit the maritime sector and national development through all the available means.
- Perform, lead, coordinate and control all the work of exploration and research of Oceanography, Geophysics and the sciences of the marine environment.
- Perform, lead, coordinate and control of the hydrographic, fluvial and oceanographic surveys for the development, compilation and elaboration of the Nautical Chart.
- Build up the technical and permanent official organization of the state, which will represent it in everything related to research about oceanography, hydrography, and navigation and also of navigation support.
- Encourage the development of the arts and sciences that are necessary for the navigation safety.

Among the main products of the institutes, we can find:

- Meteorological Atlas of Ecuadorian Seas
- Oceanographic Atlas
- Notification of the conditions for navigation Warnings
- Weather Warnings Newsletter
- Current and Waves Newsletter
- Newsletter of "El Niño" phenomenon
- Meteorological Newsletter
- ERFEN (Regional Study of the "El Niño" phenomenon) Newsletter. Summarize or inform about the results of the work meetings with other institutes dedicated to the study of the "El Niño" phenomenon (INOCAR – Oceanographic Institute of the Army, ESPOL – Polytechnic University of Ecuador, INAMHI - National Institute of Meteorology and Hydrology, INP – Fishery National Institute and University of Guayaquil).
- Chart of temperature and salinity distribution of the Ecuadorian seas.
- Chart of distribution of the "Chlorophyll A" and nutrients of the Ecuadorian sea.
- Chart of nutrient distribution.
- Current and Lunar Phase Calendars.
- Meteorological stations graphics.
- Geological information of Galapagos.
- Reports of the surface temperature of the sea.
- Inundation maps for Tsunamis, elaborated for the cities of: Esmeraldas, Bahia de Caraquez, Salinas, Puerto Bolivar, Puerto Baquerizo Moreno and Puerto Ayora.
- Map of Maximum Height of waves for the coastal sector of Ecuador.
- Bathymetric and Geologic maps of the Ecuadorian continental margin
- Maps of approximate distribution of surface bottom sediments
- Notifications of evolution of ocean atmospheric conditions.
- Notification of seismic activity of the Pacific Ocean
- National Cartographic plan of the Coastal Sector
- Tide Chart.

There is national and international interagency coordination, in accordance with actions and responsibilities. For the National System of Tsunami Warnings, they keep ties with: SGR (National Secretariat of Risk Management), Navy of Ecuador, IGEPN (Institute of Volcanology and Seismology of the State University), NOAA (National Oceanic and Atmospheric Administration), SHOA (Hydrographic and Oceanographic Service of the Chilean Navy), Navy of Colombia, USGS (U.S. Geological Survey), JMA (Japan Meteorological Agency). As part of the National Committee for the Regional Study of the "El Niño" phenomenon - ERFEN, there is a direct relationship with INAMHI (National Institute of Meteorology and Hydrology), INP (Fishery National Institute), ESPOL (Polytechnic University of Ecuador), University of Guayaquil, DGAC (Directorate General of Civil Aeronautics), FAE (Ecuadorian Air Force) AND CIIFEN (International Research Centre on "El Niño").

A special relationship is kept with INAMHI (National Institute of Meteorology and Hydrology) since they complement their work with the hydro meteorological information, according to their territorial capacities and specific competence; on one hand, INAMHI has jurisdiction over all the territory and is director, coordinator and standardizer of the national hydro meteorological politics; and on the other hand INOCAR monitors the processes in the ocean and in the coastlines.

6.5.5.2. Main Actions

As a key and priority action, there is the strengthening of the National System of Tsunamis Warnings, and for this, it is necessary to perform some specific actions such as: the installation of a Tsunami buoy in front of the coasts of Esmeraldas, optimization of the model and analysis systems, and improvement of the information systems. Currently, with the support of UNESCO (United Nations Educational, Scientific and Cultural Organization) and ECHO (European Commission-Humanitarian Aid and Civil Protection), they are developing national protocols for warnings in case of tsunamis, through a Technical Committee of Early Warnings for Tsunamis in which the SGR (National Secretariat of Risk Management), INOCAR (Oceanographic Institute of the Army) and IGEPN (Institute of Volcanology and Seismology of the State University) participate.

Other important actions are:

- Identification of areas of potential risk of impact from waves and coastal processes.
- Establishment of a coastal maritime baselines
- Establishment of a buoy network to monitor the waves and water temperature at sea
- Naval TV (project in process), Warnings of currents and waves on the web.
- Baseline of the process of corrosion and sedimentation
- Costal maritime baseline

6.5.5.3. Institutional Capacities / Vulnerabilities

The National Centre of Tsunamis Warnings – CNAT becomes a technical answer of INOCAR to the need of information of the status before the occurrence of the tsunamis that could affect the Ecuadorian continental and insular coastlines. The work of this centre is divided into 3 different themes which are: the non-structural mitigation of the impacts that a tsunami can cause, the monitoring of the seismic and tidal information, and advisement during warnings that will be issued by the authorities.

The mission of CNAT is to assess swiftly and efficiently the occurrence of tsunamis that will affect the Ecuadorian coasts, with the purpose of disseminating warnings in an appropriate manner for adecuate risk management of tsunamis.

The tasks of CNAT are:

 To disseminate Tsunamis warnings to all the national territory through official means (SGR (National Secretariat of Risk Management) and DIRNEA (National Directorate of Aquatic Spaces))

- To monitor the occurrence of seismic activity that can provoke tsunamis in the Pacific Ocean from external sources.
- Permanent monitoring of the intermediate level of the sea, from both Ecuadorian and Pacific Ocean waters.
- To contribute with the knowledge on tsunamis threats in the Ecuadorian coastal and insular territory
- To advice the local government in the elaboration of contingency plans from a technical standpoint

As part of the Centre they have a system of warnings for distant Tsunamis with international support and collective work with the countries in the Pacific network, having its headquarters in Hawaii; this system is filled with international information, and a permanent guard and monitoring are kept to guarantee accurate warnings. If it is necessary, it is possible to access the international information of these countries which had agreed on the establishment of a protocol for the exchange of information.

We have a network of tide gauges (11 stations in the coastal and insular profile with live information) and Tsunami Buoys, in agreement with the SGR (National Secretariat of Risk Management) for the National System and also as a contribution to the International system. The bouy located near the island La Plata which is for permanent monitoring, has also generated maps of tsunami inundations and a map of waves heights for the coast of Ecuador. The actions associated with this network are:

- Permanent Monitoring
- Emission of Warning
- Dissemination, once it is authorized by the SGR (radio, web, journals)

Live monitoring is very important, this is done through oceanic-atmospheric elements, meteorological networks and a network of tide gauges distributed in the coastal and insular profile. At water surface level and up to 12 meters in depth, it will provide a better assessment of the current conditions before the occurrence of an event. It is necessary to improve the coverage and the capacity of the programs and the monitoring actions, in order to decrease time of the notifications.

In order to keep track of the "El Niño" event, there have been established meteorological stations along the Ecuadorian coastaline, continental and insular profile (Island San Cristobal, San Lorenzo, Esmeraldas, Manta, La Libertad, Puna, Guayaquil, Puerto Bolivar); just like the network of tide gauges, they have a data base of approximately more than 50 years.

We have acquired a system for satellite reception of parameters such as temperature, etc. in high resolution with a regional and global coverage.

The implementation of the centre of maritime research in Santa Cruz took place in 2010; there are 2 buoys for Galapagos. As for the tsunamis of close origin, there is not any capacity of warning yet available, since the analysis and response time is reduced to minutes. With the information delivered by the buoy, INOCAR validates the shaping of tsunamis to determine the location; it is till not possible to carry out this process in a matter of seconds and thus there is a limitation for the warnings of close origin Tsunamis.

There are no contingency plans available in case of damage to the institution or schemes for service continuity. There is a high risk of decreasing functionality in case that the institution is affected by an event or incident. The equipment, infrastructure and systems are vulnerable in case of disasters. Also there is a dependence of other systems (or their information), for example the interdependence with the IGEPN (Institute of Volcanology and Seismology of the State University), which also presents vulnerabilities.

One element that presents vulnerability is telecommunications, which is a key element for the transmission of data. There is no redundancy in the system of telecommunication.

An area that is still not developed is the interrelation and cooperation with the INIGEMM (Metallurgical Geological and Mining National Research Institute) for the study of landslides at coastal level, in which INOCAR is in a capacity of sharing information and participate /advice in the research processes.

6.5.5.4. Recommendations / Requirements

- It is necessary to determine mechanisms that will help strengthen the knowledge of marine sciences of Ecuador
- Reinforce the capacity of surveillance (24/7), taking into consideration state of the art technology, data generation, automated warnings, appropriate and simple products and information for decision making directed to the politic levels according to their territorial responsibilities.
- The last events that occurred worldwide in the marine environment (tsunamis of Samoa 2009, Chile 2010, Japan 2011, El Salvador 2012, Costa Rica 2012; strong waves 2011) allows us to see the clear need of strengthening a warning system for tsunamis at local level and to project this unto a multi-threat system with the objective of offering a better service to the community.
- The technical-scientific entities have decided to promote the improvement of the perception of risks associated to the oceanic-atmospheric threats, not only from a general perspective, but from the foundation level, which is the level where decisions about safety and development, preparation and response against these events are made.
- Generate studies of tsunamis provoked by landslides in the bottom of the sea and islands, for this, it is necessary to do a survey of the bottom of the sea with a good level of details.

6.5.6. International Center for the Investigation of El Niño phenomenon-CIIFEN

6.5.6.1. Description, competencies and products

CIIFEN is an international public organization that coordinates with local institutions, without overrunning their areas of competence, but strengthening the required areas in a joint and participative way.

For its creation, the WMO (World Meteorological Organization), the UNISDR (International Strategy for Reducing Disaster, currently UN Office for Risks Disaster Reduction) and the Ecuadorian Government, through an alliance defined the strategies and actions about the establishment of the International Center for the Investigation of El Niño phenomenon- CIIFEN, which started its operations on January 10th, 2003 in the city of Guayaquil; with the participation of more than 100 experts, representatives from 33 countries and 19 international entities. In 2005 the Spanish Government was incorporated into CIIFEN{s International Board, as a cooperating state. The mission is to promote, complement and encourage scientific and applied research projects needed to have a better understanding and an early warning system for the ENOS (El Niño Southern Oscillation) and the climate variability at regional level to contribute with the reduction of the socio-economically impacts and generate solid foundations for the development of sustainable policies, to face new and existing climates scenarios ". CIIFEN became the Regional Climate Center for the WMO.

Some initiatives have been supported, such as the creation and maintenance of climate and hydrologic regional networks with scientific and technical approaches. The Climate Perspectives Forum is one of the mentioned networks, which allows validation of information generated in regional climate products such as Western and Southern-American Seasonal Forecasts. During the Climate Perspectives Forum – COF, there are debates about meteorology, processes and acceptance and post of climates products with all the meteorological services of West and South America.

In a periodic way the evolution of the Western and Southern-American Seasonal Forecast is presented, as a coordinated work with the other 6 countries of the region.

Among the main products we can find the following:

- Geographic visualizer for its further use in the SGR.
- Support in the developing of agro-climate hazard mapping of Andean countries, initiative that is currently included within each one of the Meteorologically and Hydrological Services of the region (SMHN).
- Information for Firefighters with operational and response capacity.
 - Visualizer of vulnerability-maps in case of climate

change and climate variability (Decision Making) in conservation areas, developed with the Ecuadorian Environment Ministry.

• Hazard mapping for food security with the World Food Program.

Besides, there are products that are generated on a regular basis, among them:

- Western and Southern-American Seasonal Forecast (Monthly)
- Eastern Pacific Analysis (Monthly)
- ENOS newsletter (Monthly)
- TMS and ATMS maps for the Eastern Pacific (Weekly)
- El Niño/La Niña Newsletter
- Regional Climate Database.

At least 6.600 products have been developed.

Another way of providing support is through Training; there are 3 kinds of workshops for the strengthening of institutions, authorities and communities; and the existence of audio and video archives for DRR (can be downloaded at www.ciifen.org)

6.5.6.2. Actions in the Short and Medium Terms

It is proposed to continue with the current products, as well as strengthening support to researches. It will continue with the technical support to the SMHN for the statistic and dynamic modeling.

It will continue with training, dissemination and scientific training processes, using some tools such as "Wiki for Hydrological Seasonal Forecast"; publications about vulnerability, climate change and adaptation measures; virtual classrooms, and others.

6.5.6.3. Institutional Capacities/ Vulnerabilities

With the information coming from 430 meteorological stations of the countries that make up the Western and Southern-American Seasonal Forecast, which is distributed through web and e-mail around the world; the seasonal forecast shows the separated conditions for 3 months based on the precipitation, max. temperature and min. temperature variables; as well as a brief summary of the conditions in each country.

There is an Information System for Risk Management, with the following characteristics:

- Information from 6 cantons from the coastal area and 6 cantons from the highland area, as information provisioning for decision making.
- Online system.
- Vulnerability and Climate Risk, Volcanic and Seismic Maps; including location of response units, shelters, resources and capacities at cantonal level.

CIIFEN faces the risk of losing functionality, either due to direct affectations to the infrastructure such as

harm to staff in case of an event; nevertheless, it has international component which will continue with the generation of products that support decision making processes.

6.5.7. National Secretariat of Water -SENAGUA

6.5.7.1. Description, competences and products

The mission of the Secretariat is to "Run the comprehensive management of hydric resources all across the national territory through policies, norms, control and deconcentrated management in order to generate an efficient use and exploitation of the water resource".

Its competencies and actions are focused on respecting the rights of nature, especially the associated with water, and reducing the social and environmental vulnerability in the country.

Because of the strategic and cross-cutting nature, it coordinates its actions with the Ministry Coordinator of Strategic Sectors, Economic Policy, Production, Employment and Governability, Social Development, Heritage; with the sectorial ministries of Education, Foreign Affairs, Electricity and Renewable Energy, Telecommunications, Natural Resources, Health, Tourism; Culture, Environment, Urban Development and Housing, Economically and Social Inclusion, Industry and Productivity, Finances, and Agriculture; and with the secretariats of Planning, Risks Management and Peoples' Secretariat.

Nowadays SENAGUA is divided into 9 hydrographic areas, to the management through zonal centers, the areas are:

- Mira
- Esmeraldas
- Guayas
- Manabí
- Napo
- Pastaza
- Santiago
- Jubones
- Catamayo

Products of SENAGUA are focused on megaprojects on water for human consumption, electricity generation, risk reduction and flood control. According to SENAGUA, the biggest issues on the Ecuadorian coastal provinces, are disasters caused by floods and/or droughts, due to that the secretariat started with the multipurpose projects, which have as their main objectives the building of dams to control floods during the rainy seasons and to provide water for the population during periods of low water level (for drinking water and irrigation), (Milagro, Multiple Chone, Las Gilses, Bulubulu flood control – Cañar – Naranjal, flood control system of low basin in theGuayas river). All of the projects have an environmental license granted by the Environmental Ministry.

6.5.7.2. Actions in the Short and Medium Terms

- It is proposed to quadruple the beneficiaries of the actions and projects, focusing on risk reduction; control actions over 614 000 hectares in floodable areas.
- Nowadays there are 15 projects under study.
- For the 2012-2013 period, the Technical Assistance Program of Spain will be carried out. It involves structuring of 4 Early Warning Systems to protect the Multi-Purpose Projects in the hydrographic systems in Carrizal – Chone, Portoviejo, Bulubulu and Chongón.
- Strategies to work in the community have been developed.

6.5.7.3. Institutional capabilities / vulnerabilities

- The political public structure of the Secretariat is new, which means that there are conflicts with previous bureaucratic schemes and management models.
- It requires an institutional and inter-institutional strengthening disaster risk management; also to clarify better skills on the management of water, under a joint legal framework among the various institutions.
- There is a lack of models for control and monitoring, there are no relationships established between the situation rooms system and SENAGUA.
- In order to achieve water supply in periods of drought and during disasters, a plan for a water desalination plant is been prepared.
- A computer platform with remote server and access to privileged levels is been built.
- Strengthening the direction of intersectorial networks responsible for coordinating all entities involved in water management.
- There are no disaster preparedness schemes; care plan is only performed according to an emergency function.
- Mega projects for flood control and irrigation are under execution and planning.
- There are technical considerations based on seismic zones for the execution of projects.
- To provide the staff required for assessment and, if necessary, for humanitarian response.
- In case of an earthquake in the city of Quito, there may be an impact on the functionality of the Secretariat; there are no continuity plans or alternative sites, nor a risk Committee, emergency and evacuation plans. This affects the Central Plant projects management, approvals, and modifications, with the Ministry of finance.
- The deficit of staff makes functional continuity and the level of response to be at a lower capacity.

6.5.8. Ministry of the Environment (climate change Sub Secretariat)

6.5.8.1. Description, skills and products

The Minstry of the Environment (MAE) has the mission of "effectively and efficiently exercising the stewardship of environmental management, ensuring a harmonious relationship between economic, social and environmental themes to ensure the sustainable management of strategic natural resources".

There has been no direct work with Risk Management because it is not part of their core competencies; however one of the common areas of relationship with Risk Management is climate change, so there have been approaches and joint work between the SGR and the climate change sub secretariat.

The Sub Secretariat for Climate Change has competency leading actions for mitigation and adaptation in the country to deal with climate change; hence the monitoring of the migration of agricultural areas, migration of diseases, more frequent climatic anomalies, etc., taking into account the sensitivity of the different sectors to the adaptation and resilience.

MAE and SENPALDES have generated information 1: 25,000 in relation to threats and risks with the purpose of development and land use plans.

The following projects are currently running:

- Study of vulnerability of the basin of Pastaza.
- Project Management in adaptation to reduce the social, economic and environmental vulnerability in Ecuador – GACC
- Project for Adaptation toClimate Change PACC through the Governance of water in Ecuador.
- Andean Regional Project of Adaptation to Climate Change - PRAA, focused on adaptation to the impact of the rapid retreat of glaciers in the Andes - PRAA.
- Project strengthening of the resilience of communities to the adverse effects of climate change with an emphasis on food security -FORECCSA, in the basin of the Jubones River.
- Plan for the reduction of vulnerability and food security related to the adverse effects of climate change in the province of Pichincha.
- Institutional support for the mainstreaming of climate change as a national strategy.

6.5.8.2. Actions in the Short and Medium Terms

The two main actions that are developed are:

- Work with GAD for social, economic and environmental vulnerability reduction in Ecuador. Its goals are related with adaptation measures.
- Institutional support for mainstreaming climate change. National Strategy for climate change.

6.5.8.3. Institutional capabilities / vulnerabilities

• It is required to increase coordination among the State in order to reduce or avoid duplicating

actions, by this way the demands will be solve and resources well be optimize; so, it is necessary to improve the channels and communication systems.

- Clear definition of competences as well as the shared responsibilities that exist. A key component in the institutional coordination is the research and development of science / technology, so it is necessary to include the SENESCYT in the process. It is also necessary to build and/or strengthen partnerships and cooperation policies focused onRisk Management.
- Awareness on CCA and Risk Management decision-makers, this activity is carried out on a permanent basis, but is not yet reached to all officials.
- Mainstreaming Risk Management with development.
- Support to those who have not had high level training and carry out the loyalty of high-level personnel, allowing improved formulation of programs and projects, as well as evaluation.
- Although there is much information that is processed, this fails to reach local governments or when it does it is not considered a priority, producing and generating little optimal development plans. Need to share information and optimize access to the same. The end user of the information, the community as a first responder, must have access and support in the interpretation of the same, this guarantees a base, both on the environmental level and risks management (the community has a different worldview, has of assimilated the climate issue and adapted over time).
- There are no plans integrated into the environmental aspects and risk; the recurrent effects require working for the recovery and reduction; for example, it is necessary to incorporateRisk Management in the management of coastal areas.
- It is important that international agencies and NGOs contributions, such as positive action for environmental management and risks, always within the framework of transparency, respect and in order to strengthen the Decentralized National System of Risk Management.
- Key structures such as the Scientific Technical Committee are known, but it is necessary to have an activation and ongoing work of the same; there have been meetings related to specific threats, but not an integrated work of the scientific bodies, nor there considerationof the environmental aspect in this Committee. International agencies and NGOs are supporting and facilitating this activation.
- It requires the participation of other public actors in the processes of identification and monitoring of threats.
- Identify clearly the relationship between disasters and climate change, therefore the actions and studies to be considered must have a comprehensive approach to two factors; for example, it is necessary to incorporate the theme of health in studies of climate change as an element for the increase of vulnerability; Another example is the need for people trained in environmental management, mining and risk management processes.

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 It is necessary to analyze environmental factors that may be affected and their association to disaster risksin the Environmental Impact Assessmentprocesses required for the construction works.

6.5.9. Ministry of Education

6.5.9.1. Description, skills and products

The Mission of the Ministry is to "ensure both quality and access of Initial Education, Basic General Education and Secondary Education to it to the inhabitants of the national territory, through comprehensive training, holistic and inclusive of children, young people and adults, taking into account intercultural, plurinationality, ancient languages and gender from an approach to rights and duties that strengthen social development, economic and cultural, the exercise of citizenship and the unity in diversity of Ecuadorian society".

As part of its competencies, Risk Management is located in the educational process; currently this theme is of great importance in the programming processes of the Ministry. It is their responsibility to ensure that schools and educational centers are safer in the event of a disaster.

6.5.9.2. Actions in the Short and Medium Terms

- To strengthen the education and training of teachers as responsible for the safety of students and planning processes for the management of risk in the educational units.
- Socialize and apply the methodology for vulnerability - capacity analysis and planning in schools models.
- Implement the project for the structural analysis of the educational units, with base on the priorities and depending on their location relative to existing threats.

6.5.9.3. Institutional capabilities / vulnerabilities

- The institution has established the Risk Management Directorate with direct advice to the Ministerial Office, strengthening the empowerment of the risk management theme by the managers and the structure of the Ministry.
- There is an institutional Contingency Plan; at the central level, according to the parameters established by the SGR.
- There is no full institutional strengthening in relation to training and implementation of new Risk Management models/policies / at the institution, which increases their vulnerability in the case of an event causing damages in its infrastructure or its functionality.
- In case of disaster, it cannot ensure, in the early days, the provision of alternative educational establishments of destroyed schools; there is still

no plan for continuity of operation. However, there is ongoing work on the strategy and programs of "Safe Schools", a flagship program of the Ministry, which has the support at the political level. At a complementary level it has approved the plan of public investment for education in emergency of \$48 million dollars.

- As part of the SNDGR the Bureau of education has been activated with the participation of international cooperation, which is chaired by the Ministry of Education. One of the principles that govern the work of the Bureau is to increase coordination between State bodies in order to reduce or prevent duplication of Risk Management actions, this way it will solve the demands and will optimize resources; we recommend this activity to be taken up by other technical working groups.
- The communication plan in emergencies for the education sector is in its final stage.

6.5.10. Ministry of Public Health

6.5.10.1. Description, skills and products (2)

In normal situations, systems of epidemiological surveillance and health information systems maintain a continuous monitoring of the situation of health in the population and the provision of services. Given a scenario of disaster, the health sector must reorganize the functioning of their units according to the new priorities that guide its activities in order to:

- Pay attention to the affected population.
- Determine the number of victims who require some type of health care.
- Quickly assess the health situation subsequent to the event.
- Determine the population at risk that requires any public health intervention.
- Adapt existing resources to meet the emergency.

EThe success of these processes and operations of health care in emergency and disaster situations depends greatly on the levels of coordination reached by the social actors within the territory, the community and its various organizational forms, governmental and non-governmental institutions, and agent's suppliers of health services in the territory.

"The Ministry of Public Health of Ecuador acts as the health authority to: exert thestewardship, regulation, planning, management, coordination and control of the Ecuadorian Public Health through surveillance and health control, comprehensive care for people, promotion and prevention, research and development of science and technology, articulation of the actors of the system, in order to guarantee the right of the Ecuadorian people to health", this is the Mission of the MSP.

In the Constitution adopted in 2008, for the achievement of the Sumak Kausay or the Good Living, incorporated changes that influence the Organization and structure of the health system, these changes are:

I. Organizational processes

The organizational structure of the Ministry of Public Health is based on an approach to management by processes, determining their organic systems through the identification of processes, customers, products, or services.

The Ministry of Public Health processes are sorted and classified into (see annex):

- Processes governing guiding institutional management.
- Process value aggregators are responsible to generate and manage products and services, these are the Public Health Surveillance, Public Health Governance, Provision of Services of Health and Prevention and Health Promotion and Equality.
- Enabling advice and support processes.
- Decentralized processes generate products and services intended for end-users, closer to the territory.

II. Powers of decentralized levels

The restructuring of the Ministry of Public Health aims to improve the efficiency, transparency and quality of services to citizens, implementing a typology of high and low decentralization deconcentration.

- Decentralization involves the strengthening of the processes of the Ministry of Public Health at all levels, improving the response capacity of the territories.
- To "Decentralization" refers to the transfer of powers to the autonomous governments.

The powers of each level of deconcentration are:

- Central level: planning-rectory regulationcontrol-coordination.
- Zone level: coordination-planning controlmanagement.
- Provincial level: coordination-control.
- District level: planning-management coordination-control.

III. Structure of the National Direction of Risk Management in the Ministry of Health

As of September 15, 2011, by agreement of the Ministry of Health 825, establishes the National Network of Health Risk Management and Care in Emergencies and Disasters, extending granted management competencies in the 526 2004 agreement to the integral management of health risks. In the 526 agreement is institutionalized the existence of early response (ERT) teams, the operating Committee of Emergencies on Health (EOC-S), the designation of focal points, the brigades of quick intervention (RIB) and situation rooms.

As part of the restructuring of the Ministry of Health, is relocated to the National Directorate of Risk Management within the General coordination of planning, which aims to manage and distribute health care resources based on principles of territorial equity, and contribute to the reduction between the gaps of supply and demand for services at the national level.

6.5.10.2.Institutional capabilities / vulnerabilities

I. Capacity of the health services in the country

a. Organization of health services

EAt the national level, the unit responsible for this topic is the joint National Directorate and Management of the National Health System and of the Public Network, whose mission is to articulated, coordinate and arrange with the institutions of the National Health System, the management and implementation of policies, standards, agreements, standards and technical tools in the public and complementary network of territorial levels.

According to data reported by the Ministry of Health, 2010 public sector, Ecuador boasts 132 hospitals, 160 health centers, 1,728 sub centers, 478 posts and 46 classified as others. Relations centers and hospital units from 2006 to 2010, as well as the production of health in 2010 can be seen in the graph and detailed picture.

Offers by type of health-care centers Ministry of Health 2006-2010



Source: Public Health MInistry. 2010 Health Care unit Resolution Capability and Health Care Service Regional System

Prepared by: National Direction of Information, Follow-up and Management Control

Explanatory note: "Others" means fluvial, oncological, surgical, mobile units

Production of Health Services Ministry of Public Health 2010

Total appointments by outpatient care specialty							
Specialty		Appointments					
Outpatient care	Total	Initial appointment	follow-up appointment	Prevention	Morbidity		
General practicioner's appointments	19.986.936	14.148.395	5.838.541	6.090.562	13.896.374		
Obstetrician's appointments	3.858.900	2.349.938	1.508.962	2.561.410	1.297.490		
Psychologist's appointments	216.123	121.487	94.636	27.30	188.823		
Dentist's appointments	5.971.499	4.107.367	1.864.123	2.850.793	3.120.706		
Emergency appointments	4.381.371				4.381.371		

Total deliveries	153.987
Outpatient	15.721
Inpatient	138.266
Hospital discharges	503.015
Percentage of occupation	84,4
Average stay	3,9
Bed turnover	66,0
Turnover interval	0,9
Surgical interventions	198.423
In-hospital mortality rate	3,4

The sum of most subsequent first appointments resulting in the total number of queries. Similarly, the sum of appointments of prevention plus morbidity resulting in the total number of queries.

Source: MSP. Production of services 2010 Production: National Directorate of information, monitoring and management control.

b. Strategies for Risk Management of disasters in health facilities

In the fulfillment of international commitments undertaken by the Ministry of Health as of 2007, Ecuador implemented a disaster safe hospitals initiative, understood as any health establishment, whose services remain as an accessible facility and operating at its maximum capacity and on the same infrastructure, immediately after a destructive phenomenon of great intensity of natural origin.

In this context, through the Ministerial Agreement 0550 of September 27, 2007, issued by the National Government through the Ministry of Public Health, the hospitals insurance policy is enacted in the country", which includes the following guidelines:

- 1. Having a legal technical framework that allows the implementation of the National Policy and the Hospital Insurance Program.
- 2. Establish strategic alliances and cross-agencies.
- 3. Reduce the vulnerability of existing facilities.
- 4. Apply technical and legal regulations in the new health facilities so that they are safe.

- 5. Strengthen preparations for emergencies and disasters in the health sector.
- 6. Establish and ensure a system of monitoring and evaluation to the program's hospital insurance.

Until August 2012, the most significant achievements have been made in the guidelines one, three and five.

Guideline 1: Having a legal technical framework that allows the implementation of the National Policy and Program of Safe Hospital.

- Establishment of the Insurance Committee of the Ministry of Health Hospital published
- Approval by ministerial regulation agreement signaling security for Medical Health facilities.

Guideline 3: Reducing the vulnerability of existing facilities.

- It is determined as a means to obtain a diagnosis of the level of hospital security against disasters in the country, the application of the Index of Hospital Safety (ISH) in existing facilities. This instrument (ISH) becomes a contribution of diagnosis of the structural, non-structural and functional units of health vulnerabilities and helps in decision making as well as planning activities seeking to solve the problems encountered.
- Trained a group of professionals for the implementation of the ISH in the country and form a team of hospital safety evaluators.
- In June 2012, the Ministry of Public Health began a process of institutional certification.
- Based on satellite images that identify areas prone to floods and mass movements, provided by the National Secretariat of Risk Management, five levels of threat are determined (1 no threat, 2 very low, 3 low, 4 medium and 5 high), also the data of georeferencing of hospitals and first-level units, developed by the National System of Information of the MSP, the level of threat of the health facilities of the country against flooding, with the following results was established:

No.	Province	Hospital Level 4 and 5	operational health units Level 4 and 5
1	Azuay	S/I	S/I
2	Bolívar	2	33
3	Cañar	2	31
4	Carchi	0	6
5	Chimborazo	S/I	S/I
6	Cotopaxi	S/I	S/I
7	El Oro	8	55
8	Esmeraldas	4	37
9	Galápagos	S/I	S/I

No.	Province	Hospital Level 4 and 5	operational health units Level 4 and 5
10	Guayas	0	56
11	Imbabura	1	9
12	Loja	2	46
13	Los Ríos	2	45
14	Manabí	6	68
15	Morona Santiago	5	74
16	Napo	2	19
17	Orellana	1	23
18	Pastaza	1	25
19	Pichincha	S/I	S/I
20	Santa Elena	0	6
21	Santo Domingo de los Tsáchilas	0	13
22	Sucumbíos	0	36
23	Tungurahua	S/I	S/I
24	Zamora	0	27
	Total	36	609

This information will befully validated with visual verification field until December 2012. Additioal information related to mass movements and safe areas will also be included.

Guideline 5: Strengthen preparations for emergencies and disasters in the health sector.

This guideline is given in priority to capacity-building of health facilities, especially in the aspects of organization of the actions in response to adverse events:

- Organization of hospital emergency committees.
- In all provinces of the country, training courses on hospital issues of planning for disasters, simulations and drills, and elaborations of health risks, have been carried out.
- Responses to emergencies and contingency plans, developed and/or updated plans.
- Construction of the tool to articulate the hospital plans for disaster with a plan to respond as a resource of health, in coordination with local stakeholders.
- Provision of emergency signage.
- II. Pre hospital care

a. ECU911 System

Executive Decree 988 of 29 December 2011 , under the authority of the Ministry of Security Coordination, establishes an integrated security service ECU-911 in order to provide immediate and comprehensive responses in case of accidents , disasters and emergencies, by the national police, armed forces , fire departments , the National transit Commission , and Ministry of public Health, the Ecuadorian institute of social Security , the national secretary of risk management, among others responsible for the emergency care of citizens through a technological platform and the enforcement of policies, regulations and processes that articulate service video monitoring, community alarms, receiving and dispatching calls through the free phone number 911, which replaces all numbers available in emergency response institutions in different emergencies.

According to this decree, the intersectorial committee of the integrated security service ECU- 911 is created, including the following entities:

- a. The Ministry coordinator of security or its permanent delegate, who acts as director.
- b. The Ministry of national defense or its permanent delegate.
- c. The Ministry of the Interior or its permanent delegate.
- d. The Ministry of health or its permanent delegate.
- e. The Ministry of telecommunications and the information society or its permanent delegate.
- f. The National Secretary of risk management or its permanent delegate.
- g. The National Secretary of intelligence or its permanent delegate.

The ECU911 system will be implemented in 15 centers nationwide and an operating room.

- National Centers: Samborondón and Quito
- Zone Centers: Portoviejo, Machala, Ambato, Cuenca, Tulcán
- Local Centers: Esmeraldas, Ibarra, Nueva Loja, Santo Domingo, Babahoyo, Riobamba, Macas, Lojas
- Operating Room of San Cristóbal
- b. Licensing of the services responsible for prehospital care

With Ministerial Agreement No. 1595 of August 12th, 2012, the regulation for the application of licensing process in facilities and services of pre hospital care was issued; the following aspects are defined with it:

- Licensing for pre hospital care. The process is established with the purpose of guaranteeing the fulfillment of basic standards according to complexity and resolution capacity.
- Definition of pre hospital attention level and transport.

Capacities of pre hospital attention

The following chart shows the inventory of ambulances available in Health Ministry nationwide:

Zone	Province	Existing	Ideal	Gap	Good Mechanical Condition
	Esmeraldas	15	16	1	3
	Sucumbíos	9	8	/	5
'	Imbabura	12	17	5	5
	Carchi	16	9	/	
2	Napo	10	6	/	2
	Orellana	9	6	/	4
	Pichincha	12			4

	Cotopaxi	19			10
3	Tungurahua	18	20	5	5
5	Pastaza	3			2
	Chimborazo	22			14
	Manabí	44	54	10	14
4	Santo Domingo	5	20	15	1
	Guayas	22	32	10	17
	Bolívar	18	9	/	5
5	Los Ríos	24	38	14	8
5	Santa Elena	6	16	10	3
	Galápagos	1			1
	Azuay	24	27	3	13
6	Cañar	9	11	/	
	Morona Santiago	23	10	/	6
	El Oro	35	27	8	15
7	Loja	34	20	/	13
	Zamora Chinchipe	13	10	/	7
	Cantón Guayaquil				
8	Cantón Durán				
	Cantón Samborondón				
9	Quito Distrito Metropolitano	43	57	12	22
	1				
Votes:	1. The lines in dark color represent provinces in which information sent by zone coordination is still not consolidated.				
mportant	2. To the numbe added the amb which will be re	r of ambulanc ulances that a placed by am	es conten are in bad Ibulances	nplated in mechanic to be acq	the gap will be cal conditions uired with the

III. Capacities in epidemiologic aspects (3) (4) (5)

project 'Mi Emergencia'.

The unit responsible nationwide is the National Direction of Epidemiologic Surveillance. Its mission is to determine and project the behavior of diseases and its relation with risk factors, generating timely and guality information to determine control strategy and support decisions of the sector.

a. Responsibilities for epidemiologic surveillance within the frame of the International Sanitary Regulation (Reglamento Sanitario Internacional (ISR))

In the legal framework established by the International Health Regulations (IHR] and the requirement for all member states to comply with it before the threat of an Event of Public Health Event of International Interest (Evento de Salud Pública de Interés Internacional PHEIC), it is important to consider response capabilities of entry points and the implementation of contingency plans to deal with these events. A public health emergency of international concern may be declared when a health authority of the State is assured that there is an imminent outbreak or epidemic of a communicable disease that poses a risk to the population of the State, or after the WHO activation.

its application are presented:

1. Foster world alliances

With regard to the fostering of global and regional alliances, international communication with agencies such as WHO and PAHO were strengthened after the creation of the National Focal Point of Ecuador, (Centro Nacional de Enlace de Ecuador) which has allowed the country to maintain a permanent exchange of information regarding outbreak events that could become PHEIC.

With Ministerial agreement No. 000000472 the National Focal Point of Ecuador started its operation on August 19th, 2008; it has an institutional email (cne.ecuador@msp.gob.ec), fixed and portable computers and a dedicate telephone line that operates 24/7 as stated by ISR.

- 2. To strengthen national system for surveillance, prevention, control and response to diseases.
- 3. To strengthen sanitary safety in travels and transports.

In the last quarter of 2010 the evaluation of four seaports in the country was performed using the instrument designed by MERCOSUR and proceedings have been started for the provision of physical space for International Health in the ports of Manta, Guayaquil and Esmeraldas .

Efforts have been made with the Metropolitan Municipality of Quito to have adequate space for International Health in the new Mariscal Sucre International Airport.

4-5. Prevention and reaction to International Public Health emergencies.

The National Focal Point (Centro Nacional de Enlace (CNE) of Ecuador has evaluated and notified the PAHO Focal Point events considered of international interest which fulfilled at least two of the four criteria of Attachment 2 of ISR.

6-7. Legal and Surveillance aspects

Ecuador's Constitution, adopted in 2008, guarantees the fulfillment of international agreements signed by the country, providing compliance with the IHR 2005 as state part of the WHO. In addition, the Health Act provides that the national health authority (MSP) will be responsible for dealing with issues of health security and therefore all agencies involved must observe legal provisions.

IV. Surveillance of water quality (1)

Water resources of the country are characterized by:

- In section 4 of ISR (2005) seven strategic actions to direct
- At least 75% of rivers and other bodies of water
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contaminated with organic loads, toxic substances, hydrocarbons and pathogenic microorganisms which are above international standards.

- There is a reduction of availability of Surface flows in the sierra and over exploitation of aquifers in the coast.
- Severe shrinking of glaciers (33% in the last 50 years) and water-related extreme events.
- At least 25% decrease in the historic area of the moorlands, natural flow regulators.
- Furthermore, during an emergency the MSP must activate monitoring equipment of Water Quality within the National Program of Water Quality Monitoring, which has a limited staff and lacks funds to ensure minimal operation; this hampers the effective mobilization of technicians who perform the control and surveillance of the water quality control; additionally, there are difficulties in the lifelong learning component to secure changes in the community regarding better hygiene and sanitation.

V. Intra and Interinstitutional Coordination

a. EOC - HEALTH

The organization of the Operating Committees for Health Emergency was created as per Ministerial Agreement 526, 2004 with the aim of generating a coordinated response from health actors in canton and province levels, including pre hospital care bodies and private institutions devoted to health. These spaces allow preparation and response actions in health, based on identified resources and institutional capacities.

b. Groups of Technical Work

Nationally, the MSP currently leads the Group of Technical Work No. 2 Health, in which the Ministry of Economic and Social Inclusion – (Ministerio de Inclusión Económica y Social MIES), Institute for Social Security of Police – (Instituto de Seguridad Social de Policía ISSPOL), Social Security Institute of the Armed Forces – (Instituto deSeguro Social de las Fuerzas Armadas ISSFA), Ministry of Education, Ecuadorian Institute of Social Security – (Instituto Ecuatoriano de Seguridad Social IESS), Military Health, Association of Private Clinics and Hospitals, Red Cross and others that at the discretion of the group are considered relevant.

Furthermore, Health Ministry participates in Group 1 on water access and distribution and in Group 4 on integral attention to population.

Up to now, there are no coordination protocols in these bodies.

- VI. Management of health information for emergencies and disasters
- a. National Focal Point (Centro Nacional de Enlace (CNE)

When there is a Public Health Event of International Interest (Evento de Salud Pública de Interés Internacional PHEIC), the issuance of local information corresponds to CNE.

b. Situation rooms

Their responsibility is information management related to the epidemiological situation or that generated by the effect of events of natural or anthropogenic origin. The Ministry of Health has a physical space for the operation of the Situation Room at central level and basic equipment has been earmarked for this purpose. However it is necessary to develop intra and inter institutional operation protocols, allocate human resources and improve situation rooms in the decentralized levels, according to new territorial distribution of health services.

VII. Response mechanisms and tools in health

a. Preparation and response plans / contingency before disasters

• Preparation and response plans of Health Minister have been prepared and implemented

There is an emergency plan in Health Ministry where roles and responsibilities of the areas participating in emergency and disaster situations are described as well as the current capacities in State secretariats.

Contingency Plans

In 2012 contingency plans were developed for the following events:

- Plan for health attention before the probable occurrence of ENOS 2G12.
- Health contingency plan in case of massive flow of persons in north border
- Contingency plan for avian influenza

These actions are complemented and integrated with emergency hospital plans and contingency plans for disasters developed by health institutions.

b. Rapid response teams for damage assessment and health-care need analysis

Until 2012, the Ministry had officially organized 24 teams of early provincial health response, composed of delegates in epidemiology, social communication, health, environmental, mental and cultural health. These teams have been trained in damage assessment, need analysis and risk management of disasters related with health. Between 2008 and 2010, the teams were provided withprotective clothing and basic equipment for field work.

The national response teams are formed by the same areas, however it is necessary to begin a training process to test them and ensure a timely response.
There is a document with protocols for activation and mobilization of response teams developed in 2010, which needs to be reviewed, updated and approved by the competent authority for official implementation.

c. Health response teams

During earthquakes in Haiti and Chile (2010), Ecuador provided international support with health professionals experienced in their fields (mental health, trauma, emergency and surgery), but without previous experience or training in disaster situations; this highlighted the need to organize and train healthcare teams to provide support at national and international level, with specific expertise to serve in disaster situations.

In this theme, the country does not report advances; it is necessary to start some actions with this purpose in mind:

- Establish profiles of professionals that would integrate health teams.
- Develop themes in training.
- Develop the activation and mobilization process of equipment.
- Identify and provide basic equipment for mobilization and field operation.
- Select members that would make up the national and/ or international health response teams.
- Define a national and international certification / accreditation process.

VIII. Health and Climate Change

Ecuador is working since 2010 in a Strategic Plan related with Climate Change and Health. World tendencies on the most important changes of climate change expected in health for Ecuador are:

- Increased risk of mortality effect due to heat and /or cold waves, especially for elderly, chronically sick, very young people and those living in isolation.
- Increased risk of shortages of food and water, increased risk of malnutrition and water-and foodborne diseases.
- Increased risk of deaths and injuries due to drowning, injuries and deaths due to floods and landslides, effects on health because of population migration, among others.
- Diseases transmitted by vectors and rodents.
- Effects on mental health and disorders caused by PTSD.

6.5.10.3.Recommendations / Requirements / Gaps

a. Improve safety of new and existing health institutions to face disasters

- Expansion of the National Committee of Safe Hospital, incorporating different health sectors.
- Update and implement the Plan of Action of the National Policy of Safe Hospital.
- Complement the nationwide diagnosis of hospital safety before disaster of health facilities.

- Development and implementation of improvement plans.
- Development of health risk maps with georeferenced health facilities nationwide.
- Continuous updating of hospital plans for disaster.
- Development and / or adaptation of guidelines for construction and risk mitigation in new health facilities that incorporate the criteria of Safe Hospital.
- Consolidation and systematization of information regarding hospital safety before disaster.

b. Improve pre hospital medical attention

- Improve cooperation and coordination of pre hospital service network.
- Improve operation and time response of pre hospital services.
- c. Strengthen epidemiologic surveillance within the frame of International Sanitary Ruling (Reglamento Sanitario Internacional (ISR))

National Focal Point (Centro Nacional de Enlace CIME)

- Incorporate emergency services of the main hospitals of the country to CNE to have official reporting on the occurrence of possible PHEIC.
- Improve coordination between CNE's of the countries, national committees on influenza and national groups of rapid response with disasters and emergencies offices in ministries and especially with the National Secretariat for Risk Management.
- Strengthen software of epidemiologic surveillance system SIVE_ALERTA that allows an "online " notification from any operating unit.
- Integrate a ISR module in the website of the Ministry that provides information and notification online for any user who wants to report the existence of a PHEIC to meet the requirements of the IHR.
- Provide the CNE of staff required to comply with the duties set out in the Ministerial Agreement of creation.
- Consolidate the operation of the National Focal Point (24 hours, 7 days a week) as part of the new structure of the Ministry of Health and disseminate the operating manual to the institutions involved with the ISR to establish the corresponding coordination.
- Update the Ministerial Agreement No. 0472 of 19 August 2008 on the Creation of the National Focal Point for ISR 2005 to the new structure of the Ministry of Public Health.

Inter Institutional Coordination

 It is necessary that the MSP authorities undertake more advocacy with other institutions responsible for the implementation of the IHR in Ecuador, such as, the sectors of environment, tourism, Agrocalidad (MAGAP) and the Ministry of Non-Renewable Energy (formerly Atomic Energy Commission Comisión de Energía Atómica), SGR as there is little participation.

- Strengthen human epidemiologic surveillance laboratories (P3 biosafety cabinet, implementing several clinical trials for diseases under the IHR and those of national interest), animal health (currently being implemented in Agrocalidad, as there are no monitoring systems) and environmental as key areas that have diagnostic ability of major events of national and international public health and under epidemiological surveillance.
- Develop information exchange flows between laboratories (INH) of human and animal health,(Agrocalidad) and the Ministry of Environment.

Positioning of ISR

- Position the subject of the International Health Regulations with accountable state institutions involved in this issue to enhance inter sectoral coordination.
- Review the national legal framework to identify legal obstacles for the implementation of International Health Regulations (Reglamento Sanitario Internacional (ISR)) in Ecuador, involving laws such as: Health Act, Public and State Safety Act, Customs Act and other related to Trade, Transportation, Traveler and Environment.
- Review of Sub regional Agreements; example CAN Decision 502.
- Creation of an interagency committee and a Technical Secretariat for the fulfillment of ISR in Ecuador with legal status and approval of SENPLADES.
- Bring up in international forums and meetings the particular situations that occur in some international terrestrial crossing points in each country, which could hinder the development of the capabilities that the ISR demand in these points of entry.

Preparation for epidemiologic response

- Keep a strategic reserve of medicines, supplies, and equipment for personal protection to deal with sanitary emergencies.
- Implement the notification system of PHENC and PHEIC at the points of entry providing them with necessary human and technologic equipment (epidemiologic and sanitary control).
- Improve communication of risk in case of public health events of national and international importance mainly in the entry points of the country.
- Prepare contingency plans for bio terrorism in coordination with SGR, Armed Forces and Internal and External SecurityMinistry.
- Prepare or complete the corresponding

contingency plans in case of an PHEIC at the entry points (ports, airports and border crossing) in agreement and coordination with local and institutional Emergency Operation Committees.

- Design and execute simulations and drills of these plans at the entry points.
- Coordinate with the National Health System to establish the response and responsibilities of the public and private services in the event of a national and international public health emergency mainly in the borders (intensive and intermediate care rooms, triage rooms, biosafety standards, contingency plans, etc.).
- Coordinate with the Nuclear and Environmental Safety Direction the observance of the rules established for ionizing and non ionizing radiation and especially the handling of radioactive waste and periodical report of radiological emergencies.
- Coordinate with the Environment Ministry for the identification and registration of places of chemical risk in the country.
- Coordinate with the Transport and Public Work Ministry through the Maritime and River Transport Under Secretariat to have a physical area for Public Health Ministry personnel in the ports.
- Continue the coordination with municipalities for the provision of physical spaces in the international entry points for notification to PHEIC.
- Provide personnel to improve epidemiological surveillance and control in distant towns of difficult access due to climate conditions, roads in bad condition and high mobility population.
- Establish strategies to improve notification of health units of MSP to private health services and traditional medicine services.
- Improve the surveillance system for diseases that can be prevented via vaccination, especially febrile exanthematous disease by continuous training in public and private sectors.
- Strengthen technical capacities in health services to use surveillance guidelines for diseases that can be prevented via vaccination.
- Improve notification of laboratory results at provincial level to timely establish intervention actions
- Prepare, train and provide tools for the fast intervention teams when immediate surveillance and control are required.
- Keep an active and systematic passive surveillance in order to determine if a virus is circulating in the country or not.
- Strengthen stratified monitoring of coverage by an operating unit that includes a number of persons that is proportional to the size of population.

d. Improve surveillance on water quality

- Increase availability of personnel for an efficient mobilization of technicians performing monitoring, control and surveillance of water quality, especially during emergencies or disasters.
- Improve training for control, surveillance and monitoring of water quality.
- Improve control, surveillance and monitoring of water quality in health facilities.
- Provide equipment and products for the control, surveillance and monitoring of water quality.
- Provide equipment, materials and products for water purification in health facilities
- Availability of basic hygiene kits, products and equipment for water purification in emergency and disaster situations.
- Improve actions of permanent education to secure changes in the community towards better hygiene and health habits.

e. Improve health response mechanisms

- Official organization and training of fast response teams for national, zonal and district emergencies.
- Organization and training of response team for national and international support.
- Development and/or updating of rules, protocols and guidelines for fast response teams, sanitary teams of response, EOC, situation rooms, technical work groups.
- Development and/or updating of plans for disaster preparedness of Health Ministry and health sector.
- Preparation of contingency plans at national, zonal and district level.
- Organize a decentralized body for crisis management in Health Ministry and at national level.
- f. Improve management system of health information
- Allocation of adequate technological resources for management of health information.
- Definition and use of protocols, rules and processes to guarantee the flow of information
- Development of health risk maps.

g. Improve health intra and inter institutional coordination

- Define protocols and actions in the technical working group, headed by health.
- Define and/or strengthen intra institutional coordination mechanisms for emergency situations and disasters.
- Strengthen coordination between the National Focal Point and the stakeholders with responsibilities in health themes and Risk Management.

6.5.11. Agriculture Livestock, Aquaculture and FisheriesMinistry

6.5.11.1. Description, competence and products

The Ministry of Agriculture, Livestock, Aquaculture and Fishing (MAGAP) "is the ruling institution of the multi sector that regulates, facilitates, monitors and evaluates the management of agricultural, livestock, aquaculture and fisheries production in the country, promoting actions that allow rural development and encourage sustainable growth in production and productivity fostering the development of producers, particularly represented by family farming agriculture, maintaining the incentive for productive activities in general "... Thus its mission is declared.

The Risk Management Direction of MAGAP is new; it is necessary to strengthen its knowledge and capacities and integrate it as a cross-cutting theme in the actions and programs of the Ministry.

Based on the experience and work developed, there are tools and forms available for gathering and systematization of information either for regular or emergency work.

Starting July 19th, 2012, competencies for forestation and deforestation have been defined; these are now shared with Environment Ministry.

A key element is sanitary controls through Agroquality, for vulnerability reduction.

6.5.11.2. Actions in the Short and Medium Terms

- The gathering of field information with the support of schools that have agreements and training with MAGAP will be completed.
- Scientific research is a priority activity; work is made with universities and it is important to link this work with DRR processes.
- Identify and geo reference possible shelters for cattle evacuation; this process should be completed to provide a database that would provide support in case of evacuation.
- Continue to develop programs to mitigate the effects of disasters, such as the National Irrigation Plan that takes into consideration the possible disasters.
- In the provincial offices contingency plans will be developed and updated for provincial level and based on the events that might occur therein.

6.5.11.3. Institutional capabilities / vulnerabilities

• As part of the response in case of disasters, the Ministry has a permanent activation of its provincial directorates, to support to humanitarian actions with vehicles, help in damage evaluation, food and forage distribution, support for livestock evacuation among the main actions.

- Based on the experience gained in support projects and programs to affected population, help models have been designed like agricultural packages (seeds, minor and big species, fertilization, tools, etc.); these programs are linked with reactivation plans developed with population affected by an event upon the impact study performed by Magap's provincial directorates.
- USD11 million per year are earmarked for emergencies that are budgeted in the Annual Investment Plan. Nevertheless, budget allocation to help programs has an influence on regular programs and budgets.
- There are contingency plans to be revised; one problem of the headquarters is that it shares one infrastructure with several ministries but the contingency plans are not integrated. In the case of damages to central infrastructure, all the internal processes of the Ministry would be affected as well as the continuation of the projects as there would be loss of information and effects on integral safety of personnel. There is no plan for the operation continuation; there are no alternative spaces for work. Damages to the functionality of the Ministry in different types of events.
- No plans for media recovery are available in case
 of tsunami events
- For the response and reactivation it is necessary to coordinate actions with MIPRO. There is a reactivation plan for damages produced by flooding and ash fall.

6.5.12. Productivity and Industries Ministry

6.5.12.1. Description, responsibilities and products

The mission of the Ministry is "to promote the development of the industrial and handicraft production sectors through the formulation and implementation of public policies, plans, programs and specialized projects that foster investment and technological innovation in environmentally-friendly, high quality and value-added goods and services that generate decent employment and are internal and externally marketed.

We do rely on the (small, medium and big) industrial sector's competence but risk has not been considered as a planning element.

6.5.12.2.Actions in the short and medium terms

The Ministry is currently working in the identification and construction of collection centers that help improve product merchandising and quality. In case of disasters, these centers play a key role in relief allocation and response supply.

6.5.12.3.Institutional Capacities / vulnerabilities

disasters are:

- Foster production of least affected sectors and establish disaster recovery models in the worst hit areas.
- Support production, transport and fairs held by affected population.
- Support the creation of short-term production mechanisms and strategies to offer revenue streams to distressed and displaced populations.
- Provide the industry with credit lines.
- Controls on products (warranties, product quality and non-contamination).
- Technical support to MAGAP.

There are contingency institutional plans but no response or recovery plans for affected populations. No consideration has been given to articulate these plans with the MAGAP.

A vulnerability factor is personnel turnover and limited human resources. The current personnel are mostly focused on projects, thus limiting capacity in case of emergencies or disasters.

At province level, there is no advisory technical capacity so displacement and relief is mostly organized at national level.

One of the vulnerability reduction actions would be to provide production promotion trainings through interinstitutional and university agreements.

6.5.13. Ministry of Non-Renewable Resources

6.5.13.1. Description, responsibilities and products

The mission of the Ministry is to: "Guarantee a sustainable and sovereign exploitation of non-renewable natural resources, formulating and enforcing policies, and encouraging research and development in the hydrocarbon and mining sectors ".

Several of the activities, regulated by this Ministry, may trigger emergencies and disasters, hence the importance of the control and monitoring function.

At present, there are hazard maps about landslides in certain locations and emergency plans for hydrocarbon sector with periodical drills and simulations.

There is a Risk Management Unit, organically located in the Safety, Health and Environment areas; This location, as per its personnel, limits the unit actions and a cross-cutting approach to Risk Management.

6.5.13.2. Actions in the short and medium terms

The priority is to update and develop landslide hazard maps.

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6.5.13.3.Institutional Responsibilities / vulnerabilities

- As infrastructure is shared with another Ministry, the vulnerability conditions increase; They do have plans, but these are not integrated. There is an institutional contingency plan, but no plans of external response or institutional support in case of disasters. There is no service continuity plan.
- There is an updated data base on human resources, entities, location etc., in case of emergencies. Due to the production characteristics, regulated by the Ministry, this is key information during the response processes in case of disasters.
- There is a program for the development of mitigation works, but focused on protection of infrastructure related with the productive sector.
- Like the private oil companies, Petro Ecuador, a state-run organization, has also developed contingency plans.

6.5.14. Finance Ministry

6.5.14.1. Description, responsibility and products

The mission of the Ministry is to "to help meet the country's development goals and a better standard of living for all Ecuadorians through an effective identification, formulation and implementation of fiscal revenue, expenditure and public funding policies to ensure the sustainability, stability, equity and transparency of public finances".

Its main product is the control of Budget execution. In case of emergencies and disasters, it should provide the necessary resources for humanitarian response and recovery processes.

6.5.14.2. Actions in the short and medium terms

In order to strengthen its capacity to continue operations, the ministry, in coordination with the Central Bank and the private banking sector, has planned to complete the installation of servers in order to guarantee the normal operation of the financial management system. This plan is complemented with the construction of redundant systems and contingency plans for information management.

We will continue issuing budget instructions, allocating funds and offering advice.

6.5.14.3. Institutional Responsibilities / vulnerabilities

- The current infrastructure of the Ministry is very vulnerable; in case of damages to the infrastructure and/or its components its functionality will be reduced. It is possible to recover this functionality in the network of offices at province level, but there are no plans of emergency and service continuity.
- If the central financial computing system, ESISEF,

stopped operating because of a disaster, the national system would go down and consequently services would be suspended and public funds would remain frozen during the emergency.

- In case of a disaster, in order to finance the relief plan, budget would be cut to cover the demands of affected sectors. This budget reduction would impact the programs and plans already in place and approved. Other relief options are based on the economic contribution of the Banco Nacional de Fomento to satisfy the demands of the producers. Similar actions can be performed during the events associated with massive population displacements.
- One of the options for the initial disaster relief is the funds indicated in the OSG agreement of the Finance Ministry, dated April 9th, 2012 allocating funds for accountability and other revolving emergency funds for each Decentralized Operating Entity (EOD) for a maximum amount of USD 300.000.

6.5.15. Tourism Ministry

6.5.15.1. Description, responsibilities and products

The mission of the Tourism Ministry is to "lead the tourism activity in Ecuador and develop the sector in a sustainable, conscious and competitive way while exercising the regulation, planning, management, promotion, dissemination and control roles ".

Currently, the Plan for National Tourism Training is being performed with the purpose of improving the quality of services and the use of best practices for sustainable tourism.

Another product is the registry of tourism activities, including updated information of companies legally registered in the Ministry.

6.5.15.2. Actions in the short and medium terms

- The Ministry has started a decentralization and deconcentration process with the participation of the GAD. With this action it is possible to promote the development of risk management programs in the tourism sector.
- The tourism safety committees and personal protection training will continue to be consolidated.
- The community tourism program will be fostered with actions associated with Risk Management.

6.5.15.3.Institutional Responsibilities, / vulnerabilities

- Lack of contingency plans and an alternative place for the Ministry to work; there is no redundancy in information. The Emergency Plan is currently being prepared
- Inclusion of Risk Management training processes in the National Plan for Tourism Training; The recovery models of livelihood and financial

support through the BNF, should also be given consideration.

- The registry of tourism activities can be part of the database of the Risk Management Decentralized National System to enhance the decision-making process. The registry information can be extended to include risk factors, capacities and business users.
- A relief program will be needed to help tourism business people, indebted with the National Development Bank, who may be affected by a disaster or an emergency and decide to sell their assets to pay back their obligations.
- Permanent communication is kept with diplomatic missions to evacuate foreign tourists in case of a disaster.

6.5.16. Ministry of Social and Economic Inclusion

6.5.16.1. Description, responsibilities and products

The Mission of MIES is to "guarantee the State's due diligence in the fulfillment of the economic and social rights of all Ecuadorians, especially the priority, poor and excluded groups, by means of comprehensive protection, social and economic inclusion and cohesion, promotion of people's solidarity economy and construction of citizenship ".

MIES is one of the Ministries with more territorial coverage and experience working with the communities. The 3.500 care centers all over the country and the special care centers to help boys, girls and adolescents, should be mentioned as an example.

It relies on two programs and three institutes:

- Food provision Program
- Social Protection Program
- Children and Family Institute
- People's solidarity Economy Institute
- Gerontology Research Institute

6.5.16.2.Actions in the Short and Medium Terms

Two Risk Management activities will be prioritized. On the one hand, the mapping of sites that can be considered as shelters, will be completed and complemented with the actions by SGR, and on the other hand, the Emergency Action Plan for displaced people, budgeted and in force since 2010, will continue to be implemented.

6.5.16.3.Institutional Capacities/ Vulnerabilities

- As part of the Risk Management institutional strengths, the Food program can:
 - Provide technical-administrative support for the food acquisition processes.
 - Acquire food and inputs.

- Support in distribution systems, food storage and quality verification.
- The INFA contributes through several Risk Management actions:
 - Child Development: daily care, nutrition, entertainment, family education and care in disasters and emergencies.
 - Special Protection: community and family support specialized services, fostering, schooling support, protection against mistreatment or sexual abuse, among others.
 - Provide medical support
 - Care to people with catastrophic, chronic and complex diseases.
 - Help for special events.
- The Social Protection Program can provide relief bonus management expertise in case some programs of assistance to disaster-affected people are implemented.
- There is availability of emergency plans for a reduced number of threats, but it should be updated according to the current needs. Scenarios, such as extend droughts, could exceed the capacity of the ministry. The ministry is concluding the development of the Emergency Plan for the infrastructure of the institution.
- The way in which the care centers can be affected or their vulnerability to specific threats has not been determined. A similar situation is faced by the special care centers, where it is also necessary to complete the registration and capacity assessment
- There is an advanced registry of shelters, which will be complemented with the sporting facilities identified by the SGR as temporary shelters. Some shelters have been specifically selected for special situations, such as quarantine or catastrophic diseases, which require special treatment in the extra-hospital level.
- In all provinces, in case of disasters, there is a psychological support team as part of the INFA structure, as well as focal points with damage assessment capacity.

6.5.17. Ministry of Foreign Affairs and Human Mobility

6.5.17.1. Description, Competencies and Products

According to the Good Living Plan, the ministry is "the entity in charge of the stewardship, planning, management, coordination and control of foreign policy, in fulfillment of the constitutional principles, the rules of International Rights and the Development National Plan, through:

- A strategically-planned management, supported by quality principles.
- A synergistic action with other government entities.
- Building and promotion of integration proposals with Latin-American countries.
- A strategic insertion of the country in the international agenda and the world market.

Regarding Risk Management processes and competencies, the ministry has a very important role to play as a link among all countries, and as the institution through which relief should be either requested as humanitarian services in case of emergencies or provided to a country that have been affected by a disaster.

The ministry should work to promote the strengthening of relationships and the development of integrated protocols among countries of the region in case of threats and/or regional adverse events.

6.5.17.2. Actions in the Short and Medium Terms

- Continue with the political prioritization of the regional/global Risk Management agenda.
- Conclude the contingency and service continuity plan for infrastructures and for the proper functioning of the ministry; continue with the development and strengthening of the selfprotection measures.
- Complete the creation of the Ministry Risk Management Unit.

6.5.17.3. Institutional Capacities/ Vulnerabilities

- Although the contingency plan is on the creation stage, the lack of this tool increases the people and Ministry functional structure vulnerability. For instance, the visa information system service structure shows a high vulnerability level in case of earthquakes; Another example is that although there five alternative buildings in the city of Quito, both all of the information and its backup are only kept in the headquarters.
- There is no risk management (reduction, response and recovery) plan available as a function of the competences of the ministry for the population; Only programs for specific situations, such as displacements, have been developed. In case of negative effects, the functionality of the ministry will be decreased. It is imperative to strengthen its communication system.
- In case of high-magnitude events, budgets would be cut off at central level, specially impacting human resources, so activities ought to be prioritized. In the event of disasters with a regional or worldwide effect, funds and international support would be limited, a scenario that has not been considered in the planning process.
- An aspect to take into consideration is the registration of foreigners who have been displaced to Ecuadorian territory for safety reasons. The institution does not have the capacity of immediate registration for massive displacements, but it has mobile units for migratory services. There is an agreement between Ecuador and Colombia, as well as with UNHCR, to address the displacement of people in the northern border.
- In a joint work with SGR and with support of international entities, the International Humanitarian

Assistance Management Manual for Disaster and Emergency Situations (2011) was developed. This manual includes guidelines for requesting and receiving relief, as well as for offering humanitarian assistance from Ecuador.

• As a key action in the process of recovering livelihoods, the ministry may use commercial offices available to support the AEPYS (stakeholders of the People's Solidarity Economy).

6.5.18. Ministerio de Desarrollo Urbano y Vivienda

6.5.18.1. Description, Competencies and Products

MIDUVI is entrusted with the mission of "preparing standards, policies, guidelines, plans, programs and projects on habitat, housing, drinking water, sanitation and solid waste, through an efficient, ethical and transparent management, to contribute to the good living of the Ecuadorian society".

MIDUVI under-secretariats develop:

- Policies and national regulations regarding urban development, land management, habitat social production, urban territorial organization and human resettlements, in coordination with GAD.
- Policies and Regulations for the National System of Land Registry.
- Design, dissemination and enforcement of the land appraisal and registry national standards in coordination with the AME and the GAD.
- Technical tools to support the GAD, listed in the law and its processes of planning, regulation, and control for the use, occupation and development of urban, district and cantonal lands, as well as rural concentrated settlements.
- Development of training, technical assistance and strengthening programs for the GAD.
- Implementation of spatial analysis, territorial planning and public investment allocation tools to facilitate the decision-making process and prioritize habitat, housing, drinking water, sanitation, solid waste and human settlement actions.
- Coordinate and oversee the design, management and updating of the geo-referenced inventory on human settlements.
- To offer advice to state institutions, the GAD and civil society on topics related to habitat and human settlements
- Direct social compensation of the housing bonus to the most vulnerable sectors in the society, for an amount at least equal to the goal set forth.
- Formulate and disseminate the sanitation and drinking water service technical standards.
- Cooperate with local authorities, operating companies and administrative boards of drinking water in the continuous improvement of their services.
- Increase risk prevention and mitigation programs.

6.5.18.2.Actions in the Short and Medium Terms

- The ministry has a pandemics-related prevention basic plan. Based on previous experiences acquired in disasters, response schemes has been established, but they need to be validated and consolidated as a plan.
- The housing rehabilitation projects will be maintained and complemented with construction projects. It is necessary to strengthen the DRR schemes in the projects.
- The support to GAD will be maintained with counseling and funds according to demands and capacities, either for reduction programs or recovery actions.
- Studies on soil mechanics and vulnerability will be included and detailed in the contract terms of reference for housing construction.

6.5.18.3.Institutional Capacities/ Vulnerabilities

- Create and structure the Risk Management Unit of MIDUVI. Its competences will be focused on Risk Management planning as part of the responsibilities of the ministry.
- There is sanitary engineering staff available; The possibility of supporting actions by teams to be established as response units in case of disaster, will be analyzed. Nonetheless, there is a limited amount of professionals with Risk Management Training.
- There is no recovery plan. Contingency plans helping structure a response with a rehabilitation and recovery approach, need to be implemented. Internal contingency plans have been developed but they are to be constantly strengthened and followed up.
- In case of a disaster that affects the ministry's structure and infrastructure, the capacity to continue operating will be limited and province units will be activated. Nevertheless, there is no continuity plan yet. One of the most affected activities is the execution, monitoring and control of projects.
- In case of disaster, not affecting the ministry, the investment will be focused on emergency works, thus causing a delay on planned works.
- There is no Model of Disaster Risk Reduction. For the preparation of housing projects, there are threats and risk level consultations. There is a need to expand the analysis to the environment and additional services, such as accesses and technological threats.
- Optimize territorial organization and land use programs, related with environmental and production sustainability. These programs should take into account both national and local threats, including technologies, areas of vulnerability and population risk factors and access to services in case of disaster.
- Regarding water, there is a need for the identification, characterization and vulnerability

determination of water sources. We also require defining the scenarios that could cause a reduction on the flows for the drinking water services and effects, such as: service restrictions, production sourcing, sanitation, etc.

• One of the actions to prioritize is a water provisioning plan in case of disaster, including the use of alternative sources.

6.5.19. Risk Management Secretariat

6.5.19.1. Description, Competencies and Products

The SGR has the mission of "Building and leading the Decentralized Risk Management National System to guarantee the protection of people and communities from negatives effects of natural or anthropic events, through the generation of policies, strategies and standards that promote capacities designed to identify, analyze, prevent and mitigate risks to address and manage disasters, as well as to recover and reconstruct social, economic and environmental conditions, affected by eventual emergencies or disasters.

The regulatory framework of risk management has been detailed in the section of Strategic and Legal Framework. The main competencies of the SGR, related to the risk management component are:

- Stewardship of Risk Management and establishment of sector policies.
- Regulation of the Decentralized Risk Management National System.
- Use of information generated by institutions and scientific and technical entities about threats and vulnerabilities for the risk management decisionmaking process.
- Warning system Management.
- Disaster Management.
- Implementation of risk management plans, protocols, guidelines and other tools.

6.5.19.2. Actions in the Short and Medium Terms

- To continue with the consolidation of the National System of Situation Rooms, the construction of impact scenarios, protocols of information and event registration, as well as the 24/7 operations.
- To continue implementing standards for servicing affected people in case of events. To consolidate the minimum humanitarian response standards. – Sphere.
- Develop and normalize vulnerability assessment methodologies in coordination with the GAD.
- Support harmonization of PD and OT among the levels of the GAD.
- Strengthen the social sector to have community and institutional training schemes available. To develop Risk Management strategies at all levels (Community, Public regional and Private)
- Provide maintenance and follow up to the virtual warehousing system for humanitarian response.

- Support institutions in the development of plans of contingencies and continuity of services.
- Develop risk maps supporting the planning and control activities, carried out by GAD.

6.5.19.3. Institutional Capacities/ Vulnerabilities

There is no National Plan for Risk Reduction articulated with the National Good Living Plan. It is recommended to create a National Emergency Plan, as well as plans of threat-based contingency and impact scenarios, and other tools for reduction, recovery and response.

There seem to be the conditions to move forward into a Comprehensive Early Warning National System to support decisions about the evolution of events, and standardize and norm the methodologies of the systems, including warning systems at local levels. This is a key precondition to establish a permanent and coordinated work model of the scientific and technical entities.

In the case of extended impact events, a key factor is related to the capacity of the humanitarian aid, in which a key role is played by the emergency deconcentrated warehouses, the list of local providers and the virtual warehouse system of the secretariat, which facilitates access to goods, in good conditions and no expiration risks, within the distribution chain.

For massive displacement, the SGR developed a general simulation model during the tsunami in Japan. The model evidenced limitations in the mobilization of people. The management of the volunteer program is another weakness yet to address.

The SGR's main activation and operational capabilities are included below:

- Permanent offices in 24 provinces. This territorial network relies on personnel for response, technical risk management and construction of social and institutional capacities for risk management. These capacities replicate those existing at central level.
- National System of Information Rooms, composed of three main rooms which work as mirror rooms and 24 offices at province level working 24/7 to report occurrence and evolution of adverse events and to generate scenarios and models to support decisions.
- Risk Management Committees at national, provincial and municipal level, composed of 7 Technical Working Groups, structured in each committee.
- Risk reduction local committees in rural and periurban areas (and local networks of committee), working in 10 provinces.
- Protocols for different inter-institutional actions of the national system.
- Maps of the main response capacities.
- Networks of calls and contacts to activate processes.
- Mapping of threats related to floods, landslide and distant tsunamis.

There is no consolidation of the risk management tools used by local governments and cooperating entities. Nevertheless, the following tools were recognized as part of the system:

- Risk Management Committee Manual
- Institutional Emergency Plan.
- Guide for the incorporation of Risk indicators into infrastructure projects.
- Sphere standards and regulations for the implementation of humanitarian assistance in Ecuador.
- Continuity plan of activities against emergencies.
- Family Emergency Plan.
- Manual for International Humanitarian Assistance in Emergency and Disasters Situations.
- Damage assessment models and need analysis.
- Action Protocols and Incident Command System.

At international level, there are some agreements signed with Colombia and Peru (people mobilization, use of nearby airports in case of emergency or disaster around the borders). There has also been some coordination with different embassies for the evacuation of foreign citizens if needed.

In UNASUR, there is an ongoing process to prepare a plan in order to organize and operate a regional risk management mechanism of coordination and consultation.

6.5.20. International organizations, institutions and agencies¹³

Some international organizations rely on contingency plans allowing them to have a pre-established working model for service continuity. If infrastructure and functionality were severely affected, there is national and international support available to continue operations, as part of a national support system. The United Nations System has an alternative work site, as well as an international assistance for continuity of operations, under extreme events.

Technical advisory is one of the main capabilities to manage procedures such as: risk reduction, risk modeling, construction of indicators, threat monitoring (ONUSAT, International Charter, etc.), early warning system, damage assessment, monitoring and recording, report preparation, disaster management and humanitarian assistance coordination, as well as, preparation of mechanisms for livelihood recovery. As a complementary support, all organizations are able to mobilize funds in case of large-scale emergencies upon requests by governments.

Additionally, each organization, based on its mandate, has established coordination procedures and sector assistance, for example: WFP (World Food Program) and SGR (NATIONAL RISK MANAGEMENT SECRETARIAT), UNICEF and The Ministry of Education, UNDP with SGR and The Ministry of

¹³ General information shall be registered although the following organizations were the ones that participated in this process: UNDP, WFP, UNESCO, UNICEF, PAHO, UNISDR, OCHA/DHN, UNETE and ECHO's office

Environment, UNESCO with INOCAR and The Ministry of Culture, UNISDR with SGR and GAD, PAHO with The Ministry of Health and SGR, and OCHA/DHN with SGR.

The ECHO office has defined a contingency plan in association with its partners in order to develop a disaster response scheme or program, as required. And this entity also has capacity to deploy international support teams, if necessary.

Currently, the SGR and The United Nations have started a strengthening process called "Humanitarian Country Team" (HCT) to manage the risk management coordination among national, international and non-governmental organizations. This process is at the stage of preparation of protocols and product definition.

At the moment, the main supporters of RISK MANAGEMENT are:

- **UNESCO:** Support to EWS Tsunamis. Construction of protocols.
- **UNICEF:** Strengthening of the risk management system of the Ministry of Education.
- **PAHO:** Strengthening of the hospital response systems and reduction plans.
- UNDP: Identification of vulnerability indicators at canton level. Recovery planning and strengthening of SGR structure.
- **WFP:** Response support. Work on food security and environmental actions. Coordinator of UNETE's team.
- **IOM:** Shelter management information system support.
- **FAO:** Food security and projects for livelihood management in the event of disaster.
- **UNEP:** Support for climate change projects.
- **UNISDR:** Advice to strengthen situation Room work and response. Advice provided to GAD to develop Risk Management strategies.

6.5.21. Non-government Organizations¹⁴

Not all the NGOs have implemented contingency and business continuity plans and, as a result, their capacities in the event of a large-scale disaster, may be limited. Moreover, with respect to health problems, the limited amount of personnel could be another restriction factor for the continuity and accomplishment of their functions and projects. Some organizations have the capacity to establish an international team in order to continue operating if their structure is affected.

Among their main capabilities, we should consider: te-

chnical advisory and community-level and GAD work, development early warning systems, reinforcement of their local response/ humanitarian aid capabilities, and support to relief programs. In case of large emergencies, nearly all NGOs are able to mobilize international resources upon government request. With respect to The Ecuadorian Red Cross, its main strength is to be an operational part of the pre-hospital care system, and to act as a local-and-province-based organization and an international disaster response model. Generally, such programs and projects include the reduction of underlying vulnerabilities in communities and towns.

Similar to international organizations, NGOs, according to their mandate, establish sector support and coordination processes, but local and community work is considered to be their main strength.

Another strength is the capacity for quick assessment of community projects through field professionals who are experienced on Risk Management issues.

Some organizations are developing projects, which could be affected by a disaster and their goal achievement may be delayed.

At the moment, the main risk management supporters are:

NGOs are giving real emphasis to the establishment and strengthening of HCT (Humanitarian Country Team).

- CARE: To support INAMHI reinforcing their monitoring capabilities. Local community and institutional strengthening.
- INTERNATIONAL PLAN: Support to protect small boys and girls, and teenagers in coordination with the Ministry of Education.
- **OXFAM:** To strengthen the GAD, local and community capacities. Development of early warning systems.
- The Spanish Red Cross and The Ecuadorian Red Cross: Strengthening the GAD, local, institutional and community capacities.
- **CRIC:** Strengthening the GAD, local and community capacities
- **ADRA:** Strengthening local and community capacities and support to the GAD.
- All organizations may develop proposals for climate change adaptation programs, economic reactivation and livelihood recovery.

¹⁴ General information shall be registered, but the following organizations have participated in this process: INTERNATIONAL PLAN, CRIC, CARE, OXFAM, ADRA, SAVE THE CHLDREN. UNDD, WFP, UNESCO, UNICEF, PAHO, UNISDR, DHN and (ECHO)'s office. A special case is the International Red Cross Movement, which has a special condition, as defined in the international agreements, and as part of the Ecuadorian Red Cross Movement, a private entity with national special responsibilities.

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CLIRSEN / IEE CIIFEN Ecuadorian Red Cross IGEPN IEE / CLIRSEN INIGEMM INAMHI INOCAR MAE PAHO International Plan UNICEF UNESCO UNISDR

REMOTE SENSING SURVEY

Jorge Acosta	
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CLIRSEN/INEE

VULNERABILITIES

Jairo Estacio UNPD Daniel Arteaga UNISDR

INSTITUTIONAL CAPACITIES AND VULNERABILITIES

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CRIC

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CRIC Ecuadorian Red Cross Spanish Red Cross Spanish Red Cross Spanish Red Cross **ECHO** IGEPN IGEPN INAMHI INAMHI INAMHI **INEE / CLIRSEN INEE / CLIRSEN** INIGEMM INOCAR INOCAR MAGAP MAF MIDUVI Min. of Education MEER Min. Of Finance Min. Of Finance MIES Min. Of Industry Min. Of Interior MRNNR MRECI MRECI MSP MSP MSP MSP MINTEL Min. Of Tourism Min. Of Tourism MTOP MDMQ OCHA/DHN PAHO PAHO OXFAM International Plan International Plan International Plan International Plan WFP UNPD Save the Children SENAGUA SGR UNESCO UNICEF UNISDR

IDENTIFICATION OF RISK MANAGEMENT MECHANISMS AND ACTIONS

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ADRA ADRA CARE CONELEC CRIC Spanish Red Cross **ECHO IGEPN** INAMHI INAMHI **INEE / CLIRSEN INEE / CLIRSEN** INEGEMM **INOCAR** MAGAP Min. Of Defence MIDUVI Min. Of Education MEER Min. Of Finance MIES MIFS Min. Of Industry MRNNR MIDHC Min. Of Labor MSP MSP MINTEL MTOP OCHA/DHN PAHO PAHO OXFAM Petroecuador Petroecuador International Plan WFP WFP UNDP **SENPLADES** SENAGUA SGR SGR SGR SGR SGR SGR SGR SGR SGR **UNESCO** UNICEF UNISDR Min. Salud MINTEL MTOP OCHA / REDHUM OPS OPS OXFAM Petroecuador

Miguel Valdivieso Tathiana Moreno Jorge Arteaga Melany Riqueth Nury Bermúdez Fernanda Gando Mariela Oleas Alexander Sivisaka Cecilia Menoscal **Cristian Torres** Dalton Andrade Diana Salazar Felipe Bazán Manuel García Pablo Morillo Rodrigo Rosero Pernille Petersen Óscar Robles Daniel Arteaga Julieta Sarzosa

Petroecuador Plan Internacional PMA PMA PNUD SENPLADES SENAGUA SGR SGR SGR SGR SGR SGR SGR SGR SGR UNESCO UNICEF UNISDR

World Vision

9. Annexes, Maps, Charts, Graphs and others

9.1. Chart of Provinces and cantons

INEC - DIRECTION OF STATISTICS AND CARTOGRAPHIC DATA (DICE) ADMINISTRATIVE POLITICAL DIVISION 2011

01	AZUAY PROVINCE
01	CUENCA
02	GIBÓN
03	GUALACEO
04	NABÓN
05	PAUTE
06	PUCARÁ
07	SAN FERNANDO
08	SANTA ISABEL
09	SIGSIG
10	OÑA
11	CHORDELEG
12	EL PAN
13	SEVILLA DE ORO
14	GUACHAPALA
15	CAMILO PONCE ENRÍQUEZ
02	BOLIVAR PROVINCE
01	GUARANDA
02	CHILLANES
03	СНІМВО
04	ECHEANDÍA
05	SAN MIGUEL
06	CALUMA
07	LAS NAVES
03	CAÑAR PROVINCE
03 01	CAÑAR PROVINCE AZOGUES
03 01 02	CAÑAR PROVINCE AZOGUES BIBLIÁN
03 01 02 03	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR
03 01 02 03 04	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL
03 01 02 03 04 05	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO
03 01 02 03 04 05 06	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG
03 01 02 03 04 05 06 07	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL
03 01 02 03 04 05 06 07 06 07 04	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE
03 01 02 03 04 05 06 07 04 01	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN POLÍXAR
03 01 02 03 04 05 06 07 04 01 02 23	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR
03 01 02 03 04 05 06 07 07 04 01 02 03 03	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO
03 01 02 03 04 05 06 07 06 07 04 01 02 03 04 02	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO MIRA
03 01 02 03 04 05 06 07 04 01 02 03 04 05 02	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO MIRA MONTÚFAR
03 01 02 03 04 05 06 07 04 01 02 03 04 05 60 05	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO MIRA MONTÚFAR SAN PEDRO DE HUACA
03 01 02 03 04 05 06 07 04 01 02 03 04 02 03 04 05 60 05	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO MIRA MONTÚFAR SAN PEDRO DE HUACA COTOPAXI PROVINCE
03 01 02 03 04 05 06 07 04 01 02 03 04 05 60 05 01 02 03 04 05 03 04 05 03 04 05 06 07 02 03 04 05 06 07 02 03 04 05 06 07 05 06 07 07 06 07 07 06 07 07 06 07 07 06 07 07 06 07 07 06 07 07 06 07 07 07 07 07 07 07 07 07 07	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO MIRA MONTÚFAR SAN PEDRO DE HUACA COTOPAXI PROVINCE LATACUNGA LA MANÍA
03 01 02 03 04 05 06 07 04 01 02 03 04 05 60 05 01 02 03 04 05 60 01 02 03 04 05 03 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 04 05 06 07 06 07 06 07 06 07 06 07 00 03 04 05 06 07 05 06 07 00 03 04 05 06 07 03 04 05 06 07 04 05 06 07 00 03 04 05 06 00 05 06 00 05 06 00 05 06 00 05 06 00 05 00 00 05 00 00 05 00 00	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO MIRA MONTÚFAR SAN PEDRO DE HUACA COTOPAXI PROVINCE LATACUNGA LA MANÁ PANGUA
03 01 02 03 04 05 06 07 04 01 02 03 04 05 60 05 01 02 03 04 05 60 01 02 03 04 05 60 04 05 06 07 04 05 06 07 04 05 06 07 06 07 04 05 06 07 00 07 00 07 00 07 00 00 07 00 00	CAÑAR PROVINCE AZOGUES BIBLIÁN CAÑAR LA TRONCAL EL TAMBO DÉELEG SUSCAL CARCHI PROVINCE TULCÁN BOLÍVAR ESPEJO MIRA MONTÚFAR SAN PEDRO DE HUACA COTOPAXI PROVINCE LATACUNGA LA MANÁ PANGUA PI LIII Í
03 01 02 03 04 05 06 07 04 05 06 07 04 05 06 07 04 05 03 04 05 60 05 60 05 01 02 03 04 05 60 05 60 02 03 04 05 03 04 05	CAÑAR PROVINCEAZOGUESBIBLIÁNCAÑARLA TRONCALEL TAMBODÉELEGSUSCALCARCHI PROVINCETULCÁNBOLÍVARESPEJOMIRAMONTÚFARSAN PEDRO DE HUACACOTOPAXI PROVINCELATACUNGALA MANÁPANGUAPUJILÍSAL CEDO
03 01 02 03 04 05 06 07 04 05 06 07 04 05 06 07 04 05 03 04 05 60 05 60 05 01 02 03 04 05 60 05 01 02 03 04 05 03 04 05 06	CAÑAR PROVINCEAZOGUESBIBLIÁNCAÑARLA TRONCALEL TAMBODÉELEGSUSCALCARCHI PROVINCETULCÁNBOLÍVARESPEJOMIRAMONTÚFARSAN PEDRO DE HUACACOTOPAXI PROVINCELATACUNGALA MANÁPANGUAPUJILÍSALCEDOSAQUISILÍ
03 01 02 03 04 05 06 07 04 05 06 07 04 05 06 07 04 05 03 04 05 60 05 00 05 00 05 01 02 03 04 05 001 02 03 04 05 04 05 06 07	CAÑAR PROVINCEAZOGUESBIBLIÁNCAÑARLA TRONCALEL TAMBODÉELEGSUSCALCARCHI PROVINCETULCÁNBOLÍVARESPEJOMIRAMONTÚFARSAN PEDRO DE HUACACOTOPAXI PROVINCELATACUNGALA MANÁPANGUAPUJILÍSALCEDOSAQUISILÍSIGCHOS

01	RIOBAMBA
02	ALAUSÍ
03	COLTA
04	СНАМВО
05	CHUNCHI
06	GUAMOTE
07	GUANO
08	PALLATANGA
09	PENIPE
10	CUMANDÁ
07	EL OBO PROVINCE
01	MACHALA
02	ARENILLAS
03	ATAHUALPA
04	BALSAS
05	CHILLA
06	EL GUABO
07	HUAQUILLAS
08	MARCABELÍ
09	PASAJE
10	PIÑAS
11	PORTOVIEJO
12	SANTA ROSA
13	ZARUMA
1/	
08	ESMERAL DAS PROVINCES
01	ESMEBALDAS
02	
02	MUISNE
0.0	
04	SAN LOBENZO
00	ATACAMES
00	RIOVERDE
00	GUAYAS PROVINCE
01	GUAYAQUII
	ALEREDO BAQUERIZO MOBENO
02	(JUJAN)
03	BALAO
04	BALZAR
05	COLIMES
06	DAULE
07	DURÁN
08	EL EMPALME
09	EL TRIUNFO
10	MILAGBO
11	NARANJAI
12	NARANJITO
13	PALESTINA
1/	
14	
16	SAMBORONDÓN
16	SAMBORONDÓN
16 17	SAMBORONDÓN SANTA LUCÍA
16 17 18	SAMBORONDÓN SANTA LUCÍA SALITRE (URBINA JADO)
16 17 18 19	SAMBORONDÓN SANTA LUCÍA SALITRE (URBINA JADO) SAN JACINTO DE YAGUACHI
16 17 18 19 20	SAMBORONDÓN SANTA LUCÍA SALITRE (URBINA JADO) SAN JACINTO DE YAGUACHI PLAYAS
16 17 18 19 20 21	SAMBORONDÓN SANTA LUCÍA SALITRE (URBINA JADO) SAN JACINTO DE YAGUACHI PLAYAS SIMÓN BOLÍVAR
16 17 18 19 20 21 22	SAMBORONDÓN SANTA LUCÍA SALITRE (URBINA JADO) SAN JACINTO DE YAGUACHI PLAYAS SIMÓN BOLÍVAR CORONEL MARCELINO MARIDUEÑA

25	NOBOL GENERAL ANTONIO ELIZALDE (BUCAY)
26	ISIDRO AYORA
10	IMBABURA PROVINCE
01	IBARRA
02	ANTONIO ANTE
03	COTACACHI
04	OTAVALO
05	
11	
01	LOJA
02	CALVAS
03	CATAMAYO
04	CELICA
05	CHAGUARPAMBA
06	ESPÍNDOLA
07	GONZANAMÁ
08	MACARÁ
09	PALTAS
10	PUYANGO
11	SARAGURO
12	SOZORANGA
13	ZAPOTILLO
14	PINDAL
15	QUILANGA
16	OLMEDO
12	
02	BABANOTO
02	DADA
03	ΜΟΝΤΑΙ VO
03 04	MONTALVO PUEBLOVIEJO
03 04 05	MONTALVO PUEBLOVIEJO QUEVEDO
03 04 05 06	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA
03 04 05 06 07	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS
03 04 05 06 07 08	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES
03 04 05 06 07 08 09	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE
03 04 05 06 07 08 09 10	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ
03 04 05 06 07 08 09 10 11	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA
03 04 05 06 07 08 09 10 11 12	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE
03 04 05 06 07 08 09 10 11 12 13	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA
03 04 05 06 07 08 09 10 11 12 13 13	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE
03 04 05 06 07 08 09 10 11 12 13 13	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO
03 04 05 06 07 08 09 10 11 12 13 13 13 01 02 02	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR
03 04 05 06 07 08 09 10 11 12 13 13 13 01 02 03 04	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE
03 04 05 06 07 08 09 10 11 12 13 13 13 13 01 02 03 04 05	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN EL CARMEN EL AVIO AL FARO
03 04 05 06 07 08 09 10 11 12 13 13 13 01 02 03 04 05 06	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO IIDI IAPA
03 04 05 06 07 08 09 10 11 12 13 13 13 01 02 03 04 05 06 07	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN
03 04 05 06 07 08 09 10 11 12 13 13 13 13 01 02 03 04 05 06 07 08	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN MANTA
03 04 05 06 07 08 09 10 11 12 13 13 13 13 13 01 02 03 04 05 06 07 08 09	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN MANTA MONTECRISTI
03 04 05 06 07 08 09 10 11 12 13 13 13 01 02 03 04 05 06 07 08 09 10	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN MANTA MONTECRISTI PAJÁN
03 04 05 06 07 08 09 10 11 12 13 13 13 13 13 01 02 03 04 05 06 07 08 09 10 11	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN MANTA MONTECRISTI PAJÁN PICHINCHA
03 04 05 06 07 08 09 10 11 12 13 13 13 13 13 13 01 02 03 04 05 06 07 08 09 10 11 12	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN MANTA MONTECRISTI PAJÁN PICHINCHA ROCAFUERTE
03 04 05 06 07 08 09 10 11 12 13 13 13 13 13 13 13 13 13 13	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN MANTA MONTECRISTI PAJÁN PICHINCHA ROCAFUERTE SANTA ANA
03 04 05 06 07 08 09 10 11 12 13 13 13 14	MONTALVO PUEBLOVIEJO QUEVEDO URDANETA VENTANAS VINCES PALENQUE BUENA FÉ VALENCIA MOCACHE QUINSALOMA MANABÍ PROVINCE PORTOVIEJO BOLÍVAR CHONE EL CARMEN FLAVIO ALFARO JIPIJAPA JUNÍN MANTA MONTECRISTI PAJÁN PICHINCHA ROCAFUERTE SANTA ANA SUCRE

16	24 DE MAYO
17	PEDERNALES
18	OLMEDO
19	PUERTO LÓPEZ
20	JAMA
21	JARAMIJÓ
22	SAN VICENTE
14	MORONA SANTIAGO PROVINCE
01	MORONA
02	GUALAQUIZA
03	
04	PALORA
05	SANTIAGO
06	SUCIA
07	
07	
00	
10	
IU 44	
11	
12	
13	MACAS
15	
01	IENA
03	ARCHIDONA
04	EL CHACO
07	QUIJOS
09	CARLOS JULIO AROSEMENA TOLA
16	PASTAZA PROVINCE
01	PASTAZA
02	MERA
03	SANTA CLARA
04	ARAJUNO
05	PUYO
17	PICHINCHA PROVINCE
01	QUITO
02	CAYAMBE
03	MEJÍA
04	PEDRO MONCAYO
05	RUMIÑAHUI
07	SAN MIGUEL DE LOS BANCOS
08	PEDRO VICENTE MALDONADO
09	PUERTO QUITO
18	TUNGURAHUA PROVINCE
01	AMBATO
02	BAÑOS DE AGUA SANTA
03	CEVALLOS
04	МОСНА
05	PATATE
06	QUERO
07	SAN PEDRO DE PELILEO
08	SANTIAGO DE PÍLLARO
09	TISALEO
19	
01	ZAMORA
01	CHINCHIPE
02	
03	
∩ 4	

	05		YANTZAZA
	06		EL PANGUI
	07		CENTINELA DEL CÓNDOR
	08		PALANDA
	09		PAQUISHA
20			GALAPAGOS PROVINCE
	01		SAN CRISTÓBAL
	02		ISABELA
	03		SANTA CRUZ
21			SUCUMBÍOS PROVINCE
	01		LAGO AGRIO
	02		GONZALO PIZARRO
	03		PUTUMAYO
	04		SHUSHUFINDI
	05		SUCUMBÍOS
	06		CASCALES
	07		CUYABENO
22			ORELLANA PROVINCE
22	01	-	ORELLANA PROVINCE ORELLANA
22	01 02		ORELLANA PROVINCE ORELLANA AGUARICO
22	01 02 03		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS
22	01 02 03 04		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO
22	01 02 03 04		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS
22	01 02 03 04		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE
22 23	01 02 03 04 01		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO
22 23	01 02 03 04 01 02		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA
22 23 24	01 02 03 04 01 02		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA SANTA ELENA PROVINCE
22 23 24	01 02 03 04 01 02 01		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA SANTA ELENA PROVINCE
22 23 24	01 02 03 04 01 02 01 02		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA SANTA ELENA PROVINCE SANTA ELENA LA LIBERTAD
22 23 24	01 02 03 04 01 02 01 02 01 02 03		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA SANTA ELENA PROVINCE SANTA ELENA LA LIBERTAD SALINAS
22 23 24 90	01 02 03 04 01 02 01 02 03		ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA SANTA ELENA PROVINCE SANTA ELENA LA LIBERTAD SALINAS UNFENCED ZONES
22 23 24 90 90	01 02 03 04 01 02 01 02 03 03	51	ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA SANTA ELENA LA CONCORDIA SANTA ELENA LA LIBERTAD SALINAS UNFENCED ZONES LAS GOLONDRINAS
22 23 24 90 90	01 02 03 04 01 02 01 02 03 01 02 03	51	ORELLANA PROVINCE ORELLANA AGUARICO LA JOYA DE LOS SACHAS LORETO SANTO DOMINGO DE LOS TSÁCHILAS PROVINCE SANTO DOMINGO LA CONCORDIA SANTA ELENA LA CONCORDIA SANTA ELENA LA LIBERTAD SALINAS UNFENCED ZONES LAS GOLONDRINAS MANGA DEL CURA

9.2. Scenarios for identifying capabilities/vulnerabilities

9.2.1. Earthquake in Quito city

This description is based on the project for Quito seismic risk management, developed by the National Polytechnic School, GeoHazards International, Municipality of Quito Metropolitan District, ORSTOM Quito and Oyo Corporation.

Description

A local earthquake of a 6.3 magnitude took place 25 km from the north of Quito. It is on a Wednesday, March, at 14:00, on a rainy afternoon, very common in that period of the year.

The jolt is less intense in the center of the city and even lower in the south. But, even there, it is strong enough to produce moderate damage to poor quality buildings. Neighborhoods in the north of Quito are damaged. Houses located on the western hillsides of the city collapsed. The Old City has significant damage, many historical buildings and monuments are highly damaged. The main city's entry and exit roads are affected. There are landslides and cracks in Manuel Córdova Galarza highway, in Las Tolas and Pomasqui sections. The highway to the coast (Calacalí - Los Bancos) is severely hit at the Tandayapa section. In the Carretas sector (heading Calderon), the road has slipped and the roadway is useless. The Simon Bolivar Avenue, affected by landslides, shows cracks. The mesa is fractured on 10 sites and transport is not safe. The road to Tumbaco is affected. It is necessary to consider that the new Quito airport is operating. It has not been seriously affected but its access roads are damaged. The initial report shows no less than 100 obstructions to vehicular traffic. People are leaving their vehicles to walk to their destinations. Despair prevails.

Many students are going home after the school day.

Power poles and lines have fallen down and there is no communication. It is estimated that half of fixed telephony and cable Internet services will take 7 days to restore. There is loss of electricity due to damage in the interconnected power grid. It is expected that the system will be restored within six days in Quito, but energy distribution in the city depends on the distribution network. Approximately 500 transformers have been damaged and are not operating. Cellular telephony does not work fully due to broken repeating stations and the saturation of the system.

The sewage system is affected as roads have sunk and there are water leaks due to damages in the drinking water system. The landslides have also affected the water supply system in Puengasi; Additionally, 80 meters of Papallacta aqueduct are destroyed due to a landslide.

Shopping malls and home appliance stores were looted.

Two state hospitals have their façade and structure damaged (Eugenio Espejo and Baca Ortiz); several wards had to be evacuated while structural assessments are performed.

The proposed scenario has been designed to facilitate the gathering of information about damages and response capabilities in case of disaster. This information will serve as a basis for risk management planning. This scenario is in no way whatsoever a forecast of a destructive event.

9.2.2. Drought – extreme hydro meteorological deficit

This description is based on scenarios taken into consideration as a result of climate change effects.

Description

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For 3 consecutive years, there was a deficit in winter

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rains all over Ecuador, with rainfalls ranging between 25% and 40% less compared to the expected averages for the season. In this summer season period, precipitation had a deficit between 30% and 45%. Drought periods increased by three months as an average. The official agencies have indicated that there is a severe water deficit in the main rivers of the country (Guayas, Jubones, Esmeraldas, basins of the Northern and Center Highlands).

There is an annual temperature increase of 1.5 degrees Celsius as an average (the increase is higher in summer months). Farmers have begun to sell their capital (livestock and tools) to meet their basic needs. There is a default on loan payments to National Development Bank.

Research indicates that there is an increase in migration to cities.

The technical-scientific agency forecasts are not encouraging for next year.

There are similar conditions in Peru, Colombia, Bolivia and northern Chile.

There is a increase in forest fires (see map NASA FIRMS - Global Fire Alerts - UN-FAO/UMD/NASA, report of the first year following the extreme hydro meteorological deficit).



(It is important to indicate the risk or vulnerable areas in different sectors).

The proposed scenario has been designed to facilitate the gathering of information about damages and response capabilities in case of disaster. This information will serve as a basis for risk management planning. This scenario is in no way whatsoever a forecast of an event.

9.2.3. Landslides

This description is based on emergency reports of 2007-2008 and 2010-2011 winter periods.

Description

The winter season in 2013 has had rainfall values close to the expected annual average. However, there have been highly targeted heavy rains in very short periods. For December 2013, small landslides began in Aloag - Santo Domingo road and in Pallatanga road.

In January 2014, there were landslides near Jaime Roldós neighborhood, in Cuenca, affecting 25 houses. Rainfall has increased in both intensity and frequency. Cloudiness is almost constant, especially in the national territory, so evapotranspiration is minimal, producing water saturation in the soil. Floods were reported in areas close to river banks and in the low basins of Guayas and Esmeraldas rivers.

As an unusual case, heavy rains were reported in Guayllabamba. The evaluation by MDMQ and SGR reports cracks on the hillside where the oil pipeline runs through.

In February 2014, several landslides affected the main Highlands roads. In city of Esmeraldas, the landslides may jeopardize the transport operations of oil and oil products. People remember the events of February 1998 and fear a similar situation. These fears have been spread by the media. Along the road to Echendía, there are at least 12 landslides.

Small landslides also occurred along Patate River. A similar situation is happening in the Paute, Chimbo, Guayllabamba and Blanco rivers.

By March 2014, precipitations have increased and they are expected to last until June.

The proposed scenario has been designed to facilitate the gathering of information about damages and response capabilities in case of disaster. This information will serve as a basis for risk management planning. This scenario is in no way whatsoever a forecast of an event.

9.2.4. Mass displacement of Colombian-Ecuadorian population living in the southern border of Colombia, due to armed conflicts in Nariño and Putumayo

This description is based on the sequence of events in 2009, when there was a massive displacement of people from the Colombian territory to the San Lorenzo canton in the Esmeraldas province.

Description

The border between Ecuador and Colombia shares 586 km, administratively divided into three provinces on the Ecuadorian side: Car - chi, Esmeraldas and Sucumbíos, and into two departments: Nariño and Putumayo, on the Colombian side.

For 2014, the military offensive of the Colombian government has been on the southern border. Moreover, according to recent investigations, there is increased violence and insecurity in these departments and provinces. This situation has worsened specially because of conflicts between guerrillas and military forces, hired hit men, organized crime groups, common crime and drug trafficking. Despite efforts by governments and public infrastructure investments, the problem remains.

Since the first week of October, a massive offensive action by the Colombian Revolutionary Armed Forces (FARC) has started in 25 municipalities on the southern border. There was an exodus of families towards the border area of Ecuador for safety reasons.

The initial assessment by relief agencies indicates that 3,700 displaced people arrived in Carchi, 1300 in Imbabura, 2,900 in Esmeraldas, 2,100 in Sucumbíos and 800 in Francisco de Orellana provinces (October 3-9 figures). In terms of the Awá population, leaders in the Ecuadorian territory have reported that 15% of the Awá population is expected be displaced from the Colombian territory (approximately 2200 people).

There is a high demand of shelters.

It is known that the offensive actions will increase.

Mobilization has been restricted on certain roads in border areas; emergency has been declared in border and support provinces.

The winter season has started earlier; there is heavy rainfall in Esmeraldas.

(It is important to indicate the risk or vulnerable areas in the different service sectors).

The proposed scenario has been designed to facilitate the gathering of information about damages and response capabilities in case of disaster. This information will serve as a basis for risk management planning. This scenario is in no way whatsoever a forecast of an event

9.2.5. Influenza Pandemic A (GXHX)

This description is based on the sequence of events of the 2009 A (H1N1) pandemic.

Description

On May 15, Ecuador reports the first case of influenza A (GXHX) in Guayaquil. The affected child was taken to the Infectology Hospital, where it was suspected he had influenza A (GXHX). The school he was attending had to close for a week. On May 20, Ecuador confirmed 6 new cases in Guayaquil and 1 in Quito, raising the number of cases to 8 throughout the country.

On May 22, 22 new cases of influenza A (GXHX) were reported in Guayaquil. The Minister of Health confirmed: 18 of the infected people attended a football game, and one of them is the brother of one of the people already infected with the virus and the other is a traveler who arrived from Miami.

On May 25, the Ministry of Health confirmed that the number of people infected with influenza A (GXHX) in Ecuador had risen to 66. On May 29, the number of

cases rose to 75 in Ecuador: 50 of them in Guayaquil, 10 in Machala, and 6 in Quito.

On June 5, the number of infected people rose to 157, when new cases were reported in Quito, rising to 30; 80 in Guayaquil; 22 in Machala, while 10 cases were reported in Cuenca, 5 in Manta and 10 in Ambato.

On June 9, the number cases increased to 460. Due to the characteristics of the disease spread, national emergency was declared. Transport is restricted as well as flights and exits from ports. Classes are suspended and mobilization is restricted. People are trying to seek food and medicine. There is not much movement in the cities; the media requests a curfew and mass vaccination. Only Morona Santiago and Zamora Chinchipe provinces do not report cases. The situation is similar in bordering countries. Treatment of patients is only symptomatic; the disease affects all ages, but the most vulnerable are elderly people and children.

By June 15, the first four fatalities are reported in Ambato city and the number of confirmed cases surpasses the 900 people.

By June 21, there are over 2,000 cases. Patients' recovery is slow and they require intermediate care. Due to unfounded fear, funeral companies only accept cremation, and several poor people bury their dead relatives in non-authorized sites.

The fatalities amount to 85. The government has recommended limiting attendance to workplaces and has established working schedules for public and private institutions. There is an aggressive information campaign and preventive actions for people movement. Nine ministers show symptoms of the disease and preventive isolation is recommended to the cabinet as they had a meeting about the emergency in previous days and the ministers that might be infected attended that meeting.

By June 30th, there are over 2,800 cases and the number of deceased people amounts to 293.

The proposed scenario has been designed to facilitate the gathering of information about damages and response capabilities in case of disaster. This information will serve as a basis for risk management planning. This scenario is in no way whatsoever a forecast of an event.

9.2.6. Local Tsunami (nearby source)

This description is performed with the support of INOCAR (Patricia Arreaga, Eng.)

Description

When referring to local tsunamis or nearby source tsunamis, it means that the place where waves arrive on the coast is very close to or within the area of wave generation (delimited by the area of dislocation of the seafloor) of the tsunami, or within less than an hour of travel time from its origin (< 299 km).

A scenario with a seismic event of 9.0 magnitude, located at 1.0° N and 81.5° W, at a ~ 20 km depth, off the coast of Esmeraldas, in less than an hour would reach all the Ecuadorian coastline, and an hour and a half later, the island coasts. Wave height estimates may range from 2.0 m to 10.0 m (PacWave11, PTWC, NOAA 2011).

It is necessary to consider the stages of the tide to estimate a total height because models are usually based on an average sea level reference.

El escenario propuesto se lo ha diseñado con la finalidad de facilitar el proceso de captura de información sectorial sobre afectaciones y capacidades para la respuesta a un desastre, la cual se constituirá en una base para la planificación de la gestión de riesgo, por ninguna razón se constituye en una predicción de un evento destructivo.









Flood scenario for rainy season 2013 Statistically-based rainiest seasons: 1983, 1987, 1998, 2008, 2012

9.5. Map of mass movements 2011 - 2012



9.6. Rainfall maps

9.6.1. Rainfall maps (series 1971 - 2000, according to WMO)



ANNUAL ISOHYET MAP ANNUAL SERIES 71 – 2000



9.6.2. Rainfall map. (January isohyets)



9.6.3. Rainfall map. (February isohyets)



9.6.4. Rainfall map. (March isohyets)



9.6.5. Rainfall map. (April isohyets)



9.6.6. Rainfall map. (May isohyets)



9.6.7. Rainfall map. (June isohyets)



ANNUAL ISOHYET MAP, ANNUAL SERIES 71 - 2000



9.6.9. Rainfall map. (August isohyets)










ANNUAL ISOHYET MAP, ANNUAL SERIES 71 - 2000







9.7. Areas influenced by El Niño phenomenon

9.8. Floodings during El Niño phenomenon 1997 - 1998



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9.9. Tsunami wave approximate height



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9.10. Energy distribution of coastal waves in Ecuador



Fuente INOCAR

9.11. Geophysical Institute, Communication System and Networks

9.11.1. Seismograph National Network RENSIG



SEISMIC STATION NETWORK



9.11.2. National Network of Accelerographs (RENAC)

9.11.3. Volcano Observatory Network (ROVIG)

STATION NETWORK TUNGURAHUA VOLCANO STATION NETWORK COTOPAXI VOLCANO



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9.11.4. Geodesy National Network (RENGEO)



9.11.5. Data Transmission National Network and Repeater (REPET)

Map of Analog TransmissionNetwork



Satelite Transmision Network



Map of Digital Communication Network

Microwave Network





9.12. Navy Oceanographic Institute

9.12.5.1. Location of Network of Tide Gauges



9.13. Structure of the Technical Discussion Groups of the Risk Management Committees



	7	EDUCATION, CULTURE, HERITAGE, AND ENVIRONMENT	MISNISTRY COORDINATOR FOR NATURAL AND CULTURAL HERITAGE	MINISTRY OF EDUCATION	MINISTRY OF CULTURE	MINISTRY OF ENVIRONMENT	MINISTRY OF TOURISM	MINISTRY OF SPORTS
	9	PRODUCTIVITY AND LIVELIHOOD	MINISTRY COORDINATOR FOR PRODUCTION AND EMPLOYMENT	MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES - MAGAP	MINISTRY OF INDUSTRY AND PRODUCTIVITY - MIPRO	MINISTRY OF ECONOMY AND SOCIAL INCLUSION - MIES	MINISTRY FOR NON-RENEWABLE RESOURCES	LABOR MINISTRY
	Ð	POPULATION COMPREHENSIVE SECURITY	MINISTRY COORDINATOR FOR INTERNAL AND EXTERNAL SECURITY	MINISTRY OF DEFENSE COMACO-FFAA	MINISTRY OF INTERIOR (NATIONAL POLICE)	FIREFIGHTING DEPARTMENT	CIVIL PROTECTION VOLUNTEERS SGR	CANTON COUNCIL, METROPOLITAN POLICE ACCORDING TO THE REGION UNDER EMERGENCY)
LE (NATIONWIDE)	4	POPULATION COMPREHENSIVE CARE	MINISTRY OF ECONOMY AND SOCIAL INCLUSION - MIES	MINISTRY OF PUBLIC HEALTH- MSP	MINISTRY OF EDUCATION	MINISTRY OF CULTURE	MINISTRY OF SPORTS	MINISTRY OF URBAN DEVELOPMENT AND HOUSING MIDUVI
TECHNICAL ROUND TAB	e	INFRASTRUCTURE AND REHABILITATION	MINISTRY OF TRANSPORTATION - MTOP	MINISTRY OF URBAN DEVELOPMENT AND HOUSING MIDUVI	MINISTRY OF PUBLIC HEALTH- MSP (AREA FOR SANITATION INFRASTRUCTUTE)	MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY	MINISTRY OF TELE COMMUNICATIONS	MINISTRY OF EDUCATION
	2	SANITATION, HYGIENE AND HEALTH PROMOTION	MINISTRY OF PUBLIC HEALTH- MSP	MINISTRY OF ECONOMIC AND SOCIAL INCLUSION - MIES	MINISTRY OF EDUCATION	ECUADORIAN INSTITUTE OF SOCIAL INSURANCE - IESS	ISSFA ARMED FORCES SOCIAL SECURITY INSTITUTE FOR	ISSPOL POLICE FORCES SOCIAL SECURITY INSTITUTE
	-	WATER ACCESS AND DISTRIBUTION	MINISTRY OF URBAN DEVELOPMENT AND HOUSING MIDUVI	UNDER-SECRETARIAT FOR DRINKING WATER AND SANITATION MIDUVI	MINISTRY OF PUBLIC HEALTH- MSP	MINISTRY OF ECONOMIC AND SOCIAL INCLUSION - MIES	MUNICIPALITY ASSOCIATION OF ECUADOR - AME	MUNICIPAL AND RURAL GOVERNMENTAL COUNCIL OF ECUADOR - CONAGOPARE
		WORK AREA	COORDINATOR ENTITY FOR DISCUSSION GROUPS			PUBLIC SECTOR		

AND RELATED NGOS	SUPPORTING COMITTEE FOR WORK AREAS, PUBLIC AND			PUBLIC			WORK AREA			
NATIONAL COUNCIL FOR ELECTRICITY - CNEL	SENAGUA	SUPPORTING COMMITTEE	MINISTRY OF FINANCE				DRINKING WATER ADMENISTRATIVE BOARDS ACCORDING TO THE AREA IN EMERGENCY	WATER ACCESS AND DISTRIBUTION	-	
	ASSOCIATION OF PRIVATE CLINICS AND HOSPITALS IN ECUADOR	SUPPORTING COMMITTEE	MINISTRY OF FINANCE	NATIONAL POLICE (FORENCICS)			MINISTRY OF SPORTS	SANITATION, HYGIENE AND HEALTH PROMOTION	2	
MINISTRY OF NON- RENEWABLE NATURAL RESOURCES	MINISTRY OF FOREIGN AFFAIRS AND HUMAN MOBILITY	SUPPORTING COMMITTEE	MINISTRY OF FINANCE		CANTON COUNCIL (ACCORDING TO THE EMERGENCY AREA)	MUNICIPALITY ASSOCIATION OF ECUADOR - AME	PROVINCE ADMINISTRATION AND COUNCIL	INFRASTRUCTURE AND REHABILITATION	ω	TECHNICAL ROUND TAB
INTERGOVERNMENTAL AGENCIES - AGECI	MINISTRY OF JUSTICE, HUMAN RIGHTS AND CULTS	SUPPORTING COMMITTEE	MINISTRY OF FINANCE	INMOBILIAR	NATIONAL POLICE	CANTON COUNCIL (ACCORDING TO THE EMERGENCY AREA)	TOWN SECRETARIAT, SOCIAL MOVEMENTS, AND CIVIL REGISTRY PARTICIPATION	POPULATION COMPREHENSIVE CARE	4	LE (NATIONWIDE)
CIVIL REGISTRY	MINISTRY OF JUSTICE, HUMAN RIGHTS AND CULTS	SUPPORTING COMMITTEE	MINISTRY OF FINANCE			ELECTRICITY AND RENEWABLE ENERGY MIN.; SUB SECRETARIAT FOR INVESTIGATION CONTROL- NUCLEAR APPLICATIONS - MEER/SCIAN	NATIONAL TRANSIT COMMITTEE	POPULATION COMPREHENSIVE SECURITY	СЛ	
MINISTRY OF ECONOMIC AND SOCIAL INCLUSION - MIES	SENAGUA	SUPPORTING COMMITTEE	MINISTRY OF FINANCE	INMOBILIAR	MINISTRY OF ENERGY AND ELECTRICITY	MINISTRY OF TOURISM	MINISTRY OF TRANSPORTATION	PRODUCTIVITY AND LIVELIHOOD	6	
PETROECUADOR		SUPPORTING COMMITTEE	MINISTRY OF FINANCE				TOWN SECRETARIAT, SOCIAL MOVEMENTS, AND CIVIL REGISTRY PARTICIPATION	EDUCATION, CULTURE, HERITAGE, AND ENVIRONMENT	7	

			TECHNICAL ROUND TAB	ILE (NATIONWIDE)			
	-	5	e	4	Ð	9	7
WORK AREA	WATER ACCESS AND DISTRIBUTION	SANITATION, HYGIENE AND HEALTH PROMOTION	INFRASTRUCTURE AND REHABILITATION	POPULATION COMPREHENSIVE CARE	POPULATION COMPREHENSIVE SECURITY	PRODUCTIVITY AND LIVELIHOOD	EDUCATION, CULTURE, HERITAGE, AND ENVIRONMENT
	Transport and Public Works Ministry MTOP	ECUADORIAN RED CROSS	AGECI	ECUADORIAN RED CROSS	ECUADORIAN RED	MEER-SCIAN Electricity and Renewable Energy Ministry, Under	ECUADORIAN RED
	ECUADORIAN RED CROSS		CONCOPE		CHOSS	secretariat of Hesearch Control Nuclear Applications	CHOSS
COMMITTEES FOR THE SUPPORT OF WORKING AREAS PUBLIC	INTERNATIONAL PLAN, NGO well-known in this topic	NGO well-known in this topic	ADRA SCOUTS of Ecuador, NGO well-known in the theme	ADRA SCOUTS of Ecuador NGO well-known in the theme	ADRA NGO well-known in the theme	Corp. Financiera Nacional CFN Banco Nacional de Fomento BNF	INTERNACIONAL SCOUTS PLAN of Ecuador
AND PRIVATE SECTORS AND RELATED NGOS	NATIONAL POLICE Cross- cutting support	NATIONAL POLICE Cross- cutting support	NATIONAL POLICE Cross- cutting support	NATIONAL POLICE Cross- cutting support	NATIONAL POLICE Cross-cutting support	NATIONAL POLICE Cross-cutting support	NATIONAL POLICE Cross-cutting support
	ARMED FORCES Supplementary support	ARMED FORCES Supplementary support	ARMED FORCES Supplementary support	ARMED FORCES Supplementary support	ARMED FORCES Supplementary support	ARMED FORCES Supplementary support	ARMED FORCES Supplementary support
	Other public institutions, privat companies) to favor the reduction	te enterprises should be incorp ion, response and recovery mec	borated under the criteria and hanisms	I coordination of EOC / RMC	and/or the members of t	he technical working grou	os (institutions /private
ITIZEN COMMUNI	TY PARTICIPATION						

NOTE: The annex represents the organization of the technical working groups. However, for emergency, disaster, risk reduction and recovery actions at province, canton, parish levels, the presence and the mission of the working groups should be maintained and the institutions at territorial level (public or private) should adapt themselves to the actions of each and every work group. In order to manage reduction, response or recovery situations, it is not necessary to call the seven discussion groups; the groups called should be those needed and related with the type of situation.

9.14. Exposure of health units to flooding and landslide threats

Health Operating Units per administrative zones	Low flooding threat	Medium flooding threat	High flooding threat	Total Country
ZONE 1	109	76	18	203
ZONE 2	51	4	4	59
ZONE 3	59	18	3	80
ZONE 4	119	41	21	181
ZONE S	143	58	25	226
ZONE 6	84	39	7	130
ZONE 7	117	51	25	193
ZONE 8	58	26	0	84
ZONE 9	1	0	0	1
NON DELIMITED ZONE	5	0	0	5
Total	746	313	103	1162

Specialized, general and basic hospitals	Low flooding threat	Medium flooding threat	High flooding threat	Total country
ZONE 1	10	2	1	13
ZONE 2	3	0	0	3
ZONE 3		1	0	4
ZONE 4	5	3	2	10
ZONE 5	16	4	1	21
ZONE 6	7	1	0	8
ZONE 7	10	5	1	16
ZONE 8	3	1	0	4
ZONE 9	1	0	0	1
Total	58	17	5	80

Health Centers and Posts	Low flooding threat	Medium flooding threat	High flooding threat	Total country
ZONE 1	99	74	17	190
ZONE 2	48	4	4	56
ZONE 3		17	3	76
ZONE 4	114	38	19	171
ZONE 5		54	24	205
ZONE 6	77	38	7	122
ZONE 7		46	24	177
ZONE 8	55	25	0	80
NON DELIMITED ZONE	5	0	0	5
Total	688	296	98	1082

(10).

· · /				
Health Operating Units per administrative zones	Low landslide threat	Medium landslide threat	High landslide threat	Total country
ZONE 1	93	50	11	154
ZONE 2	29	14	4	47
ZONE 3		32	4	75
ZONE 4	94	47	11	152
ZONE 5	120	25	8	153
ZONE 6	49	73	4	126
ZONE 7	105	55	28	188
ZONE 8	66	1	0	67
ZONE 9	32	16	2	50
NON DELIMITED ZONE	5	5	0	10

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Total general 632 318 72 1022

Specialized, General and basic Hospitals	Low landslide threat	Medium landslide threat	High landslide threat	Total country
ZONE 1	5	0	0	5
ZONE 2	4	0	0	4
ZONE 3		1	0	1
ZONE 4	7	1	0	8
ZONE 5	9	1	0	10
ZONE 6	4	4	0	8
ZONE 7	12	2	2	16
ZONE 8	3	0	0	3
ZONE 9	2	3	0	5
Total	46	12	2	60

Health Care Centers and Points	Low Landslide threat	Medium landslide threat	High landslide threat	Total country
ZONE 1	88	50	11	149
ZONE 2	25	14	4	43
ZONE 3		31	4	74
ZONE 4	87	46	11	144
ZONE 5	111	24	8	143
ZONE 6	45	69	4	118
ZONE 7	93	53	26	172
ZONE 8	63	1	0	64
ZONE 9	30	13	2	45
NON DELIMITED ZONE	5	5	0	10
Total	586	306	70	962

9.15. Public Health Ministry

9.15.1. Structure of Processes in the Public Health Ministry





9.15.2. Incidence rate for dengue fever / malaria 2012 MSP (Public Health Ministry)

MAP AND CHART OF CASES PER TIME SERIES 1994-2012 | 1994-2012 TROPICAL DISEASES

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9.15.3. Hospital characterization based on the Hospital Safety Index (ISH) for 2012

Name of the Hospital	City	Typology	Category	Date
Luís Gabriel Dávila	Tulcán General!		В	2008
Francisco de Orellana	Coca	General	С	2008
Marco Vinicio Iza	Lago Agrio	General	С	2008
General Docente	Riobamba	General	А	2009
Brigada 11 Galápagos	Riobamba	General	В	2010
Abel Gilber Pontón	Guayaquil	General	В	2010
San Luis	Otavalo Basic		С	2010
Francisco Icaza Bustamante	Guayaquil	Specialty	В	2010
Alfredo Noboa Montenegro	Guaranda General		В	2011
Shushufindi	Shushufindi	Basic	В	2011
Eugenio Espejo	Quito	Specialty	В	2012
Pablo Arturo Suárez	Quito	General	С	2012
Enrique Garcés	Quito	General	В	2012
Maternidad Isidro Ayora	Quito	Specialty	А	2012
Baca Ortiz	Quito	Specialty	В	2012
Gonzalo González	Quito	Specialty	С	2012
Adulto Mayor	Quito	Specialty	В	2012
Alfonso Villagómez	Riobamba	Specialty	С	2012
Gustavo Domínguez	Sto. Domingo	General	В	2012
Martín Icaza	Babahoyo	General	В	2012
José María Velasco Ibarra	Tena	General	В	2012
Delfina Torres de Concha	Esmeraldas	General	С	2012
Estatal de Baeza	Baeza	Basic	А	2012
Cayambe	Cayambe	Basic	А	2012
Yaruquí	Yaruquí	Basic	В	2012
Sangolquí	Sangolquí	Basic	В	2012
Machachi	Machachi	Basic	А	2012
Nanegalito	Nanegalito	Basic	А	2012
Colta	Colta	Basic	В	2012
Guamote	Guamote	Basic	В	2012
Alausí	Alausí	Basic	С	2012
Chunchi	Chunchi	Basic	В	2012

27 of these hospitals have a short, medium and long term action plan. All of them in different levels have implemented improvement measures in the functional and or non-structural aspects.

9.15.4. Levels of pre hospital complexity

	LEVELS OF	PRE HOSPITAL ATTEI	NTION
Complexity levels	Category of units	Name	Type of transport
1st level of complexity	APH-1	Support Unit of pre hospital attention and support	Ambulance type I Vehicle of fast intervention Ambulance only for transport Ambulance for vital basic support
2nd level of complexity	APH-2	Unit of pre hospital attention of advance support	Ambulance Type II Prepared to provide advanced vital support
3rd level of attention	APH-3	Unit of pre hospital attention of specialized vital support	Ambulance type II prepared to provide vital support and specialized in intensive care

NOTES

