
Draft Document

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1. Brief overview of the Southern Oscillation of el Niño Event

1.1 Definition of the Southern Oscillation of el Niño Event

El Niño Southern Oscillation is an alteration of the ocean-atmospheric system, which main scenario is the Equatorial Pacific Ocean. This is an event that takes place in irregular periods from 3 to 15 years (Fig. 1). Its main characteristic is the sustained warming of the sea surface temperature along the equatorial zone that alters the atmospheric circulation over the Pacific. This event modifies the intensity and directions of the winds on the surface and the upper atmosphere, therefore altering the climatic patterns in the Pacific. Besides it generates remote impacts named teleconnections in other places of the planet. The definition of El Niño causes a lot of debate because countries like The United States have adopted a so called “operational definition”. This definition used since April, 2005 by the NOAA\(^1\) (National Ocean and Atmospheric Administration), states that El Niño condition is declared when the Equatorial Pacific Ocean remains a positive sea surface temperature anomaly on Niño 3.4 region close or above 0.5°C averaged during three consecutive months. The whole global physics related to ENSO was synthesized in one parameter. This definition, despite all the local scientific objections has demonstrated to be useful and effective in terms of prevention and planning, for USA and other regions such as the Caribbean and Central America. The problem in Andean countries is not the definition per se, the issue is the strong influence of NOAA statements in the opinion of authorities in Latin America and of course Andean Countries that do not know about the National scope of NOAA definition and extrapolate this definition to every country reducing credibility of national forecasts, and increasing misinformation on users. The experience since this definition is on place has been strongly negative in countries as Colombia, Ecuador and Peru and the contradictions have been more significant since Niño 1+ 2 region has been desynchronized with the region Niño 3.4 (used by NOAA for ENSO prediction).

Now National institutions of Andean countries and Latin America in general, use all the information provided by NOAA, and these data which is extremely useful is very well analyzed, but in general terms the Institutions have learned, that at the end the better forecast is the local one, where experience, local observations and global information is combined.

After the El Niño event of 1987-1988, the scientific literature on the topic has increased in levels never seen before. This climate episode, because of its extraordinary intensity and terrible impact worldwide, permitted among other things, lead a pattern of worldwide impacts (Fig. 2), which by that time was validated successfully. However since 1998 until now, the Pacific Ocean according to many authors, has came into a new phase of decadal climate variability\(^2\). Despite the fact, that there is nothing conclusive yet, the latest scientific analysis, suggest that the Pacific Ocean has entered a negative phase of the PDO (Pacific Decadal Oscillation), and that one of the probable impacts of this stage could be the reduction on the intensity and frequency of warm events known as el Niño and also an amplification of cold events known as la Niña\(^3\).

This new hypothesis has become stronger due to the new evidence: the teleconnection patterns of typical pattern of the ENSO, postulated before have been wrong and not fitting for the warm episodes of the years 1997-1998. In the Pacific have prevailed cold conditions, their related impacts and the events of el Niño or close to a Niño have only been weak to moderate events. One of the most dramatic cases of the region occurred in Ecuador in the years 2002-2003, when the NOAA announced a El Niño event with an intensity from weak to moderate, which is now accepted by the scientific community as such, Ecuador didn’t experience the expected impacts.

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\(^{1}\)National Ocean and Atmospheric Administration (USA).


impacts according to the classical impact patterns, but also experienced in the highest peak of this event, the worst deficit of precipitation in the last 20 years.4

The contradiction between the global predictions, particularly the NOAA and the expected local impacts, established as evidence, the problem of the definition of the ENSO and the limitations of the typical pattern of the effects of the ENSO in the whole world. In this matter, the scientists have learned the lesson and they are carrying out a more independent process of analysis, with many and diverse sources of information, more global models and without allowing the statements of the NOAA and other organisms of global influence be conclusive for the locals predictions. The huge amount of scientific information, observations in real time and improvement of the models, added to local capacities and the empirical experience of the experts of the region to make a more accurate diagnostic of the impacts on the countries, which will definitively is a progress in the countries in the region of the Andes, specifically Colombia, Ecuador, Peru, and Chile.

1.2 Observed Historical Tendencies

Since the last El Niño Event 1997-1998, the Pacific has registered prevalent neutral and cold conditions, which started with the La Niña event since 1999 up to 2001. During 2002-2003, a weak Niño event took place, its impacts at a regional level was seemingly different to the last El Niño. By the end of the year 2004 and the beginning of the year 2005, warm conditions were registered, however these conditions never evolved to an El Niño event. The evolution of the temperature en the Niño regions (Fig. 3), in the last 10 years are shown in Fig. 4. In the last decade, despite the fact that there have not been any major El Niño events registered, it is clear that the climate variability and its effects, systematically impact year after year vulnerable communities throughout the region. An increase in the extreme events of short duration but great intensity is evident, an irregular distribution of precipitations in the seasonal periods of rain and the increase of the daily difference between minimum and maximum temperatures of the air. In general terms, and according to the climate analysis from 20055 (Fig. 5) the region has characterized for a deficit on the precipitations. Finally, an important aspect in the last decade, is the complex behavior of the ocean zone adjacent to Ecuador and Peru called NIÑO 1+2 that has a great local influence in the rainy seasons of these countries. Since 1998 until the beginning of the year 2006, the variability of this zone has been desynchronized with the fluctuations of the central Pacific, that is why the local capacity to predict the behavior of el NIÑO 1+2 has been limited and doubtful, considering that the current knowledge of the physics involved in the coupled ocean-atmosphere system along the Eastern Pacific is not well understood yet at local and global level. This situation is partially solved with a rough extrapolation of global circulation models from 95°W to the South American coast. The problem is not much related with monitoring this region, because is fairly good at surface level. The real issue is the weakness of local institutions to solve the scientific problems of the dynamics in this area which is producing its variability. This lack of science is not related with the data, because, there are relevant historical data and research cruises in this area, since 30 years ago, which have not been translated in scientific knowledge that can be applied in better climate and ocean forecasts. On the other hand, since June 2006, El NIÑO 1+2 region seems to appear more coherent than previous years; all this marks a great difference in the evolution of El Niño event 2006-2007.

1.3 Current observations and models used to predict the climate patterns related with the ENSO events

There are more than 12 global models with capacity to predict the ENSO, however most of them are based on the operational definition of the NOAA, they are very useful when related to the estimation of rainfall and the increase of the temperature of the sea, but the resolution to a regional or local scale is very limited. However, new organisms like CIIFEN6 among others like the IRI7 have promoted the prediction of the ENSO in terms of its direct effects, like rainfall and the increase of the temperature in the environment, beyond predicting the

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4 Boletín Meteorológico del INAMHI, Ecuador, Marzo 2003
7 International Research Institute for Climate Prediction and Society (http://iri.columbia.edu/)
ENSO under a perspective that are not satisfying for the countries typically affected by it. Since the year 2005, in the Andean region, a regional mechanism which is the implementation of a Virtual Climate Outlook Forum has been developed to make regional forecasting that allows, with certain limitations (spatial scale and prediction precision) predict if the rains will be over or under the averages (Fig. 6). This mechanism is under the WMO8 structure and regionally coordinated by CIIFEN9, it use a regional data base of 126 stations which was agreed to be shared between National Meteorological Services from Venezuela, Colombia, Ecuador, Colombia, Peru, Bolivia and Chile. This information is analyzed using a standard methodology, the results are compiled by CIIFEN and then a virtual discussion is held, the consensus forecast is further disseminated to a wide community of users. The presentation of this forecast is very friendly and is expressed in terms of probability. The current regional forecast will be mentioned further in this document. It seems to be a good and cost-effective regional mechanisms for climate predictions in Andean countries. This mechanism will be strengthened through a Regional Public Goods Project submitted by CIIFEN in 2005 and approved by IDB to be executed early in 2007.

Besides all these efforts, there are various global models that make seasonal rain forecasts worldwide like ECMWF10, the Climate Forecast System (CFS) from NOAA, the seasonal forecasts of Météo France, the Japan Meteorological Agency and the United Kingdom Meteorological Office. The latest results of these models are seen on Fig. 7. The models have developed a growing ability for the forecasting of rainfall and temperatures. Their level of credibility improves considerably as the measure of the temperature of the ocean registers values above average and this sign persists for some time. Up to the moment when this document was elaborated, the levels of correlation between the observed parameters versus the predicted values (the level of certainty of these models) for the NOAA-CFS, are superior up to 90% (Fig. 8). Consequently, up to this date and in the following 4 months the capacity of the seasonal models, that is dynamic and statistic ones is high, this will permit with a good accuracy, provide the climate scenarios for the region.

The analysis done up to this date of the ENSO event, shows temperature between 1.2°C and 1.3°C above the average in the Equatorial Pacific except in Niño 1+2 where these values are close to 0.7°C. Under the sea surface between 0 and 250 m depth, registered temperatures are 3.5°C above average. The heat contained in the Equatorial Pacific shows a tendency towards increase and above normal; all these facts along with the last models outputs, suggest the probable duration of this warm episode until the second trimester of the year 2007 (Fig. 9). In relation to the atmosphere, intensification in the trade winds from the west in the Western Pacific is observed as well as important anomalies in the outgoing long wave radiation (closely related with the cloudiness) near to the date line. Evident impacts in Indonesia and the west side of Australia were also evidenced. The index of southern oscillation and the other global indexes suggest the development of a El Niño Event with a weak to moderate intensity. Along the Western Pacific, until now there is a coupling between ocean and the atmosphere typical of El Niño on its previous stage to maturation. As a consequence of the winds of the Western Pacific, a Kelvin Wave is spreading towards South America, and its arrival is expected by the end of November and during the first weeks of December. This analysis is shown in Fig. 10. Because of the magnitude of this wave and the seasonal change, it is estimated that the sea surface temperature in Ecuador and Peru coast increase up to 1°C above average therefore, to provide to the atmosphere enough energy to maintain precipitations above normal all through the coast of Ecuador, the northern coast of Peru and keep the zone of clouds that produce rain (zone of Intertropical convergence) (Fig. 11). Over these countries between the months of January to April of the year 2007. As a consequence of this dynamic, more probabilities of below normal rainfall are estimated in the central and northern zones of Colombia and central zone of Bolivia.

2. Regional Analysis of the Impacts of the ENSO 2006-2007

2.1 Probable impacts in the Andes Region

The global analysis of the warm episode in progress, suggest remarkable differences with the last El Niño event 2002-2003. One of them is the time of the year of development, while this event would reach its peak in

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8 World Meteorological Organization
9 Centro Internacional para la Investigación del Fenómeno de El Niño (CIIFEN) www.ciifen.int.org
10 European Center of Medium Range Forecast (www.ecmwf.int)
October and then it would decline before December\textsuperscript{11}, the current El Niño event, would reach its maximum peak between December 2006 and February 2007\textsuperscript{12}, with a further declination until May 2007. This situation will have direct effects in the rainfall season in Ecuador and Peru and probably will influence in the weakening or delay of rainy season in Colombia, after March or April 2007. Under these circumstances, the evolution of this event and the historical statistics of the influence of the Pacific Ocean in South America, the Climate Forum for the West part of South America held in November 2006\textsuperscript{13} and coordinated by the CIIFEN (Fig. 12) foresees:

**Colombia:** More probabilities of close or below normal precipitation in most parts of the country, with more emphasis in the center and southern region of the Andes. However, there is possibility of isolated and intense precipitations that would not last long.

**Ecuador:** More probabilities of close or above normal rainfall on the northern and central coast, Amazon region, and Galapagos.

**Peru:** More probabilities of above normal rainfall in the northern zone, southern highlands and part of the plateau. Close to normal conditions in the rest of the territory.

**Bolivia:** More probabilities of rain or below normal rainfall in the center and eastern regions, more probabilities of above normal rainfall in the north of La Paz and southern part of the country.

**Chile:** More probabilities of normal rainfall in the plateau region in northern of Chile and the central region. More probabilities of close or above normal rainfall in the southern and austral regions.

The statistical analysis of meteorological information of Venezuela, Colombia, Ecuador, Peru, Bolivia, and Chile suggest more probabilities during November 2006-January 2007 period, that the maximum temperature will be above normal in Venezuela, most of Colombia, coast of Ecuador, Peru, and Bolivia and the North of Chile. The minimal temperature is estimated with more probabilities to be close or above normal in most of the region (Fig. 13).

Also, more probabilities of above normal rainfall are estimated between Argentina and Uruguay border as well as the northeast of the Amazon region.

### 2.2 Probable magnitude and reach of the impacts at regional level

The determination of the regional impacts was done based on the historical analysis of the impacts caused by the hydro-meteorological events associated with the El Niño events from the data base of DESINVENTAR\textsuperscript{14}, FAO\textsuperscript{15}, Pan-American Magazine of Health, OPS\textsuperscript{16}, CRID\textsuperscript{17}, Health Ministry of Peru, Ministry of Public Health of Ecuador, The Colombian Civil Defense, INDECI\textsuperscript{18}, National Direction of Civil Defense of Ecuador. Due to the current scenario of probable impacts at a regional level, the order of priority is the following:

**Agriculture and Livestock Sectors:** Probable damages in the agricultural and livestock on the Atlantic coast of Colombia and probable damages in the center of this country associated with a moderated deficit of precipitations. Probable affectations in the agricultural sector in the entire coastal region of Ecuador associated with a moderate excess of precipitations and floods. Probable affectations in the agricultural sector on the north coast of Peru, associated with moderate excess of precipitations and agricultural affectations in the central and southern highlands associated with a moderate deficit of precipitations.
Health Sector: Impacts in the access and availability of clean or safe water spread of vectors and diseases which are contagious like dengue, malaria, cholera, and leptospirosis.

Infrastructure Sector: Moderate impacts on houses and schools that are established in zone of risk in case of floods and landslides in Ecuador and Peru

Road Sector: Probable impacts on secondary roads and moderate damage risk on main roads associated with landslides in Ecuador and the North of Peru

Energy Sector: Probable impacts on the supply of energy and possible speculation with the prices, especially in Colombia. Probable effects in nets of electrical distribution on the coasts of Ecuador and the north of Peru.

2.3. Relative Vulnerability on the population of the regions and areas of concentrated economy activity.

During the last years the region has increased its vulnerability to climate events, especially when there has not been any important progress in one of the most important sectors for the economy: the agriculture, the main income of rural populations and in general terms, those who are the poorest.

Despite there are not updated and documented vulnerability indicators in these countries, it is strongly evident, that the non adequate land use has increased, mostly by the internal migration of communities. This has become dramatic in the case of Ecuador, because several communities have moved from highlands to the coastal region, such as Babahoyo, Quevedo, Portoviejo and Machala. These new inhabitants are not familiar with the behavior of the rivers and the natural flooding regime and make constructions that are easily destroyed with the first seasonal rainfall every year. Other factor that is increasing the vulnerability is the increasing misinformation about climate and the lack of culture to use the information, communities are still reluctant to use the information provided by National institutions when they have and they prefer to use the ancestral methods which are not working well because the climate change. The role of the Local governments in Climate risk management is increasingly weak and totally dependant of the international cooperation which is always addressed to response, humanitarian aid and reconstruction. Finally is important to mention the vulnerability increment associated with sedimentation of the rivers, intervention of the riversides along all thee main basins, and the collapse and lack of maintenance in sewage systems.

There are not vulnerability indicators at sub national level, that must be designed in order to provide a better and most consistent vulnerability monitoring to these countries. In terms of increment of vulnerability Ecuador, could be easily the most critical case in the region.

Agriculture in the Andean countries represents a remarkable contribution for their economies and it provides work to 29% of the labor force in Colombia, 32% in Ecuador, 35% in Peru, 43% in Bolivia, 14% in Chile, and 13% in Venezuela. This represents a population dedicated to agriculture in the region of nearly 28´301,000 people. The surface of land dedicated to agriculture in the region is of approximately 149,865,000 hectares, out of this surface only 4572 hectares, that is 3.05% receive irrigation, this means that 97% of the crops depend on rain.

The aggregated value of the electrical, water and gas sectors, represent a constant price in 2004 of 264,000,000 dollars for Bolivia, 2651,000,000 dollars from Chile, 3,256,000,000 dollars for Colombia, 185,300,000 for Ecuador, 1429,000,000 dollars or Peru, and 2,861,200,000 dollars for Venezuela. The rate of dependence on water renewable resources has a total of 51.24% in Bolivia, 4.12% in Chile, 0.94% in Colombia, 0% in Ecuador, 15.53% in Peru, and 41.42% in Venezuela.

19 FAO, FAOSTAT, 2002
20 CEPAL, 2005
One of the cross cutting issues for the Andean region and particularly the countries being studied here are the impacts of the climate and consequently of el Niño event in the health sector. In the regions where normally el Niño causes precipitation deficits like in the north and center of Colombia, the center highland of Peru, the main impact is the access to water, which has a strong relation in this area with health, because this forces people to look for alternative sources of supplying and storage of water that finally end up in causing diseases. In the regions typically affected by the excess of rain like the coastal region of Ecuador, the north of Peru, the health issue is caused by two situations, one is the impact of the floods in the sources of storage of clean water, which contaminates this water, that is later on drank by people. The mixture of sewage water and clean water, are frequent when there are strong rains and floods. The other health issue is the generation of vectors of infective diseases like dengue, malaria, and other more complex diseases like cholera and leptospirosis.

To a regional level and as a result of numerous workshops in the region, common problems have been established that contribute to the vulnerability, one of them and possibly one of the most common ones and with more damage is the information management. Although, El Niño information, has been discussed better than it is been done previously, however there are still some problems to information about climate in rural sectors which are the most vulnerable and poorest ones. Therefore no matter how intense this event could be, this sector of the population will have the most direct impacts.

Despite the efforts carry out by public institutions in charge to provide services on climate information of high quality, resolution, reliability, and opportunity there has not been an acceptable balance between the demands and the climate information. Part of the problem resides on today’s limitations in the management, process and numerical models of the data obtained by the observational nets of public entities in these countries and the limited conversion process on technical or scientific information that can be efficiently applied to the users. By seeing all these limitations, nowadays there is still a lack of information among most of the users of the region on topics like climate variability, the ENSO and its effects.

Another factor of vulnerability with different level of influences in the countries from the Andean region is the lack of institutional coordination when it is time to discuss disasters and the different degrees of incorporation of risk management, in the national planning. On in this matter it is important to indicate that Colombia, Ecuador, and Peru have National Committees for the follow-up and early warning of the ENSO, coordinated by the CPPS into the ERFEN Program framework with different levels of influence in each country but with a institutional platform that can be linked to development and planning sectors. The limited land use and planning management to act in favor of the population established in the zones of high risk at the moment of a flood is still a common problem in these three countries, which means that it could be the main factor for a non-stopable circle of disaster-reconstruction-disaster, therefore causing underdevelopment in the region. The role of the Local Governments is very important in this matter, and even if there are some positive examples of positive intervention, there is still institutional weakness to execute successful policies of territorial ordering.


3.1 Colombia

To describe in a more graphic matter, the possible impacts in Colombia, the impacts of El Niño 2006-2007 have been synthesized (Table 1). Areas with the most historical affectation are mapped in Fig. 14. The current ENSO event, will have a probable intensity that ranges from weak to moderate, therefore the possibility of seeing an event like the one from 1997-1998 is discarded. However, according to the available seasonal forecast, deficit of precipitations is what is expected to be seen in Colombia. Compare to past years, the hydroelectric sector in Colombia is handling a whole prevention system for el Niño event. Therefore, the risk of
rationing is lower, but there is still a possible increase on the prices in the energy market for the first months of next year, which will have consequences on the population and their families’ economy. In Colombia the water supply for the population is done through two systems, 85% of the town councils use a gravity and pumping system which use shallow waters, and the other 15% of the town councils use underground systems, that take water from under the soil. From the last system mentioned 70% is located in urban zones with populations that range from less than 100,000 people.

The direct impact on the quantity, continuity, and quality in the supplying of drinkable water for the Colombian people has its origin in a probable decline of the usable caudal, associated with the deficit of precipitation, the increase of evaporation and the presence of high temperatures.

Because of the experiences from the past, before a regime of precipitation deficits associated with El Niño event, the problems of supply are generated in the sites where intakes are located. They use gravity to join to the aqueducts of the main cities and city councils. Depending on how serious the deficit is, the intakes are re-located, the material for water connection could get damaged, pumps can be closed by sediment, this can increase the expenses on chemicals for the treatment of these problems, accelerated damage of pumps, and removal of mud. Because of the low caudal, the pressure could diminish and affect the populations located in high grounds of the Colombian Atlantic Coast. A problem that the Colombian population would probably face in March, 2007, when the highest peak of rain occur, if the event continues in its development for this date, the rainy season in the North of Colombia could be delayed. The drought conditions, the high temperatures, and the evapo-transpiration could have a direct impact in water demand, forcing the extraction of water from other sources and a decline to extreme levels, which are added to the quality of the water. The livestock sector, would be potentially affected by the absence of water, this fact has historically caused bacterial and infectious diseases, as well as weight loss in the livestock, and even death. A chain effect is the generation of dairy products and the increase of the costs of production.

An important aspect to be considered in the case of Colombia, and a scenario of El Niño event is the vulnerability associated with hydrographic basins, specially because of the intervention processes that are a main characteristic in the Colombian territory, specially in the Cauca and Magdalena basins where 70% of the Colombian population lives. 40% of the country’s greatest basins represent vulnerability between moderate and medium, being the basins from this region the most affected ones.

The Energy Sector

In Colombia, the generation, transmission, and commercialization of electrical energy is done through a Interconnected Electrical system. There is a design system that supports itself on market performance. In other occasions, like El Niño 1991-1992, Colombia experienced a collapse in the interconnected electrical system which caused a serious rationing of electricity for more than 6 months, the current conditions have changed and the sector has a constant follow-up system of the climate evolution and the dynamic planning that allows them, to provide, supervise, reserves despite the precipitation deficit. Besides, the electrical sector has diversified in the whole country, reducing the dependence on hydro electrical generation on a 15%. The most important impact that can be taking into account is the increase in the energy prices if the El Niño event 2006-2007 extends into the month of April, 2007, this situation could be evaluated again on December, 2006. The increase on the price of electrical energy is linked to the increase in the costs of production and it could influence in the inflation and growth of Colombian economy for the year 2007, if all this is alternated with gas or carbon thermal centrals.

The Agriculture Sector

The possible impacts of el Niño event 2006-2007 in the agricultural sector, are estimated on a foreseen growth of the temperature of the air and precipitation deficit and its eventual delay from the months of March and April, 2007. The areas that would be mostly affected by the event in the Andean Region and the Caribbean which

26 Verbal Conference of National Center of Energy in Colombia, VI Climate Outlook Forum for Western South America, Armenia, Colombia, November 2006
represent 55% of the cultivated lands, 80% of the livestock and most of the dairy production at a national level. The direct impacts are the increase of sanitary problems, the reduction of farming yield and the increase of the prices of food for the final consumer.

On the other hand, there is also a possible chance to lose vegetable coverage and erosion of arid areas. When the conditions of the rain, temperature, and relative humidity are altered, this could generate a hydro stress in vast areas of the territory and negative effects on the development, performance, and sanitary levels in the different crops and the livestock. Among the crops that could be affected there are: coffee, corn, yucca, rice, banana, potato, cotton, ñogo, and sorgo.

In the Andean region, the range amplification between the highest and lowest temperatures could generate evaporation or frosts, like in the highlands from Cundinamarca and Boyaca departments, therefore causing physiological problems in the crops like the potato; in the case of the coffee these variations could affect the flourishing and the formation of the fruit.

The Ministry of Agriculture and Cattle from Colombia has identified the following agro ecological areas as vulnerable in the current climate scenario: Tolima - Huila, Cundinamarca – Boyacá, Santanderes, Cesar – Guajira, Atlántico – Magdalena – Norte de Bolívar, Córdoba – Sucre – South o Bolívar, Valle de Cauca, Nariño, Meta – Casanare – Arauca, Caquetá – Putumayo – Guaviare, Caldas – Risaralda – Quindío, Antioquia. The following crops are the most vulnerable from the most to the least vulnerable we have: cotton, rice, peas, onion, soybeans, vegetables, corn, potatoes, Sorgo, tobacco, yucca, along with other transitory crops27. The expected impacts in Colombia when facing el Niño 2006-2007 in cotton are shown in Tables 2 and 3.

The Forest Fires

Another factor to be considered as a potential impact is the high risk of forest fires, especially in the departments of Guajira, Cesar, Boyaca, Bolivar, Meta, and Tolima. In 1997-1998, these losses reached up to 52.3 million dollars28. It is believed that there might be forest fires in the Departments of Cundinamarca, Tolima, Antioquia, Caldas, North of Santander, Huila, Valle del Cauca and Bogota.

The Health Sector

In relation to the impacts in the health sector, the epidemiologic diseases, specially those diseases transmitted by vectors like the malaria, hemorrhagic dengue, classical dengue, among others, they will traditionally they will concentrate in the poorest rural and suburban areas of the region, that is the Caribbean and the Pacific, regions where there are the lowest indicators of sewage coverage, drinkable water, and in general they present the highest rates of unsatisfied basic needs. For the Caribbean region, the sewage coverage reaches 4% in rural zones and 52% in urban zones. In the Pacific Ocean region the sewage coverage reaches 22% in rural zones and 78% in urban zones.29

In Colombia, the dengue has become a epidemic disease in almost all the places located under 1800 meter under sea level. The event El Niño (Fig. 15) definitively presents a high risk of increasing the morbidity and mortality because of hemorrhagic dengue and classical dengue,

In the case of the malaria, it is strongly provoked by El Niño event, and high risk of increase is expected of cases in areas of Colombia typically affected by this vector. There is direct correlation between then most affected municipalities because of the restriction of drinkable water and the presence of the outbreak of the vectors.

27 Verbal Conference of Agriculture Ministry of Colombia, VI Climate Outlook Forum for Western South America, Armenia, Colombia, November 2006
The Institutional Framework

The planning constitutes one of the main functions of the public administration in Colombia, which is developed in different territorial areas. The National Plan of Development is proposed by the National Government and debated at the Congress to be approved as a law in a six-month period after the new government is established. In Colombia, there is a National Planning System that promotes the concordance and agreement between the plans and municipal, regional, and national programs. (Fig. 16)

The knowledge of the phenomenon and the hydro-meteorological hazards correspond to the Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM), entity appointed to the Ministry of Environment and legally framed in Law 99 of 1993 or the regulatory framework of The Environmental National System. The IDEAM operates a meteorological network integrated by stations that provides climate information and a hydrological network formed by stations that allow a permanent monitoring of the climate and hydrological conditions of the country and generate the necessary instruments for the authorities to activate the alerts about the occurrence of extreme hydrological events.

The Control Center of Contamination of the Pacific (CCCP), which depends on the Maritime Direction of the Colombian Navy, is another one of the entities that observe and studies the oceanographic conditions of El Niño event. Colombia has been participating in the Regional Study for El Niño Phenomenon (ERFEN) in the Permanent Commission of the Southern Pacific.

The Colombian institutions that are part of the Technical Committee of the ERFEN are the: The Oceanographic and Hydrographic Investigation Center (CIOH), The Center of Contamination Control of The Pacific (CCCP) The University of the Valley, and the IDEAM. This committee is coordinated by the Colombian Oceanographic Commission, which works directly with the National Colombian section of the CPPS.

In relation to the permanent institutional framework and the knowledge of vulnerability and risk, the autonomous regional and sustainable development corporations (CAR) are the organisms of the Environmental National System with jurisdiction for the different departments and regions; the main goals is the protection of the environment and develop techniques to recognize the risks at a departmental level. The Autonomous Regional Corporations are part of the different Department committees for prevention and attention of disasters.

When the earthquake of Popayan occurred in 1983 and the volcanic disaster that destroyed the city of Armero in 1985 took place the National Government worked on new ways of oriented organization in order to improve the institutional framework at the time of facing disasters.

One of the first action taken was the conformation of the Emergency National Office (ONAE). The presidential office and the approval by the Congress of Law 26 from 1998 and later the Decree 919 from 1989, constituted the base for the creation of the National System for the Prevention and Attention of Disasters.

Colombia has a relatively robust and coherent disaster risk management system which could need some support to integrate several valuable components into a National and inter sectoral framework which coordinates actions and ties the capabilities bases on a National Climate early Warning system and a National Planning Department.

Lessons Learned from the Risk Management Related to the ENSO in Colombia30.

The following are the lessons learned from el Niño 1997-1998 in Colombia:

1. The limited participation of the National System for the Prevention and Attention of Disasters in the management of the disaster and its institutional weakness in engaging the other institutions and be recognized as a coordinator in case of a disaster.

2. There were disagreements about the competition and the institutional relation between the Environmental National System and the National System for the Prevention and Attention of Disasters.

3. The National Government did not recognize the National Committees of Emergency and the National System for the Prevention and Attention of Disasters, ordered by a law, but they created a new unit that was only temporary.

4. Mutual interferences between Ministries during the emergencies.

5. The need to define formal rules that balance the relation between institutional sectors, especially the SNPAD with the environmental, agricultural and health systems during the emergency.

6. The National System for the Prevention and Attention of Disasters, as a coordinating entity of the national system, was oriented to the arrangements for the emergency and operational measures, it was slow at the moment of respond and it lacked a technical capacity to promote institutional answers for the territory.

7. There was no relation between the System and the sectoral management.

8. The IDEAM had a relevant role in the issue of an early warning; however a lack of coordination was evidenced between the scientific entities and the lack of mechanisms and rules for the broadcasting of the information.

9. It was evident that the information on risks in not part of the national institutional framework at the time to take decisions and handle the emergency.

10. It was evident the need to increase the scientific knowledge and the observational capacity of el Niño event.

### 3.2 Ecuador.

To describe in a more illustrative way the potential impacts of the ENSO in Ecuador, the potential sectoral impacts of el Niño 2006-2007 Ecuador (Table 4), have been summarized and the areas with historical damage have been mapped (Fig. 17). These references are from the events of 82-83 and 97-98 in Ecuador, the losses show a common pattern.

**The Agricultural Sector**

Considering an El Niño event that ranges from weak to moderate, even if we talk about a normal rainy season, the agricultural sector, which is the most vulnerable one in Ecuador, is the one that reports the highest damage historically (Table 5). This is a proof that the cause of most of the disasters in Ecuador is the lack of adaptation that the society has to the climate. Of all the damage caused 41% is due to ENSO 82-83, 86-87, 91-92, 97-98, 02-03. Therefore, 59% occurs because of other climate events which have no visibility.

In the case of El Niño event, the probable impacts deal with floods, especially in the provinces of Manabi, Los Rios, and Guayas, but there might also be eventual floods in El Oro. Crops that might be affected the most are: rice, corn, cotton, soybean, and sugar. It is believed that the most impacted sector will be the smaller farmers, especially because of the little access to information they have and the lack of technical support to generate other alternatives.

**The Infrastructure Sector**

Taking into consideration, the most probable scenario and the potentially flooded rural areas on the coast, the lost of infrastructure could be associated with two factors, one are the floods that would partially affect the main roads, with moderate impacts, but the effects on secondary roads could be really serious, especially in Manabi, Los Rios and Guayas. This would isolate farmers and they wouldn't be able to sell their products and this at the same time would mean expenses for the attention of emergencies and the damage of bridges that have not received maintenance. The other factor to be considered in the damage of roads is the mud slides, especially in the zones of Esmeraldas, central zone of Manabi, Guayas, and El Oro. This removal of soil and mud would threat the main road system and important suburban areas in unstable zones that have a well-known high risk.

**The Health, Educational and Housing Sectors**

The social sectors of Health, Educational and Housing historically present a low percentage of losses compared to other sectors, however the implications in the population and the crisis that follow have not been estimated
from a social point of view and neither has its economical impact. In the case of the health sector, and despite
the fact that Ecuador has shown great progress on this area at the time to prevent these vectors, they will show
up. Before the scenario of the expected climate, it is believed that cases of classical and hemorrhagic dengue,
malaria, leptospirosis, and eventually cases of cholera will appear in marginal urban populations. In the case of
the housing sector, the rural zones of the Ecuadorian coast have experienced an intense migratory dynamic in
the country. This means, that new settlements in zones of high risk caused by floods have appeared, without
any consideration of prevention actions in the construction of the houses in the country side of the coast, like
the pillars of the houses. One of the reasons why this happens is the lack of knowledge these new inhabitants
have of their new territory.

In this same context, it is worth mentioning that historically in Ecuador, the disasters are distributed this way:
60% in the 5 provinces of the coast, 32% in the 10 provinces of the highlands, and 8% in the Amazon region
and Galapagos,. In Table 6 there are event that are related to hydro-meteorological phenomenon at canton
level that show the first degree of damage. The tendency to register more disasters occur in the cantons with
more population and investment, which does not reflect the intensity of the hydro-meteorological events but the
incapacity to adapt to the environment and the weaknesses at the moment to face these events.

The percentage of disasters in the ENSO is less than 50% in the reports by the 7 cantons identified to have
higher impact rates, being Quito and Cuenca the ones that present the lowest percentage. In Esmeraldas,
Portoviejo, and Quito, there are the same proportion of floods and mud slides. In the case of Chone, Babahoyo,
Machala, and Guayaquil the problems that exist are caused by floods and present a low percentage of mud
slides, except for Machala that shows a tendency to diminish disasters and Quito and Babahoyo maintain a
tendency to a permanent impact rate which gets worst when they face these events

Table 7 presents the percentage of losses by sectors in the cantons with the highest impact rates and in Table
8 is shown the progress achieved in the development sectors based on risk management.

The Transference of Climate Risk in Ecuador

In the agricultural sector, the risk transfer is weaker. There is no confidence in this mechanism, in spite that
private insurance companies offer protection products to the plantations in case of a natural threat. There
seems to be more interest when the insurance companies offer protection of the potential production, instead of
covering the plantation at the moment of the disaster, buy this type of insurance requires an better quality
during the productive process, which is convenient from the perspective of risk management, but it is complex
to carry out due to the need to modify conducts, practice and technologies.

In the fishing sector, is common to insure boats, specially the ones from the fishing fleet that belong to big
companies.

The big companies of drinkable water ad sewage insure the infrastructure and material therefore, setting an
example to smaller companies.

In matters of roads and transportation there is no insurance for the infrastructure of the roads. The roads that
are under concession have insurance in case of an accident.

In the housing sector the big municipalities insure all the infrastructure and properties, but this does not happen
in smaller ones.

In the bigger cities the insurance market for houses and belongings is more dynamic; they are hired by people
with more economical power.

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31 DESINVENTAR considers floods, land slides, rainfall, thunderstorms, store surges, sedimentation, frozens, droughts, heat
waves and others.
In health, the development of private health insurance has increased in the last 10 years and the growth is sustained, but it is only for bigger cities.

The infrastructure in health and education, are not protected.

Most of the energy sector is protected.

In the industrial sector, the big and mid-size companies usually hire insurances to protect their facilities. This does not happen with smaller companies.

There is a behavior pattern, in which there is a direct relation between the more economic capacity people the more insurance they hire. There is a need to educate the population on the transfer of risk and benefits. Also there is a need to propose insurance mechanisms that reach the lowest economies, like state insurances, community insurances, and provisional cooperative funds, among others.

It is strongly recommended to start actions at Governmental level in Ecuador to implement public/private mechanisms for climate risk transference, accompanied of a well structured strategy for awareness and promotion of cost benefits of risk mitigation and transfer, including the private sector and small farmers. The new Government authorities could be an opportunity to refresh new initiatives. It is important to tie the National risk management agenda with the Sustainable Development Agenda in Ecuador, which implies to put together new actors and institutions.

Institutional Framework

In Ecuador the GNGR, which is called by the INECI, that coordinates it, for the implementation of the resolutions of the Hyogo Framework, 2005. It is formed by the INECI, National Direction of Civil Defense (DNDC), the Ministry of the Environment, SENPLADES. It is an ad-hoc group. Despite Government has expressed interest on institutionalize it, is strongly recommended to implement new actions with the new authorities to formalize it, so its actions acquire strength and can become a formal cell of a national system for risk management.

SENPLADES is the national planning office. It has established an important group of sectors in risk management: agriculture/fishing, water/sanitation, roads/transportation, housing, health, energy, education. It has elaborated the sectoral plans of energy, health, water/sanitation that are built based on ad-hoc sectoral structures called Sectoral Committees. The influence of SENDAPLES in the state structure is very limited. It does not have the legal mechanism to interfere in the sub national governments and the municipalities and it cannot interfere to the annual budget assigned directly to the Ministry of Economy and Finances.

The DNDC is the entity that rules the National System of Civil Defense. It is made up of 22 provincial councils and each council has been responsible for the conformation of the Canton Councils that are structured formally since El Niño event 97-98. Most of the Canton Councils on the coast are working. The system counts with a logistic center in each province. They are supplied in a very heterogeneous way. At the time to prepare emergencies, the DNDC works closely with the Ministry of Education. The field of natural disasters has been part of the educational curriculum for over a decade now.

The structure of the system is more decentralized, but its budget has been reduced, at a point that it cannot fulfill its permanent activities, its performance en certain activities now depend on project financed by international entities, especially in the strengthen components of the Canton Councils and Provincial Councils and the training of adults.

32 Grupo Nacional de Gestión de Riesgo
33 Instituto Nacional de Cooperación Internacional
34 Secretaría nacional de Planificación y Desarrollo
On one hand, the transformation of the COPEFEN into a directing entity in risk management and the development of the PREANDINO project in SENPLADES has disturbed the communication between these entities and the DNDC.

COPEFEN is one of the national entities whose main objective is finance with international funds (condition that shows weakness in the creation of this organism) the identification of threats, works on mitigation, and the requirement of reconstruction by the governments of the provinces, and municipalities. Right this institution does not have resources for investment.

CORPECUADOR is another one of the entities, created as the result of the reconstruction after the event 97-98. This entity was the result of a political agreement that was trying to obtain financial resources that were not captured by the COPEFEN to finish with the reconstruction process until the year 2008. This institution counts partially with its own finance. The execution of the Master Plan requires 3 billion dollars. Up till now, 20% of the 1600 million dollars have been executed, which was only directed to infrastructure and up to the year 2008 40% will be executed.

Guayas is one of the most affected cantons by the ENSO. Since January 97-98, the city council took the decision to include in its political agenda the risk management, but from a preparation for emergencies point of view. Through a decision of the city council the Risk Unit was created, and it is directed by the Multi sectoral Commission formed by representatives of all the municipalities departments and presided by the Canton Development Planning Direction

ERFEN is a government program, integral and multi-disciplinary for the regions study of the ENSO, in the meteorological, oceanographic, biological – marine and biological-, and fishing fields. In Ecuador, INAMHI, INOCAR, INP, ESPOL, and the Civil Defense participate here. The performance of the ERFEN in Ecuador is influenced by the dynamic that the INOCAR has, which is the organism that presides it. The contributions to the international community are subscribed to the periodic evaluation of the climate and the ENSO and that is built with the support of all the institutions that form the ERFEN. This is an environment of coordination more than an investigation.

INOCAR is an organism that is part of the Navy, this institute carries out oceanographic investigation and they spread ocean-meteorological information. It also produces oceanographic information for the country. On the coastal region of Ecuador, the institute is identified and the source of meteorological information, however this is not its mission, it counts with important technological facilities, however it requires experts on the climate issue and numerical modeling to improve its forecast. Among the most important facts that can be considered for the formation of a net of 45 radio stations of all the Ecuadorian coast and Galapagos which would daily be informed by the INOCAR. Despite this initiative, which is free, it is not used appropriately to inform the population.

INAMHI counts with 67 climate conventional stations and 28 that are automatic for the meteorological control. For the hydrologic control, there are 118 hydrologic stations working. The maintenance of these stations is directly done by the INAMHI, the logistic support is given from Quito, it has a regional office in Guayaquil with many limitations of personnel, logistics, and service. The INAMHI has a very centralized structure that limits its action considerably, on the Ecuadorian coast. This institution needs to incorporate professional with high academic preparation in their fields of expertise to produce research to improve the forecast services.

INP develops marine biology investigations to rationalize the use of fishing resources. The investigations done here are based on the oceanographic data that the INP itself register through cruises that it organizes, besides from the information it receives from fishermen and the big fishing industries. It's an important scientific part of the controlling State; however its potential is not fully used in benefit of the sector. The INP presents the government all its investigations along with recommendations. The management of resources passes through a negotiation process; the government doesn't take advantage of this information. The analysis of this information is shared with the Fishing Chamber, the Civil Defense and the ERFEN
ESPOL maintains a modest role in the work done by the National ERFEN, and it is nor performing any investigations that would contribute to the improvements the capacity of prediction at a national level. There is a great distance between this and other universities with the operational centers that have the obligation to follow this topic. There is a need to promote an effective interaction process between the academic and operative sectors and in favor of the national interests.

Lessons Learned from the Risk Management Related to the ENSO in Ecuador

1. The experience of the El Niño event 97-98 was carefully documented and it would seem enough as to establish policies and strategies directed to diminish the effects of a future El Niño event. There have been some changes; however there hasn’t been a sustainable development in the different aspects of the institutional framework.

2. The institutions that generate knowledge of the natural phenomenon strengthen their monitoring capacity; however there was no academic improvement for their staffs.

3. The producers of information of the social and economic sciences are not integrated in the construction of vulnerability knowledge; as a consequence there is no agreement between the natural and social aspects to produce applied knowledge necessary for a better work.

4. The universities understand the topic of risk management from the perspective of preparation and attention, which are their main roles. They are not ready to be part of the institutions that produce knowledge, in order to carry out the climate risks for the development. Besides, the preparation for investigation is weak, which is something that influences negatively on a topic that requires these abilities.

5. Political decisions were taking while trying to incorporate a risk reduction in the national institutions, however this generated problems in the structure of preparation and response, it has also weaken some institutions in their development. This institutional confusion has generated reactions that are clear in many proposals for the creation of a National System of Risk Management, which been inter-sectorials and with no centralization differ in their objective (DNDC, COPEFEN, SENPLADES).

6. At a local level, in most of the municipalities, the reduction of risk is not part of their institutional agendas and there seems not be political will to include it. The municipalities affected by El Niño ask for financial support for the mitigation works, because they do not consider these needs as an investement as part of their annual budget. One of the limitations to incorporate the topic of risk reduction at a local level is the lack of knowledge about political profits when the subject is fully understood.

7. The institutions that work from a basin experts point of view are growing weaker, this is the case of CEDEGE in Guayas. The responsability of the basin management has been appointed to the Councils of the Provinces, without any technical nor financial aid.

8. The media, especially radio stations and the written press are asking for more information on climate forecast.

9. In reconstruction, ad-hoc institutions are created to manage additional funds, because the financial organism require it or because of local political agreements. These entities become permanent, therefore becoming part of the structure of the state and later falling into the established system.

10. However, the national finance entities, like the Ecuadorian Bank for Development (BEDE) and the Ministry of Economy and Finance (MEF) reproduce the patterns of traditional investments which in the areas exposed to hydro-climate events are not sustainable.

11. Most of the initiatives involved with Risk Management are financed by International Cooperation Agencies, since the national planning up to the contingency plan of the municipalities.
12. The social sectors that are traditionally engaged with risk management are not enough. There are other key sectors that are not incorporated to the process.

3.3 Peru

To describe in a more illustrative way the potential impacts of the ENSO in Peru, the potential sectorial impacts of el Niño 2006-2007 (Table 9) and the areas with historical damage have been mapped (Fig. 18).

Considering the current scenario, it is expected above normal rainfall and probable floods in the departments of Tumbes and Piura that will affect banana and rice crops. There might be a reduction on the production of rice in Piura, Lambayeque, San Martin, Loreto, and Arequipa. There might be effects on the yellow corn on the northern and central coast, and the high jungle. There are high probabilities that there will be plagues in the potato crops in the highlands, specially in Huanucom Junín, Puno, Cuzco, Arequipa, and the central coast. There might problems with the citrins and fruit in the northern and central coast, there would be an important diminish in the production of asparagus, sugan cane, and mango in the zones of Ica, La Libertad, Lambayeque, and Piura.

The Health Sector

There might be a probable problem in the health services because of damage in the infrastructure caused by rain in the northern part of the country. It is also estimated a posible outbreak of endemic diseases in the regions affected the most by rain, these diseases might be the clasic and hemorrhagic dengues, malaria, and cholera. In general, there is chance of an increase in the epidemiologic risk.

The Infrastructure Sector

There might be some damage in the main roads and secondary roads systems, and also in the lines of distribution of electrical energy in the in the zones affected the most by rain. It is estimated possible landslides in hills of the departments of Apurimac, Cuzco, Junin, and San Martin that could affect human settlements.

In Table 10 are shown the emergencies associated with the effect of El Niño event in Peru, what is perceived as a recurring impact pattern: floods, intense rains, and landslides which are the ones that affect people the most, without considering the impact of the outbreak of epidemics. In Table 11, according to historical analysis, there is a geographical zonification of the impacts, which allows to do a focused prospection on the departments that have been affected the most by El Niño, keeping the proportions with the ENSO 2006-2007, because of its probable intensity which is from weak and moderate.

The Institutional Framework

In Peru, the institutional organization for the prevention and attention of disasters is framed in the National System of Civil Defense –SINADECI35, the SINADECI is conceived as an interrelated group with public and private organisms, organized population, norms36, and resources, that are oriented to the protection of the population in the occurrence of natural or anthropogenic disasters.

After the experience with El Niño Phenomenon in the years 1997-1998, there has been progress in the conformation and establishment of coordination mechanisms of the prevention and attention of disaster activities. For the coordination at a national level of the acions and execution of the projects related with the prevention and rehabilitation, in the year 200237, the Multisectorial Commission for Prevention and Attention of Disasters –CMPAD, was created.

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35 Created in 1972 by Law No. 193338
36 To this norm has been added other derived from descentralization which took place during the last five years and state transference and activation of prevention, management and response to disasters: Law No.27867, 2002, Art. No. 61.
37 Done with Supreme Decree No. 081 from Ministries Pesidence
The participation of the sectors in the actions of civil defense takes place through the execution of prevention plans, work for disasters, or imminent danger, and emergent labor and rehabilitation. The representatives of the organisms and institutions of international cooperation (Certified Embassies in the country, public and private institutions) and National and International Non-governmental Organizations that have resources from international cooperation and that operate in topics related to the prevention and attention of disasters, they are integrated to the SINADECI through the Consultive Council of International Relations. Besides, they are part of the Committees of the Civil Defense.

It is necessary to point out that the SINADECI, counts with a National Plan of Prevention and Attention of Disasters, approved by DS N° 001-A-2004-DE/SG, that defines in the scope of the institutions that are part of the SINADECI, the formulation of strategies, actions, programs, and instruments for the management at a sectorial, regional, and local sectors. Right now, they are in the process of elaboration of The plans of Prevention and Attention of Disasters to a Sectorial, Regional, and Local Level. It is the responsibility of all the parts the formulation and implementation of these plans. These plans are not linked to the national and local planification processes development, there is not an institutionalization that direct this topic at a national level, since there are isolated efforts from some institutions. In the last decades, the most important institutions in charge of this topic have been disabled, for example: The National Planning Institute and the National Institute of National Urban Development.

In Peru, the institutions in charge of the knowledge and study of el Niño Phenomenon, are grouped in the Multi-sectorial National Committee in charge of the National Study of el Niño Phenomenon – ENFEN.

It is made up by the Institute of the Sea of Peru – IMARPE; The Meteorologic and Hydrology National Service of the Peruvian Navy – DHN -; The Geophysical Institute of Peru – IGP-; The National Institute of Natural Resources –INRENA, and the National Institute of Civil Defense –INDECI. The ENFEN is part of the Program “Regional Study for El Niño Phenomenon” ERFEN, formed by the countries that are members of the Permanent Commission of Southern Pacific –CPPS.

The institutions that are part of the ENFEN, handle different concepts and definitions about El Niño, there are many different criterions discussed and definitions that are not uniformed, at a national and international level and even inter-institutional one, causing disagreements and confusion in society in general.

Another limitation is the one that deals with the lack of exchange of information, methodologies in a better risk evaluation (damages, losts, victims) and the impacts caused by el Niño.

Just like it happens at a regional level, in the ENFEN there is no agreement in the definition of what the ENSO is between institutions.

As a priority issue for Peru, the country needs a more comprehensive national plan for Institutional coordination and have a National Planning Entity that assumes this role.

Lessons Learned from the Risk Management Related to the ENSO in Peru

1. The Multi-sectorial commission of Prevention and Attention of Disasters – CMPAD, is only dedicated to the rehabilitation and preparation topics in the case of a disaster.

2. There is inequality on the matters of organization and preparation to cope El Niño event between the regions in Northern Peru, specially Piura that represents a major resilient factor.
3. There does not exist a strategy of production, diffusion, and communication of climate information that considers the demands the different types of users and the scales of analysis that exist in the country.

4. The decision-making organisms in the field of development planning, do not take advantage of the available climate information.

5. There is no consensus between the scientific institutions at a regional level (ERFEN) and national level (ENFEN) about the definition and concept of the ENSO.

6. The different actors, at a national and sub-national levels relate the climate information more to emergency and disaster topics than to topics related to the development planning.

7. The main disagreements between taking decisions about the use of the soil in the urban areas and the information about El Niño, occur for the influence of political interests and the speculation of land properties by some authorities.

8. The actions of non-governmental Organisms in topics related to the knowledge of the impacts of El Niño is very important to the strengthen of the local abilities.

4. Recommendations for the Actions of the Bank

4.1. Identification of the problems at a regional scale

- Absence of policies and alternatives of implementation for the territorial management.
- Weakness in the local governments in the management of climate risk.
- Limited interaction between the sectors that have the knowledge and their institutional framework with the levels of planning and other sectors of development
- Limitations in the management of climate information in the most vulnerable populations.
- Limitations in the implementation of mechanisms of transference of climate risk.
- Scarce involvement of the private sector in risk management
- Cultural resistance that limits the perception of climate risk and its management in the rural sector.
- Limitations of the human resources in the institutions that provide climate information.
- Limitations in the systems of climate early warnings.

4.2 Identification of the development sectors that will probably be affected.

The sectors to be affected and arranged in terms of estimated impacts are:

AGRICULTURAL AND CATTLE SECTOR (Colombia, Ecuador, and Peru)
HEALTH SECTOR (Colombia, Ecuador, and Peru)
INFRASTRUCTURE SECTOR (Ecuador and Peru)
ROAD SECTOR (Ecuador and Peru)
ENERGY SECTOR (Colombia and Peru)

4.3 Action Lines recommended for the IDB

Action Line No. 1: Territory management

Problem to be faced: Absence of policies and alternatives in the implementation for the territory management.

Geographical Area: Hydrographic basins of el Cauca and Magdalena (Colombia), Chone and Guayas (Ecuador), and Tumbes (Peru).
Sector of Development to be assisted: Agriculture and cattle raising sectors, infrastructure and road sectors, water and sanitation sectors.

Time to achieve results: medium term

Anticipated products of the intervention:

Territorial arrangement, reduction of the social and economical impacts associated with floods and droughts, involvement of the private sector and relevant parts in the management of hydrographic basins, strengthen of local governments.

Working mode or framework of the bank for effective interventions and improved responses:

There will have to be joined work with the corporations and institutions in each country, that are in charge of the hydrographic basins, emphasizing the intervention in territory ordering and risk management, through the local governments and their plans of development as well as the harmonization of policies for the sustainable development in the geographic context of the hydrographic basin.

Financial Instruments and facilities in Risk Management of the Bank to be applied:

Regular loans
Disaster Prevention Fund
Discrete Technical cooperations

Action Line No. 2: Local Governments Strengthening

Problem to be faced: Weakness of the local governments in the climate risk management.

Geographical Area: Small municipalities of the Atlantic coast of Colombia, the coast of Ecuador, and northern and southern highland of Peru.

Sector of Development to be helped: Agriculture and cattle raising sectors, infrastructure and road sectors, water and sanitation sectors, education

Time to achieve results: medium term

Anticipated products of the Intervention:

Strengthen of local governments, improved capacity in the climate risk management at a local level, territorial ordering, reduction of the social and economical impacts associated with floods and droughts, involvement of the private sector and relevant social and economical actors.

Working mode or framework of the bank for effective interventions and improved responses:

The work will be done along with the small municipalities in the implementation of the processes that will direct them to improve the management of climate risk, helping with the elaboration of plans of development, the involvement of important sectors and community leaders, the private sector and specific actions on the territorial ordering and improvement of the flow of climate information for decisions making.

Financial Instruments and facilities in Risk Management of the Bank to be applied:

Regular loans
Disasters Prevention Fund
Sectoral Facility for Disasters prevention
Discrete Technical cooperations

**Action Line No. 3: Strengthening of Inter Institutional Coordination**

**Problem to be faced:** Limited interaction between the sectors that have the climate knowledge and their institutional framework with the levels of planning and other sectors of development

**Geographic Area:** Colombia, Ecuador, and Peru.

**Sector of Development to be helped:** Agriculture and cattle raising sectors, infraestructure and road sectors, water and sanitation sectors, education and energy sector.

**Time to achieve results:** short term

**Anticipated products of the Intervention:**

Creation of a direct mechanism of communication between the National ERFEN Committees, the Planning Offices and the ministries in charge of the development sectors that are more vulnerable. Strengthen of the ERFEN National Committees in each country.

**Working mode or framework of the bank for effective interventions and improved responses:**

The work will be done along with the Permanent Commission of the Southern Pacific and the ERFEN National Committees to implement an interaction process with the other sector of the government and formalize procedures for the flow of information, decision-making and feedback of impacts, experiences, and measurement indicators.

**Financial Instruments and facilities in Risk Management of the Bank to be applied:**

Disasters Prevention Fund
Sectoral Facility for Disasters prevention
Discrete Technical cooperations

**Action Line No. 4: Strengthening of Climate Information management**

**Problem to be faced:** Limitations in the management of climate information in the most vulnerable populations.

**Geographical Areas:** Atlantic Coast and the coffee production territory, coast region of Ecuador, Northern part of Peru and the central and souther highland of Peru.

**Sector of Development to be helped:** Agriculture and cattle raising sectors, infrastructure and road sectors, water and sanitation sectors, education and health sectors.

**Time to achieve results:** short term

**Anticipated products of the Intervention:**

Regional networks of climate information. Agreements with rural media and local governments for the permanent flow of information. Training for trainers in charge for the use of climate information and decision making in rural communities.

**Working mode or framework of the bank for effective interventions and improved responses:**
The work will be shared with the local governments, the institutions that provide climate information, the mass media in rural sectors, the private sector, community leaders, ONG’s and important parts to establish a mechanism for the flow of climate information that can be sustainable as time passes by.

**Financial Instruments and facilities in Risk Management of the Bank to be applied:**

- Disasters Prevention Fund
- Sectoral Facility for Disasters prevention
- Discrete Technical cooperations
- Regional Public Goods

**Action Line No. 5: Implementation of financial mechanisms for risk transference**

**Problem to be faced:** Limitations in the implementation of mechanisms of transference of climate risk.

**Geographical Areas:** Small municipalities in the Atlantic Coast and the coffee production territory of Colombia, coast region of Ecuador, Northern part of Peru and the central and souther highlands of Peru.

**Sector of Development to be helped:** Agriculture and cattle raising sectors.

**Time to achieve results:** medium term

**Anticipated products of the Intervention:**

- Involvement of the local governments in transferring the climate risk.
- Implementation of mechanisms of climate risk, incentives to the rural capitalization and lines of credit for work and investment.
- Training for trainers in peasant communities.

**Working mode or framework of the bank for effective interventions and improved responses:**

- Establish a close coordination with the local governments, national entities that provide funds for the agriculture sector, and banks of the rural sector, financial mechanisms that allow, the partial or total transfer of the climate risk.

**Financial Instruments and facilities in Risk Management of the Bank to be applied:**

- Regular loans
- Disasters Prevention Fund
- Sectoral Facility for Disasters prevention
- Discrete Technical cooperations

**Action Line No. 6: Institutional Strengthening**

**Problem to be faced:** Limitations of the human resources in the institutions that provide climate information.

**Geographical Areas:** Colombia, Ecuador, and Peru.

**Sector of Development to be helped:** Knowledge

**Time to achieve results:** Medium term.

**Anticipated products of the Intervention:** Critical Mass of experts on oceanography and meteorology, specialized at a post-graduate level in climate prediction, oceanography, and systems of information.

**Working mode or framework of the bank for effective interventions and improved responses:**
Finance, under an institutional scheme specialized post-graduate studies, for the experts of IDEAM, CCCP in Colombia, INOCAR and INAMHI in Ecuador, SENAMHI, DHN, and IMARPE in Peru, and ensure the necessary formal mechanisms, so these experts return to their specific technical functions in their own institutions after their academic preparation.

Financial Instruments and facilities in Risk Management of the Bank to be applied:

Regular loans
Disasters Prevention Fund
Sectoral Facility for Disasters prevention
Discrete Technical cooperations
Regional Public Goods

Action Line No. 7: Institutional Strengthening

Problem to be faced: Limitations in the systems of climate early warnings.

Geographical Areas: Colombia, Ecuador, and Peru.

Sector of Development to be helped: Knowledge

Time to achieve results: medium term

Anticipated products of the intervention:

Strengthen of the national systems of climate early warning. Improvement and/or implementation of the information systems. Definition of the climate indicators and national protocols to announce alerts of El Niño event. Climate and oceanographic retrospective studies and related to the historical impacts to determine the cause and effect relations. Implement models for climate and oceanographic predictions.

Working mode or framework of the bank for effective interventions and improved responses:

Finance through Scientific and operational institutions, the development of the information systems with new technologies, also the technical research that will allow national operational definitions of El Niño in terms of national impact, apart from a substantial improvement in the ability to climate and oceanographic modeling at a national scale.

Financial Instruments and facilities in Risk Management of the Bank to be applied:


Action Line No. 8: Local Communities Capacity Building

Problem to be faced: Cultural resistance that limits the perception of climate risk and its management in the rural sector.

Geographical Area: Atlantic Coast and the coffee production territory in Colombia, small municipalities of the coast region of Ecuador, Northern part of Peru and the central and souther highland of Peru.

Sector of Development to be helped: Agriculture and cattle raising sectors, education, health, water and sanitation sectors as well as the infrastructure sector.

Time to achieve results: Medium term.
Anticipated products of the Intervention:

Training of a basic instructional model for trainers from rural communities. Basic educational material. Empowerment of the educational processes in the management of climate risk through local governments.

Working mode or framework of the bank for effective interventions and improved responses:

Finance through local governments permanent training campaigns to community trainers, based on a basic instructional module and support material that will allow to give this knowledge a social point of view in relation to the benefits that will get by using the climate information in the development activities.

Financial Instruments and facilities in Risk Management of the Bank to be applied:


**Action Line No. 9: Risk Maps and Identification needs**

**Problem to be faced:** Compilation and systematization of risk maps and needs in three countries that have already worked on by previous national and international initiatives.

**Geographical Area:** Hydrographic basins of el Cauca and Magdalena (Colombia), Chone and Guayas (Ecuador), and Tumbes (Peru).

**Sector of Development to be assisted:** Agriculture and cattle raising sectors, infrastructure and road sectors, water and sanitation sectors.

**Time to achieve results:** immediate

**Anticipated products of the Intervention:**

National and regional cartographic and data bases.

**Working mode or framework of the bank for effective interventions and improved responses:**

National inventories of previously generated risk maps in Colombia Ecuador and Peru and identified need in tens of national workshops and previously initiatives.

**Financial Instruments and facilities in Risk Management of the Bank to be applied:**

Regular loans
Disaster Prevention Fund
Discrete Technical cooperation
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<thead>
<tr>
<th>Sector and Sub Sector</th>
<th>Total impact (million US$)</th>
</tr>
</thead>
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<tr>
<td>Services</td>
<td>309.5</td>
</tr>
<tr>
<td>Water and Sewage</td>
<td>1.8</td>
</tr>
<tr>
<td>Electricity generation</td>
<td>307.7</td>
</tr>
<tr>
<td>Health</td>
<td>40.9</td>
</tr>
<tr>
<td>Ground Transportation</td>
<td>5.9</td>
</tr>
<tr>
<td>Marine Transportation</td>
<td>2.0</td>
</tr>
<tr>
<td>River Transportation</td>
<td>3.9</td>
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<tr>
<td>Productive sectors</td>
<td>148.6</td>
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<tr>
<td>Agriculture</td>
<td>101.1</td>
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<td>Catering</td>
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<tr>
<td>Industry</td>
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<tr>
<td>Other Sectors</td>
<td>58.6</td>
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<tr>
<td>Forest fires</td>
<td>52.3</td>
</tr>
<tr>
<td>Houses</td>
<td>3.5</td>
</tr>
<tr>
<td>Medical emergencies</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>NATIONAL TOTAL</strong></td>
<td><strong>563.5</strong></td>
</tr>
</tbody>
</table>

Table 1 (b). Estimated impacts of El Niño 2006-2007 event in Colombia, considering the probable intensity of the event and historical impact patterns in Colombia. Sources: Food and Agriculture Organization, FAO, Revista Panamericana de la Salud, Desinventar Database, La RED, Organización Panamericana de la Salud, OPS, Centro Regional de Información Sobre Desastres, CRID, Defensa Civil Colombiana, 2006

<table>
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<tr>
<th>DROUGHTS</th>
<th>OCEANICS</th>
<th>AGRICULTURE</th>
<th>ROADS / ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Droughts in Valle del Cauca, Caldas, Casanare, Guaviare, Vichada, Arauca, Choco, Antioquia, Santander, Norte de Santander, Tolima, Magdalena, Huila, Córdova and Nariño. Possible floods in Valle de Cauca at the Municipio El Cerrito. Possible forest fires in Cundinamarca, Tolima, Antioquia, Caldas, Cauca, Norte de Santander, Huila, Valle del Cauca and Bogotá.</td>
<td>Some coastal zones of the pacific coast affected by high tides and far storms, specially in Tumaco, Buenaventura, El Charco, Santa Bárbara, Fco. Pizarro and Bahía Solano.</td>
<td>Low precipitation in the northern region. Decrease in fruits production, vegetables, cereals, specially corn, decrease in cereal seeds availability. Affectation in the coffee crops quality and grass quality. Possible plagues in potatoes and vegetables crops in Boyacá, Cundinamarca, Quindío, Caldas, Huila and Risaralda. Possible decrease in milk production.</td>
<td>Possible damage of roads and secondary ways at southern area.</td>
</tr>
<tr>
<td>Cultivo</td>
<td>Departamento</td>
<td>Área Sembrada 2006 (ha)</td>
<td>Lluvias muy por debajo de lo normal</td>
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<td>---</td>
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<td></td>
<td>Bolívar</td>
<td>1.822</td>
<td>19.9%</td>
</tr>
<tr>
<td></td>
<td>Cauca</td>
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<td>96.7%</td>
</tr>
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<td></td>
<td>Cesar</td>
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<td>4.7%</td>
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<td>Córdoba</td>
<td>20.617</td>
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<td></td>
<td>Huila</td>
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<td>Meta</td>
<td>863</td>
<td>2.0%</td>
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<td>Sucre</td>
<td>3.304</td>
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<td></td>
<td>Tolima</td>
<td>14.979</td>
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<td>Valle del Cauca</td>
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<tr>
<td>Total</td>
<td></td>
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<td>25.9%</td>
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Table 2. Historic percentage of area affected according to rain level for cotton, in Colombia. Source: Ministerio de Agricultura y Ganadería de Colombia, 2006.

<table>
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<tr>
<th>Cultivo</th>
<th>Departamento</th>
<th>Área Sembrada 2006 (ha)</th>
<th>Lluvias muy por debajo de lo normal</th>
<th>Lluvias moderadamente por debajo de lo normal</th>
<th>Lluvias ligeramente por debajo de lo normal</th>
<th>Lluvias ligeramente por encima de lo normal</th>
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<th>Lluvias muy por encima de lo normal</th>
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<td>3.6%</td>
<td>0.0%</td>
<td>1.5%</td>
<td>2.1%</td>
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Comparative of Sectors Damages

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<tr>
<td>Prevention-Emergency</td>
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FLOODS
Intense rains from the north of Esmeraldas to the south in Guayas, with possible flood in rural areas by river overflow in Manabí, Esmeraldas, El Oro and Los Ríos. Could be affected zones highly populated as Machala, Babahoyo, Portoviejo, Chone and Esmeraldas

OCEANICAS
Some coastal zones of the pacific coast affected by high tides and far storms in Guayas, El Oro and Manabí. Possible isolated strong winds in Guayas, El Oro and Manabí

SALUD
Apparition of new cases of dengue and malaria in the coast. Low possibilities of isolated cases of leptospirosis and colera, specially in Manabí. Damage of the educative infrastructure in the coast and urban and rural zones, possible delay of the school cycle in the coast.

AGRICULTURA
Local affectation to important crops of sugar cane and banana in El Oro, Los Ríos and Guayas. Minor affectation to corn crops in Manabí.

VIALIDAD / ENERGIA
Damage of the main road way in Manabí and Los Ríos. Isolation of rural population by road damage in Guayas, Los Ríos and Manabí.

Tabla 4 (b). Estimated impacts of El Niño 2006-2007 event in Ecuador, considering the probable intensity of the event and historical impact patterns in Ecuador. Sources: Food and Agriculture Organization, FAO, Revista Panamericana de la Salud, Base de Datos Desinventar, La RED, Organización Panamericana de la Salud, OPS, Centro Regional de Información Sobre Desastres, CRID, Ministerio de salud Pública del Ecuador, Dirección Nacional de Defensa Civil del Ecuador, 2006
Exposure of the Development Sectors to the Climatic Risk

<table>
<thead>
<tr>
<th>Priority Sectors</th>
<th>Direct exposure to climate</th>
<th>Necessary exposure to risk zones</th>
<th>Unnecessary exposure to risk zones</th>
<th>Disaster level</th>
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<td>High</td>
</tr>
<tr>
<td>Water /Sewage</td>
<td></td>
<td></td>
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<td>Medium</td>
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<td>Home</td>
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<td>Media</td>
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<td></td>
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</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Industry</td>
<td></td>
<td></td>
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<td>Low</td>
</tr>
<tr>
<td>Energy</td>
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<td></td>
<td></td>
<td>Low</td>
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Table 5 Approximation to a susceptibility pattern of the Climatic Risk development sector in Ecuador. Source: Proyecto de Asistencia Preparatoria para la prevención del fenómeno El Niño en Perú y Ecuador, Elaborated by: María Augusta Fernández, PNUD-OCHA-ISDR, 2005

<table>
<thead>
<tr>
<th>Cities of higher disaster level in the period 1970-2003</th>
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<tr>
<td><strong>Provinces</strong></td>
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<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td><strong>Provinces</strong></td>
</tr>
<tr>
<td>Esmeraldas</td>
</tr>
<tr>
<td>Manabí</td>
</tr>
<tr>
<td>Guayas</td>
</tr>
<tr>
<td>Los Ríos</td>
</tr>
<tr>
<td>Pichincha</td>
</tr>
<tr>
<td>Imbabura</td>
</tr>
<tr>
<td>Bolívar</td>
</tr>
<tr>
<td>Tungurahua</td>
</tr>
<tr>
<td>Napo</td>
</tr>
<tr>
<td>Pastaza</td>
</tr>
<tr>
<td>M. Santiago</td>
</tr>
<tr>
<td>Chimboradoz</td>
</tr>
<tr>
<td>Cañar</td>
</tr>
<tr>
<td>Azuay</td>
</tr>
<tr>
<td>Loja</td>
</tr>
<tr>
<td>Z. Chinchipe</td>
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Table 6 Regions of higher disaster level in the period 1970-2003 in Ecuador. Source: Proyecto de Asistencia Preparatoria para la prevención del fenómeno El Niño en Perú y Ecuador, Elaborated by: María Augusta Fernández, PNUD-OCHA-ISDR, DESINVENTAR Data, 2005
<table>
<thead>
<tr>
<th>Cities</th>
<th>Water / Sewage</th>
<th>Education</th>
<th>Energy</th>
<th>Industry</th>
<th>Health</th>
<th>Agriculture</th>
<th>Roads/Transp.</th>
<th>Houses</th>
</tr>
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<tr>
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<td>4</td>
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<tr>
<td>Guayaquil</td>
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<td>1</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>24</td>
<td>29</td>
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<tr>
<td>Cuenca</td>
<td>10</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>17</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td>Esmeraldas</td>
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<td>2</td>
<td>4</td>
<td>5</td>
<td>10</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td>Chone</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>27</td>
<td>21</td>
<td>35</td>
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<tr>
<td>Portoviejo</td>
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<td>3</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>21</td>
<td>11</td>
<td>40</td>
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<td>Babahoyo</td>
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<td>6</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>17</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>Machala</td>
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<td>4</td>
<td>4</td>
<td>11</td>
<td>4</td>
<td>24</td>
<td>20</td>
<td>28</td>
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</table>

### Advances in the development sectors in function of Risk Management. Areas Affected by El Niño

<table>
<thead>
<tr>
<th>SECTORS</th>
<th>RISK MANAGEMENT</th>
<th>knowledge</th>
<th>Risk reduction</th>
<th>Preparedness and response</th>
<th>Reconstruction</th>
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<td></td>
<td>Climatic information</td>
<td>Risk zones identification</td>
<td>Structural measures</td>
<td>Non-Structural measures</td>
<td>Risk transfer</td>
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<tr>
<td>Agriculture</td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>Fishery</td>
<td>D</td>
<td>na</td>
<td>C</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>Water/Sewage</td>
<td>C</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Roads / Transport</td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Houses</td>
<td>na</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Health</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>D</td>
</tr>
<tr>
<td>Energy</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Education</td>
<td>D</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>Industry</td>
<td>na</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>B</td>
</tr>
</tbody>
</table>

A = Advance with progressive sustainability  
B = Some advances, Non-Consolidated processes  
C = Few advances  
D = Any advance  
na = Non Applicable

<table>
<thead>
<tr>
<th>FLOODS</th>
<th>DROUGHTS</th>
<th>OCEANICS</th>
<th>HEALTH</th>
<th>AGRICULTURE</th>
<th>ROADS / ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible floods in Tumbes and Piura with affectation to babana and rice crops. Probable intense rains near Tumbes, Paríñas, El Alto, Lobitos, Los Órganos and Piura.</td>
<td>Possible droughts in the Sierra and southern area of the country.</td>
<td>Some coastal zones could be affected by high tides and far storms specially in Ancash, Callao, Ica, La Libertad, Lambayeque, Lima, Moquegua, Piura and Tumbes.</td>
<td>Affectation to the health services by damage of infrastructures by rain, possible return of endemic diseases in the regions affected by rains, such as dengue, malaria, and colera. In general exists a probability of epidemic risk increase.</td>
<td>Possible decrease in rice crops yield in Piura, Lambayeque, La Libertad, San Martín, Loreto and Arequipa. Possible affectation to the winter variety of yellow corn in the central and north coast and Selva Alta. Possible affectation of plagues to potato crops in Sierra, specially in Huánuco, Junín, Puno, Cusco, Arequipa and central Coast. Affectation to citrics and fruits in the central and north coast. Important decrease in Sugar cane, Mango, Espárragos in Ica, La Libertad, Lambayeque and Piura.</td>
<td>Damage of main and secondary roads and problems in electric distribution lines in zones affected by rains. Possible land slide in Apurimac, Arequipa, Cusco, Junín and San Martín may affect houses located at hills.</td>
</tr>
</tbody>
</table>

Table 9 Estimated impacts of El Niño 2006-2007 event in Peru, considering the probable intensity of the event and historical impact patterns in Peru. Sources: Food and Agriculture Organization, FAO, Revista Panamericana de la Salud, Base de Datos Desinventar, La RED, Organización Panamericana de la Salud, OPS, Centro Regional de Información Sobre Desastres, CRID, INDECI, 2006
<table>
<thead>
<tr>
<th>EVENT</th>
<th># Emgs</th>
<th>DAMAGED PEOPLE</th>
<th>DEATHS</th>
<th>HURTS</th>
<th>DISAPPEARED</th>
<th>DESTRUED HOUSES</th>
<th>AFFECTED HOUSES</th>
<th>AREA (Ha.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAND SLICE</td>
<td>7</td>
<td>75</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>0</td>
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<tr>
<td>SLICE</td>
<td>292</td>
<td>28271</td>
<td>257</td>
<td>87</td>
<td>36</td>
<td>1929</td>
<td>4128</td>
<td>6140</td>
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<tr>
<td>EPIDEMY</td>
<td>23</td>
<td>6914</td>
<td>27</td>
<td>1041</td>
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<td>0</td>
<td>50</td>
<td>0</td>
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<td>FLOOD</td>
<td>1540</td>
<td>1028310</td>
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<td>701</td>
<td>40</td>
<td>64863</td>
<td>217580</td>
<td>268010</td>
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<td>INTENSE RAIN</td>
<td>554</td>
<td>107855</td>
<td>77</td>
<td>133</td>
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<td>5334</td>
<td>24311</td>
<td>5526</td>
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<td>SWELL STORM</td>
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<td>2570</td>
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<tr>
<td>OTHER MET. O HYD EVENT.</td>
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<td>0</td>
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<tr>
<td>OTHER BIOLOGICAL EVENT</td>
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<td>37</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>OTHER INDUCED EVENT</td>
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<td>243</td>
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<td>294</td>
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<td>32</td>
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<td>TOTALS:</td>
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<td>116206</td>
<td>357953</td>
<td>444290</td>
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Table 10 Emergencies related to the effects of El Niño event in Peru. Source: INDECI, 2006
<table>
<thead>
<tr>
<th>Department</th>
<th>LAND SLIDE</th>
<th>LAND SLIDE IN HILLS</th>
<th>FLOOD</th>
<th>INTENSE RAIN</th>
<th>SWEEL STORM</th>
<th>OTHER MET OR HYD. EVENT</th>
<th>OTHER BIOLOGICAL EVENT</th>
<th>OTHER INDUCED EVENT</th>
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<td>ANCASH</td>
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<td>2984</td>
<td>765</td>
<td>37</td>
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<tr>
<td>APURIMAC</td>
<td>5</td>
<td>3503</td>
<td>1260</td>
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<td>AREQUIPA</td>
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<td>1860</td>
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<td>31486</td>
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<td>AYACUCHO</td>
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<td>22517</td>
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