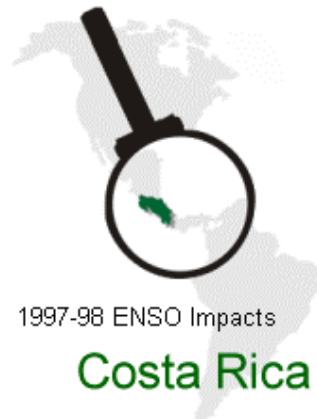


Reducing the Impact of Environmental Emergencies Through Early Warning and Preparedness - The Case of El Niño-Southern Oscillation (ENSO); Case of Costa Rica



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COSTA RICA

Executive Summary

Introduction

With the announcement of the 1997-98 El Niño at the beginning of 1997, Costa Ricans began a massive response at the national level. National media, government ministries, agriculture and fisheries began preparations based on prior experiences with El Niño phenomena since 1982. As such, Costa Rica represents an intriguing case study of early warning and response to climatic anomalies. Significantly, not all prevention strategies worked as planned, and some had unforeseen consequences. These experiences provide a revealing window on the possibilities of response to early warnings, and the limitations of such strategies.

One initial conclusion of the review of the 1997-98 El Niño response is that Costa Rica in fact has adopted a “culture of preparedness,” as recommended by international disaster prevention efforts, such as the International Decade for Natural Disaster Reduction (IDNDR 1998). This preparedness is especially clear in contrast to the lack of preparation on the part of other Central American countries.

A more sobering observation is the delicate policy decision of climate prediction. As probabilistic statements, forecasts have a likelihood of error; the impact of mispredictions must be carefully weighed with the benefits of early preparation, and led to very different approaches on the part of the various organizations involved in the early analysis of the 1997-98 event, with different institutions favoring more and less speculative forecasts.

Global and historical context of El Niño for Costa Rica

El Niño-Southern Oscillation (ENSO, or ENOS in Spanish) is a climate phenomena arising out of the interaction of global scale air masses and the Pacific Ocean. While first noted and named El Niño by Peruvians and Ecuadoreans because of the coincidence of coastal ocean warming with the Nativity (El Niño - The Child) the phenomenon extends in some form along a great length of the American shore of the Pacific.

The connection between El Niño and climate variations of great concern to Costa Rica was not explicitly recognized until the 1980's, when a fortuitous conversation between Dr. Michael Glantz, a leading El Niño researcher (Glantz 1996), and Patricia Ramirez, a leading Costa Rican climate researcher (Ramirez 1992), identified the coincidence of periodic Costa Rican droughts with years of El Niño (Glantz and Ramirez, personal communication). At that time, Ramirez was studying droughts in western Costa Rica for the purposes of improved agricultural adaptation to climate variability, since periodic droughts were the cause of losses and economic instability in the agricultural sector. At approximately the same time, the Laboratory for Oceanography was established at the National University in Heredia, Costa Rica, a center which would eventually provide critical researchers and information for national climate analysis (for example, Quiros 1990).

As one of the areas first and most directly affected by the El Niño ocean warming, Costa Rica is a site of research activities into the historical evolution of the El Niño phenomenon (Tree ring research). The role of El Niño in global climatic variability (Grove 1998, Jacobs et.al 1994,

Rodbell et.al., 1999), and its impact on global climate change (Williams 1997, Timmerman 1999) have become key questions for understanding current and future climate conditions.

El Niño has now become a topic of public discourse, which is reflected in the publications of national institutions. The Bulletin of the National Meteorological Institute IMN (Spanish acronym), published as a vehicle for communicating technical meteorological information to the public, shows a concern with the ENSO phenomenon. At least 3 bulletins in 1991 and 1992 explicitly describe El Niño or associated phenomena (IMN 1991a, IMN 1991b, IMN 1992). A more recent bulletin discusses Decadal Oscillation in the Pacific (IMN 2000).

Costa Rican Climate Patterns

Costa Rica is characterized by two typically tropical climate patterns, on its Caribbean and Pacific coasts. The coasts are separated by a volcanic cordillera, which divides the weather patterns. The central plateau and intermountain valleys at an elevation of 1200 meters is home to the major cities and a large part of the Costa Rican population (See Map 1). The populated central plateau is significantly cooler than the coastal regions, but generally follows the weather pattern of the Pacific coast.

The most widely recognized climate pattern is the rainy climate of the eastern, Caribbean watershed, which is responsible for Costa Rica's well-known humid tropical rain forest vegetation following Holdridge's classification of vegetational life zones (Holdridge 19xx). In contrast, the Northern Pacific watershed has a distinct monsoonal pattern, with intense rains followed by months of drought; this area is characterized by Dry Tropical Forest in the Holdridge system.

Costa Rican climate patterns, and their variations, are a product of its inter-oceanic and inter-hemispheric location. As a narrow land bridge dividing the Caribbean/Atlantic and the Pacific, Central America in general, and Costa Rica in particular, are directly affected by ocean/atmosphere interactions. The east-west Walker circulation which covers the breadth of the Pacific (see esp. WMO 1999) tends to cause subsidence of dry air on the western coast of the isthmus; the volcanic mountain range which divides the isthmus tends to create a rain shadow, so that even when pressure gradients favor the introduction of moist Caribbean air, most precipitation remains in the Caribbean watershed.

The other major influence on the Costa Rican climate is the Inter-Tropical Convergence Zone (ITCZ), which marks the dividing line between the north-south and south-north cycling Hadley cells (WMO 1999, Glantz 1996), within which warm air rises at or near the equator, and subsides some 30 degrees north and south of the equator. The ITCZ migrates south in the northern winter months, and north in the northern summer months, crossing Costa Rica; the convective currents of the ITCZ are an important source of moisture for both the Pacific and Caribbean watersheds.

Obviously, Costa Rica's climate is extremely sensitive to subtle changes in the relationships between the Pacific and Caribbean air masses, and the northern and southern air masses. Disruptions caused by El Niño have a direct impact on day to day, and season to season climate; however, since the impacts depend on the precise location of the ITCZ and the relative pressures of the ocean air masses, the climate forecast is easily mistaken.

The Identification and Announcement of 1997-98 El Niño Event

By the time the 1997-98 El Niño event was first detected in 1997, the phenomenon had been linked in the public mind to earlier events of the 1980's and 1990's. The linkage was so strong that the Director of the Costa Rican Meteorological Institute felt a need for extreme caution in the possibly premature identification and official announcement of an "El Niño Event" as it would have sown panic among some sectors of the population. Even with the caution exercised, cases arose where actions were taken which went beyond reasonable and prudent precaution to unnecessary caution to the detriment of the Costa Rican population.

Ironically, the initial announcement of the El Niño event in official circles was made by regional organizations, rather than the national institutions. In March of 1997, the head of the Regional Commission for Hydraulic Resources¹ communicated the possibility of an El Niño event beginning later that year. This note was sent first to another regional institution, CORECA², and from there it was communicated to the ministers of relevant institutions in the different countries of the isthmus. In view of the apathetic response to the announcement from most of the Central American countries, the regional institutions may have been justified in their somewhat speculative initial announcement, which relied on the one and only climate model which predicted the onset of El Niño (more than a dozen climate models are commonly used, and none of the others predicted the event).

The actual wording of the CRRH/CORECA announcement was quite reserved, indicating the possibility of an El Niño event; it did not predict with certainty, and it did not suggest the possibility of a strong event. Nevertheless, it was a more forceful indication than the National Meteorological Institute considered appropriate; the national institute only issued its first advisory when there was a much more positive forecast in May and June.

Preparation for the 1997-98 Event

Of all the countries of Central America, Costa Rica's prompt and active response to the announcement was unique. The initial speculative announcement prompted the formation of El Niño commissions within national institutions, and the creation of an interinstitutional coordinating committee.

In the ministry of agriculture, the El Niño commission began reviewing contingency plans for drought. In some cases, preparation simply consisted in activating existing plans which had been developed even before periodic droughts had been associated with El Niño. The expected impact of El Niño was an early onset of the dry season in November of 1997, and its extension into August or September of 1998; the normal monsoonal dry season lasts from November until May.

The preparation effort was mostly directed toward consciousness raising among the agricultural population during the latter part of 1997, in preparation for drought in mid-1998. Public

¹ The CRRH is part of the regional economic integration structure collectively known as SICA, the Secretariat for Central American Integration. SICA's specialized regional institutions respond to commissions of heads of relevant national ministries or institutes from each of the Central American countries. The governing commission for CRRH is made up of the heads of the meteorological institutes for each country. Their objective is to complement the work of national organizations by ensuring that regional, transnational concerns are not overlooked in the face of purely national policy concerns.

² Regional Council for Agricultural Cooperation

informational meetings were convened, and conducted by ministry officials. In some cases the meetings were attended by high officials in the meteorological institute, the Oceanographic Laboratory of the National University, of the CRRH.

The consciousness raising was hindered by the then current weather conditions; a heavy rainy season beginning in June of 1997 made producers skeptical. In some cases, the drought warning was issued in the middle of torrential downpours and floods, which seemed to limit the credibility of the prediction. To make matters worse, the first predicted impact of the El Niño was an early cessation of rains at the end of 1997, which did not occur. This warning had been issued in the public meetings, and caused great embarrassment for the meteorologists, as it made their entire message suspect.

The most active and intrusive preparation for the El Niño event was the recommendation to reduce the cattle herd in the Pacific monsoonal climate zones of Guanacaste and the Central Pacific Coast, as it was expected that the extended drought would push producers past the limits of their customary water and food supplies. As a result, there was a massive sell-off of the western herd, pushing down prices in the market, and redistributing animals to areas where the impact of the drought was expected to be less severe.

In the water sector, the major preparation was the acceleration of existing irrigation and well-boring projects to help ensure water in potentially affected zones.

The national insurance agency, INS, cut off credit to farmers on the west coast, apparently in response to a similar action by the national agency in Panama. Protests by farmers led to a careful meteorological review of specific regions, and the re-establishment of credit in zones where there was a minimal possibility of drought.

Impacts of the 1997-98 El Niño

At the outset, it must be stated that it is extremely difficult to differentiate El Niño impacts from normal climate variability in Central America. Given the torrential nature of the rains and the limited capacity of watersheds, floods are common throughout the region on an annual basis. Further, drought is a normal feature of Central American climate; traditional methods have been developed to respond to the annual drought, but a crisis may ensue with the extension of the 'normal' dry season by a few weeks.

The official report of the FAO Economic Commission for Latin America (CEPAL 1999) finds approximately \$100 million in damage, combining impacts in agriculture, fisheries and forestry. Drought, irregular rains and water shortage lead to losses principally in the dryer zones of the country. The ocean warming typical of the El Niño event lead to a decrease in the fish catch in national waters, in an exact parallel to well-known impacts in Peru.

Losses in forestry are of special note. The extended dry season leads to an accumulation of combustible material in dry tropical forest areas which makes the control of fire extremely difficult. Fortunately, in Costa Rica the use of fire for agricultural clearing has been largely eliminated, and while the occurrence of forest fires did increase, the frequency was nowhere near the crisis levels achieved in other Central American countries (Araquistain and LaForge 1998).

Surprisingly, one of the major impacts of the El Niño was in animal production, not in the most drought-prone areas, but in the less prone areas where animals had been moved in preparation for the extended drought. Costa Rica's Northern Plain is an anomalous climate area; following the traditional division of climate zones along the continental divide, the Northern Plain falls in the Caribbean zone. However, in parts it is much closer to the Pacific Coast than to the Caribbean, and the continental divide is so low as to be non-existent. While it generally follows the Caribbean pattern of having virtually no dry season, its driest period is dryer than that of other areas in the Caribbean climate area.

For the 1997-98 El Niño event, the climate of the Northwest portion of the Northern Plain was much more like the Pacific than the Caribbean. Ironically, the relatively benign traditional climate had not required that ranchers of that area to develop contingency plans to prepare for drought. In fact, Ministry of Agriculture officials reported that the ranchers responded inadequately to the impending drought because they could not believe it would come to pass as predicted; they continued to expect that the rains would begin 'next week', and took inadequate action to protect their cattle. To make matters worse, the climate prediction for El Niño did not include drought for the northern zone (See Map 2, from CORECA/MAG 1997), so ranchers felt confident on the basis of historical patterns and official predictions that the drought would not be overly extended.

Another ironic impact of the El Niño 'drought' was increased water damage to crops and flooding. Long-time meteorological researcher and former head of the National Meteorological Institute Patricia Ramirez found that total precipitation during El Niño years does not vary significantly from long-term averages (personal communication). The apparent drought is caused by a change in rainfall pattern, where rain tends to cluster in very short time periods. Aquifers do not recharge, plants and infrastructure are damaged by heavy showers, and there follows a relatively long period before the next rain.

A bittersweet impact was the restructuring of the mandate of the National Emergency Commission (CNE, in Spanish). Along with the Ministry of Agriculture, the CNE began preparations for El Niño through the allocation of disaster response budget to areas of expected impacts. This initiative was curtailed by a Supreme Court ruling which confirmed that its disaster response mandate required that it take no action until the disaster had actually occurred, and its planned activities were postponed until El Niño impacts actually manifested themselves. In the wake of El Niño, national legislation was changed to permit the CNE to prepare for predicted disasters.

Conclusions and Lessons Learned

The principal conclusion of the El Niño event is that there is a willingness and capability to respond to early warning of climatic events in Costa Rica, even when these are not entirely certain. Government officials and producers were able to take raw information and transform it into meaningful responses based on their previous experience, and the expected nature of the El Niño impacts.

On the negative side, El Niño forecasts were too imprecise to permit specific preparations for impacts. Major errors were made in the forecast which had negative economic impacts for farmers who took action based on forecasts. Unfortunately, impacts are very localized, and farmers and government officials must make decisions on specific farms, rather than regions.

While there is not doubt that the heightened alertness of the producers in response to the knowledge of the El Niño event is positive, it is not prudent to make long-term plans on that forecast, since it may be generally correct or incorrect, and in addition, may be specifically correct or incorrect. The proper response to the forecast is to hedge your bets, and be prepared for contingencies.

Several efforts are currently proposed and underway to improve predictive capabilities of major climatic events such as El Niño. The major recommendation to such efforts is 'Do not be satisfied with generalities.' While meteorologists may find probabilistic statements satisfying and appropriate in forecasts, decision-makers require more clear-cut information which helps them make correct decisions, and avoid foreseeably bad decisions. This lesson may have nothing to do with forecasting, but more to do with the development of improved, detailed descriptions of meteorological processes, along with methods of communicating relevant information to non-professional users.

The potable water sector has determined that an important forecast data is air temperature. During the 1997-98 El Niño the national water service AyA (Aguas y Alcatarrillados) found a surprising increase of some 5% in water consumption, which they attribute to increased temperature (AyA 1998).

At the same time, there is an important niche for generalized, seasonal predictions. On an isthmus, hydrological cycling is greatly accelerated. Improved seasonal forecasting can be critical for decisions about water control decisions for flood control, hydroelectric generation, and irrigation. Similarly, these generalized forecasts may be useful to farmers for generalized management decisions (whether to plant corn or sorghum, for example). The eventual integration of seasonal forecasts into production planning requires a certain period for learning and development communication techniques, as farmers and other users learn how to interpret seasonal forecasts in the context of their own activities.

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COSTA RICA

Setting

1. What is the **socioeconomic setting** of your country? (Include a brief description of the government mechanisms for dealing with climate-related impacts; the ministries, task forces, and public safety mechanisms, etc.)

Costa Rica is a country with great experience in and preparation for natural disasters. The basic mechanism for dealing with all emergencies is the National Emergency Commission (CNE), which significantly is a commission rather than a ministry. The CNE is made up of a board of directors with representatives from several ministries: Ministry of Agriculture and Livestock (MAG), the Ministry of Health, the Ministry of Environment and Energy (MINAE; Ministerio de Ambiente y Energia) that is in charge of the IMN (Meteorological Service) and the Ministry of Transport and Public Works (MOPT; Ministerio de Obras Publicas y Transportes).

In 1998, the CNE was legally enabled to react to any situation by the declaration of the state of emergency, making it by definition a reactive rather than pro-active body. The 1997-98 El Niño saw the culmination of a long-standing dispute regarding the proper scope of CNE actions; the CNE initiated a series of preparatory activities in response to the prediction of El Niño, although these efforts were quickly cut down by a legal ruling which concluded it was illegal for CNE to prepare for disaster, as it was only empowered to react. In the aftermath of El Niño, this law was changed to allow more scope for preparation. (Gaceta #78:199 – 13-10-1999)

Costa Rica has no mechanism for preparing for El Niño *per se*; the announcement of El Niño leads to the mobilization of plans for flood and drought preparation. A number of organizations take the lead in dealing with the climate-related impacts. A key organization is the National Meteorological Institute (IMN; Instituto Meteorologico Nacional) as the provider of climatic information. Their information goes to institutions representing the different sectors of production and services in the country. These representing organizations prepare for the foreseen impacts. In Costa Rica these organizations are these: ICE (Instituto Costarricense de Electricidad), the country's electrical company, AyA (Acueductos y Alcantarillados), the national drinking water service, MAG (Ministerio de Agricultura y Ganaderia); Ministry of Agriculture and Livestock. Furthermore, there are the CNP (Consejo Nacional de Produccion), an organization involved in supporting farmers, INCOPESCA: involved in support of the fishery sector, SENARA, an institution providing farmers with irrigation. The health sector is represented by OPS (Organización Panamericana de Salud) and the Ministry of Health.

Institutions and Ministries involved in the response to the 1997/1998 El Niño event

AyA (Acueductos y Alcantarillados)	National drinking Water Service
CNE (Comisión Nacional de Emergencia)	National Emergency Commission
CNP (Consejo Nacional de Producción)	National Commission for Agricultural Production
ICE (Instituto Costarricense de Electricidad)	National Electrical Company
IMN (Instituto Meteorológico Nacional)	National Meteorological Institute
INCOPESCA (Instituto Costarricense de la Pesca)	Costa Rican Institute for Fishery
MAG (Ministerio de Agricultura y Ganadería)	Ministry of Agriculture and Livestock
MINAE (Ministerio de Ambiente y Energía)	Ministry of Environment and Energy
Ministerio de Salud	Ministry of Health
MOPT (Ministerio de Obras Publicas y Transportes)	Ministry of Transport and Public Works
SENARA (Servicio Nacional de Aguas Subterráneas, Riego y Avenamiento)	Institution providing farmers with irrigation.
OPS (Organización Panamericana de Salud)	Pan American Health Organization

One aspect of the socio-economic setting which complicates the presentation of the ‘Costa Rican Response to El Niño’ is the presence of many international and regional organizations, which act in Costa Rica, or are based there.

Central America has an ongoing process of Economic Integration, supported by UN-ECLA (Economic Commission for Latin America) and the European Union. There is a Secretariat for Central American Integration (SICA), which contains specialized agencies for research or policy formulation. The organizations involved on a regional scale are in Costa Rica are CRRH (Regional Commission for Hydraulic Resources), CORECA (the Regional Council of Ministers of Agriculture), CCAD (the Central American Commission for Environment and Development), and CEPREDENAC; a regional organization concerned with the prevention of natural disasters.

Costa Rica is also part of the hemispheric organization, the OAS (Organization of American States). The headquarters of IICA, the OAS's International Institute for Agricultural Cooperation, are in Coronado, which coincidentally houses the offices of CORECA (mentioned above). Another organization of the OAS, the Pan American Health Organization (OPS) has offices in San Jose. In addition, CATIE (the Tropical Agriculture Center for Research and Higher Education) is a regional organization, with a primary focus in Central America and the Caribbean, headquartered in Turrialba.

On a world-scale, organizations as IDNDR (International Decade for Natural Disaster Reduction, now ISDR, International System for Disaster Reduction) and the WMO (World Meteorological Organization) are active in the country; WMO has its headquarters for North and Central America in San José, Costa Rica.

The two main (state) universities are involved in research and scientific support. From the UCR (University of Costa Rica) the Department of Meteorology of the School of Physics is active, as well as the geophysical research center CIGEFI (Centro de Investigaciones Geofísicas), which, in spite of its name is also working on climatic affairs. The UNA, National University, has a research program named SERIO (Servicio Regional de Información Oceanográfica); it is part of the School for Oceanography, which studies coastal areas. This center houses an AVHRR antenna, which it uses for collecting NOAA weather imagery; it distributes information on sea surface temperature to the fishing industry.

The profusion of organizations in Costa Rica makes the task of identifying the source of information somewhat problematic. Regional and international organizations are closely tied to international sources of information, and in some cases act as conduits for information. At times it becomes difficult to distinguish lines of authority and paths of communication because these are multiple and somewhat redundant, given the overlapping domains of international, hemispheric, regional and national bodies. It is noteworthy that no destructive rivalries were noted despite this potentially conflictive situation; obviously, certain tensions and disputes did arise, but these were limited in scope and impact. Groups cooperated regardless of affiliation, and collaborated to form teams for evaluating and responding to the event.

From March 1997, a series of workshops and meetings with most of the involved organizations were organized. Some emergency laws (decretos) were signed to initiate and accelerate taking of measures. The effective mechanism for dealing with the 1997-98 event can be divided into phases; in the discovery and declaration phase, the regional organizations CRRH and CORECA were instrumental. These organizations coordinated with the National Meteorological Institute and the Ministry of Agriculture to disseminate the information regarding the upcoming event.

In several ministries, specific El Niño commissions were designated to deal with the event. These ministerial commissions coordinated and oversaw very specific preparation activities and action plans within their respective ministries.

An important and somewhat unique mechanism of response was coordinated through CORECA, the regional Council of Ministers of Agriculture. This body had been charged with 'keeping an eye on' El Niño or other climatic events, even before El Niño became a great concern. CORECA seems to be the institution most directly responsible for the initial response to the El Niño report, although their role was primarily catalytic; all real 'actions' were carried out through government ministries.

CORECA formed a working group, composed of Patricia Ramirez, then Director of the National Meteorological Institute, Eladio Zarate, the Executive Director of the CRRH (Regional Commission for Hydraulic Resources) and Carlos Brenes, the head of SERIO, the Oceanographic Institute based at the National University. This team, including Manuel Jimenez of CORECA, made a series of field visits to evaluate and predict impacts from El Niño. The conclusions of the working group were then passed on to the ministries through CORECA. This mechanism was possible because no other countries in Central America showed sufficient concern for the coming event to request services, so Costa Rica uniquely benefitted from their initial concern.

2. What are the **climate-related and other natural hazards** affecting your country? (List them in order of concern.)

Costa Rica is located on an isthmus formed by the collision of two tectonic ‘plates’, separating the Caribbean from the Pacific Ocean. This position places it in the path of many weather events, including Atlantic hurricanes, northern cold fronts and a generally very rainy climate. As a result, floods and landslides are common occurrences in the country, sometimes caused by ‘extreme’ events, such as hurricanes, and at other times caused simply by heavy rains.

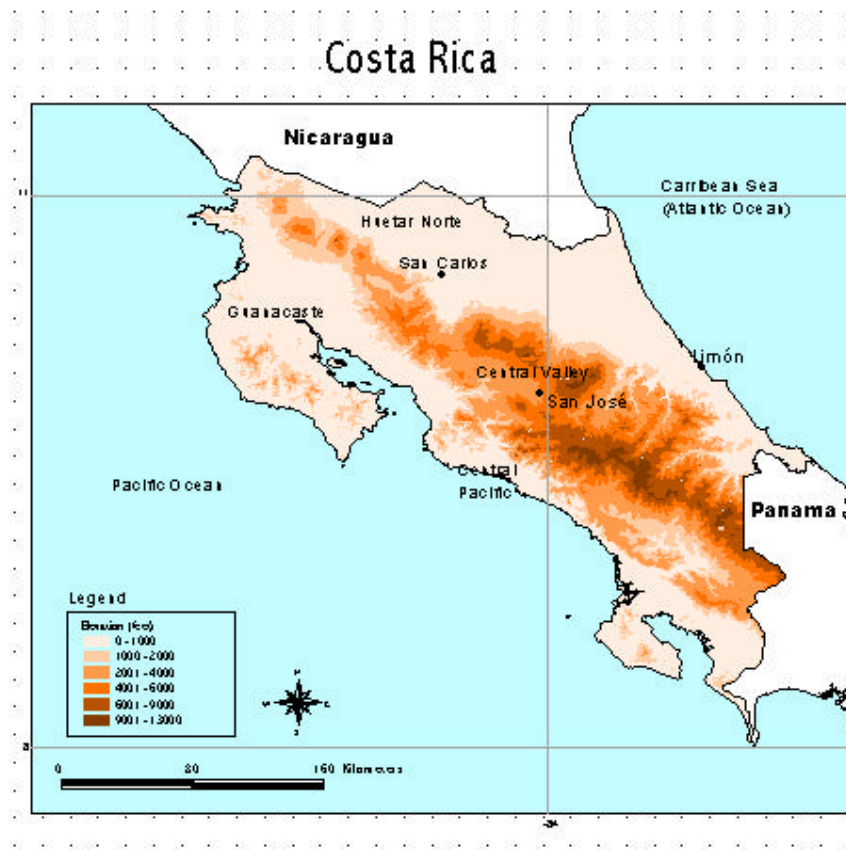
Costa Rica’s western coast has a monsoon climate, characterized by 6 months of rain and 6 months of drought. The population has adapted to this pattern, but slight extensions to the annual droughts can cause problems. Forest fires have been common in the past, although in recent years public campaigns have reduced the use of fire in agriculture, and improved the control of the fires, which continue to be used. Despite the long dry period, the total amount of rain in the west is over 2000mm in many areas, so there is intense rainfall during the rainy season, and flooding is common.

El Niño is now recognized as a phenomenon, which tends to prolong the Pacific dry season, and cause drought problems.

Other miscellaneous climatic hazards are brief windstorms locally called tornadoes, but which infrequently reach wind speeds of more than 100mph. In the Central Valley, farmers suffer from occasional hailstorms.

In addition to climatic hazards, Costa Rica’s geological setting makes for frequent tectonic events. Earthquakes are common, with direct damage to humans and infrastructure caused by earth movement. Earthquakes may cause additional hazards in the form of terrestrial landslides, or marine landslides, which in turn cause tsunamis.

General Map of Costa Rica



Like earthquakes, volcanoes have both primary and secondary impacts. There are 7 major volcanoes in Costa Rica, one which is constantly active, and others, which are periodically active. Volcanoes often cause direct damage due to ash and gases. Secondary problems arise from the tendency of ash deposits to mobilize with heavy rains, and become mudflows.

Costa Rica's multiple hazards and frequent disasters have helped create a 'culture of prevention', which in many cases can be seen to mitigate impacts of disasters through the process of planning and preparation.

Sources: Desinventar (www.desinventar.org)

Website CNE (www.cne.go.cr)

3. What was the **level of scientific research** in your country relating to El Niño?

Higher education and research are a strong part of Costa Rican culture. Literacy and higher education levels are more comparable to developed countries than to Latin American countries. There are 3 major public universities in Costa Rica (the University of Costa Rica, the National University, and the Technological Institute), CATIE (Tropical Agricultural Research and Education Center, with the longest standing agricultural

masters program in Latin America) and a growing number of private colleges and universities. The public universities and CATIE are actively involved in research of international caliber.

Although El Niño was not specifically identified in Costa Rica until after the 1982-83 event, there is a history of climatological and meteorological research for agricultural and other purposes.

The scientific research on El Niño can be divided in two parts:

1. *Forecast using models*: The national meteorological service (IMN) does not have its own models and depends on international institutions like NOAA.
2. *Climatic forecasts using statistics*: This is the most important part of the research of the national meteorological service. In the past 2 years agrometeorology has become part of the research, with the idea of being able to provide more specific information to sectors such as agriculture and livestock production.

Lic. Werner Stolz of the IMN classifies the level of scientific research in Costa Rica as 'intermediate'; nevertheless, it seems clear that the level of scientific capability both institutionally and personally were instrumental in providing a high level of information and awareness of climatic phenomena in general.

4. Identify and document (with citations, if possible) the **historical interest**, if any, in the country (popular, political, media, etc.) in El Niño before the onset of the forecast and/or impact of the 1997-98 event.

Since 1982/1983 there is an historical interest to speak of. The strong Niño event in 1982/83 caused an increasing interest in the subject. Most scientific research as well as political/media interest dates from the '1990s. Prior to that time, there was research interest in drought as an isolated phenomenon. Patricia Ramirez mentions that early in her career, while studying drought, it was brought to her attention that the drought in fact corresponded to the El Niño years.

Since the 97/98 event, the El Niño phenomenon has become common popular knowledge. One can hear people in the street and taxi drivers commenting on the El Niño phenomenon.

Central America was affected by the extremely destructive Hurricane Mitch during the La Niña event following the 1997-98 El Niño, thus serving to further heighten public awareness and concern for the El Niño/La Niña phenomenon.

1997-98 Event

1. Trace the **flow of information on the 1997-98 El Niño** within your country, using the following guidelines:

a. When did the various agencies first hear about this developing El Niño?

Eladio Zárate as the head of the CRRH published an article in *ENERGIA*, "Uso de datos climatológicos y oceanográficos procesados en centros mundiales para el diagnóstico temprano de sequías en Centroamérica". (Use of processed climatic and oceanographic data in world centers for the early diagnosis of droughts in Central America). In this article he announces the El Niño phenomenon can be expected to present its influence in Central America with a probability of 75%. He argues a majority of the forecasts indicates the development of a warm phase of El Niño in the second half of 1997. Although there was no 100% certainty, Zárate considered the Central American region should be prepared for a period of droughts. He mentions forecasts will be updated constantly and more precise and detailed information will become available.

This article was submitted in March 1997. Other sources mention that only one model predicted the development of a Niño around March 1997, and consider Zárate's forecast a minority opinion.

Information about the coming Niño had been circulating internally in the national meteorological service; however, it was not until May 1997 that the information was made public. The first "Bulletin" about El Niño from the IMN (meteorological service) was published in May 1997, IMN continued publishing about the development of the phenomenon on a monthly basis until July 1998.

It has to be understood that the political position of the IMN requires more prudence in its publications as the Costa Rican society depends on their forecasts in a lot of ways.

In May '97, Zárate sent a letter to Manuel Jiménez from CORECA, informing a moderate Niño had been forecast. At the same time, the first Bulletin of IMN was also published, transmitting the same message. This Bulletin is always sent to the national emergency commission (CNE) and the Ministry of Agriculture and Livestock (MAG). CORECA also informed the minister of agriculture in May 1997. Institutions such as ICE, AyA etc. are contacted through the CNE or directly by the IMN.

b. Where did the information come from?

Eladio Zárate as head of the CRRH, claims to be the first to have spread the news about the developing El Niño, based on "the opinion of the international community" and "the majority of the forecasts using mathematical, physical, statistical and climatological methods" (Zárate, 1997).

Fairly soon followed the IMN, based on information from international institutions such as NOAA, using a number of models in their forecast. Nevertheless, Manuel Jimenez of CORECA

noted that the position of head of the IMN was always much more conservative than that of the other members of the technical commission.

The MAG CORECA report states that IMN&SERIO came with a forecast of El Niño in March 1997.

c. When did they first hear it would be a strong event? From whom?

In his May letter to Manuel Jiménez (CORECA), Zárate mentions a forecast of a moderate event.

In “Bulletin 4” of CRRH, published around 7 July 1997, is mentioned that values of anomalies of temperature in some regions of the tropical Pacific Ocean are the highest registered since the strong 82/82 Niño event. It says the majority of the forecasts indicate that the strength of the El Niño phenomenon is growing.

The Bulletin of September 1997 of the IMN mentions a strong Niño event coming up: “*La fase cálida del ENOS se caracteriza por anomalías positivas de la superficie del mar y valores negativos del Índice de la Oscilación del Sur, por tanto, estos valores indican la presencia de un evento fuerte, que ya en agosto alcanzaron una magnitud superior a los observados en la fase madura del evento de 1982-83, considerado hasta ahora el mas intenso del siglo.*” (“The warm phase of ENSO is characterized by positive anomalies of the surface of the ocean and negative values in the index of the Southern Oscillation, consequently these values indicate the presence of a strong event, that already in August were superior to the numbers observed in the mature phase of the event in 1982/83, until now considered the most intense Niño of the century”). (Source: www.imn.ac.cr)

d. Which agencies first received the information?

As mentioned above, the ‘early warning’ of the CRRH catalyzed actions from CORECA; IMN was aware of the same information, but took a more conservative view of its significance. Information about the possibility of El Niño was passed on to government agencies through CORECA.

e. Were these the appropriate agencies to first receive the information?

Since CRRH and IMN are in charge of meteorology on a regional and national level, they seem the appropriate agencies. Their network of contacts permits an efficient dissemination of the information.

The flow of information in this case raises an important issue of responsibility. The IMN consciously delayed the issuing of an El Niño warning, knowing that it would tend to cause an over-reaction. The 1982-83 event had been so significant that as a government body, it was felt inappropriate to issue a speculative report on such an important issue. As regional organizations with a different set of responsibilities, CRRH and CORECA did not feel so constrained.

Patricia Ramirez, head of the IMN during the 1997-98 event, mentioned repeatedly that the cost of an erroneous forecast could be a loss of credibility for the IMN, and the inability to mobilize a response to a future event, even if that forecast was seen as less speculative by the IMN.

Fortunately for the meteorological community, the El Niño did, in fact, occur. Thus the early speculative prediction did not turn out to be a ‘false alarm’. The following year, the head of CRRH, who had issued the early warning, became the new the head of the IMN. Nevertheless, it is important to consider what could have been the longer-term impact of an erroneous forecast, and if that should lead to a rethinking of the role of the regional organizations in the El Niño prediction and preparation.

f. How was the information obtained?

Through international contacts with the leading climatological institutions as NOAA, NCEP.

g. How was the information transmitted?

The first “Bulletin” about El Niño from the IMN (meteorological service) was published in May 1997, IMN continued publishing about the development of the phenomenon on a monthly basis until July 1998. The “Bulletins” are sent to the CNE and the MAG. Further transmission of the information to institutions representing the different sectors went through CNE or directly with the IMN.

Transmission of information among responsible institutions does not seem to be a limiting factor in the preparation of the El Niño event. The biggest problem is considered the lack of precision and the incapacity in predicting the intensity of the phenomenon.

Media

h. How did the media first report the developing El Niño?

In a search of the main newspaper archives of *La Nacion* and *Al DIA*, first articles about the El Niño 97/98 phenomenon date from 9-7-1997.

i. How did the media cover the event over time? (Quote headlines, names of radio stations, TV programs, etc., with dates.)

Newspaper articles write about damages, flooding, drought, fires, some background information on the climatic phenomenon, problems in agriculture, measures of the government.

Some headlines of the *La Nacion* newspaper (see also Appendix II):

Fear for more destructive Niño (28-8-1997)

El Niño will hit hard, experts say impact will be the same as in 1982 (11-7-1997)

March will be very hot (9-1-1998)

Premature “birth” of La Nina (10-7-1998)

Low coffee yields because of El Niño (11-6-1998)

Learn to swim! (23-1-1998)

The earth has a fever (21-12-1997)

Some headlines of the *Al Dia* newspaper:

Fire consumes forestry reserve (31-1-1998)

El Niño affects production onion and potatoes because of clouds (28-4-1998)

Front comes from United States (31-12-1997)

INS lost c.143 millions; El Niño makes insurance and credit less available (1-9-1997)

Heavy rains for tomorrow (20-8-1997)

Infrastructure damaged (6-8-1997)

Niño disappears (26-10-1995)

Nature without mercy (24-10-1998)

j. Was the 1997-98 El Niño compared with any previous events?

The 1997-98 El Niño has been compared with previous events as shown in the following articles:

28-8-1997

Fear for more destructive Nino

AFP. Geneva

The actual Niño phenomenon, an oceanic and atmospheric anomaly that affects the tropical Pacific and disturbs global climatic conditions, could exceed the intensity of the 1982-1983 event, estimate experts in Geneva.

11-7-1997

Impacto Impact will be equal to 1982, experts say

- *Entities prepare mitigation plan*

- k. Before the mention of the 1997-98 El Niño, when was the previous mention of El Niño in the media?

Newspaper articles on El Niño previous to the reports on the 97/98 event have been published in October 1995.

Teleconnections (i.e., Expected effects of El Niño)

1. What are the scientific views about the existence and the strength of El Niño teleconnections to the country area? [WMO to address this question]

Scientific views about the about the existence and the strength of El Niño teleconnections to the country mainly consist in a description of the climatic system, and changes that occur during El Niño periods. Possible impacts are described (e.g., P. Ramírez and Fernández, W.; El Niño, la oscilación del sur y sus efectos en Costa Rica: una revisión).

The forecast of the El Niño phenomenon and its impacts is still a controversial subject. During the 97/98 El Niño in Costa Rica scientific views from a climatological point of view were mainly represented by these individuals: Patricia Ramirez (former head of the IMN, during the 97/98 Niño, actually working for the CRRH, Eladio Zárate (former head of the CRRH, actually director of the IMN) and Carlos Brenes (head of the regional service for oceanographic research).

Patricia Ramirez argues that there is no real forecast. She argues many models have been developed and do not give consistent results; during the 97/98 Niño in Costa Rica important parts of the forecast were wrong. Although her position as head of the National Meteorological Institute would force her to take a more conservative view of the prediction than a more independent meteorologist, who maintains the same position even after leaving her position in the IMN.

Eladio Zárate, who claims to have been the first to foresee the 97/98 Niño, and suggests a general consensus in the international scientific community on the subject. Considering the fact he published the 97/98 forecast, he seemed to have more faith in forecasting this climatic phenomenon. Carlos Brenes is known for having a stronger faith in the accuracy El Niño forecasting. It has been reported that he predicted a strong Niño event coming up in 97/98, although the prediction seems to have been made in an informal context.

Apart from forecasting the existence of the El Niño phenomenon, another aspect of the forecast is the effect the phenomenon has in the different parts of the country and with what intensity. As Costa Rica is a country with strong climatic gradients and a high climatic diversity over a short distance, a weather forecast in general, and effects of complex climatic phenomena as El Niño, are hard to predict. Nevertheless, it is generally agreed that El Niño causes droughts in the northern and central Pacific and excesses of rainfall on the Atlantic side. The northern zone of the country (Huetar Norte, San Carlos) has a strong climatic gradient, which makes it harder to foresee possible effects of El Niño. In this region, the 97/98 Niño caused unforeseen droughts that caused considerable damage, mainly in agriculture and animal production.

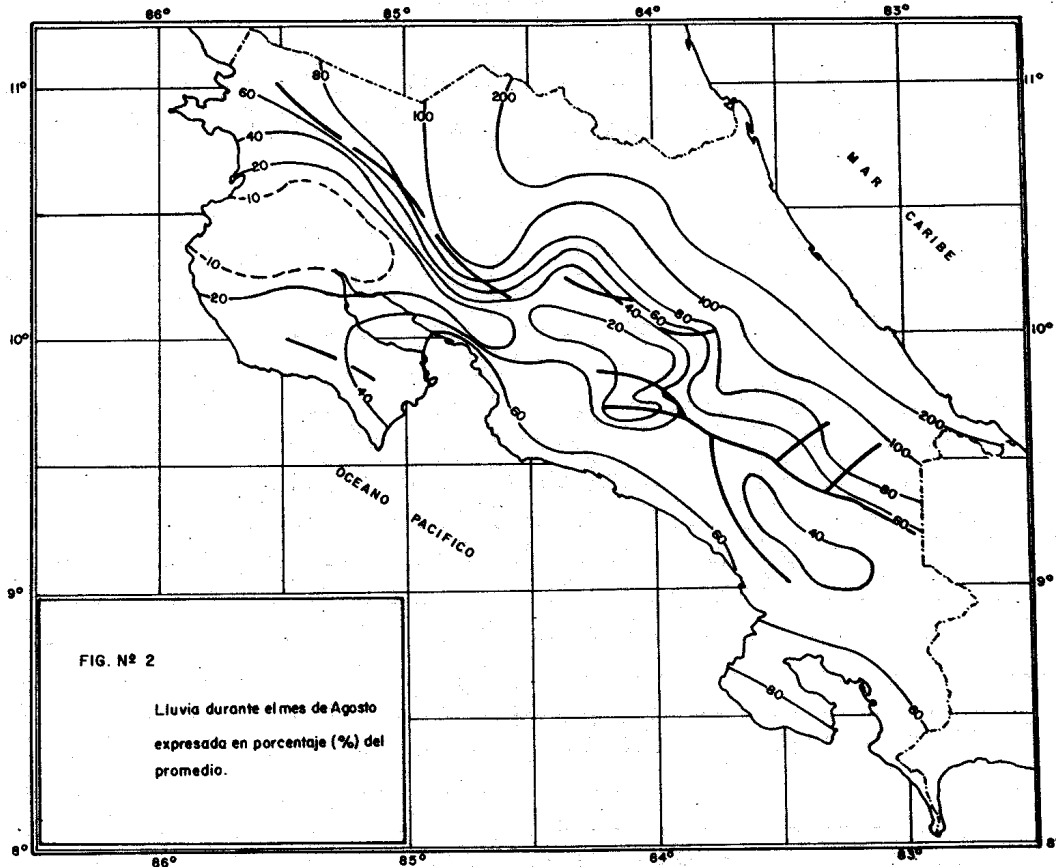
2. If known, what were the climate-related anomalies and impacts in your country of the **1982-83 event**?

The climate-related anomalies and impacts of the 1982-83 event were not recognized as being part of the El Niño phenomenon at the time. Documentation on climate variability describes droughts in this period. It was actually Michael Glantz who made the first connection between the climate related anomalies and “EL Niño” in a congress in December 1982 on climatic variability (personal communication with Ramirez, P.). Climate variability was not considered to be part of the El Niño phenomenon, which was thought to be limited to Peru and Ecuador. It was not until 1986-87 that droughts and other climate-related phenomena were described as part of El Niño (see Ramirez and Manso, internal document IMN).

Information on the climatic impacts of 1982-83 can be found in the monthly bulletins of the IMN (National Meteorological Institute) and in some studies on droughts by the School of Geography of the UNA (National University).

Climatic impacts in 1982-1983 as reported by the IMN in their monthly bulletins.

The following map with rainfall anomalies was published in August 1982. This map shows a 200% increase in rainfall for the month of August in the Atlantic zone of the country, and a maximum decrease of 10% less than normal.



3. What were the 1997-98 climate-related physical and social impacts of the 1997-98 El Niño in your country? (Include agriculture, health, water supply, migration, etc.)

CEPAL carried out a detailed survey of the damages caused by the El Niño event. The results were published as an extensive report; a tabular summary of these impacts is presented as Table 1.

**Table 1. SUMMARY AND DISTRIBUTION OF EVENTS OF
HYDROMETEOROLOGICAL CHARACTER RELATED TO THE
1997-98 EL NIÑO PHENOMENON
(April 1997- August 1998)**

Date	Type of event	Affected areas	Victims			Damaged Houses	Damaged infrastructure	Affected agriculture
			Deaths	Affected	Hostels			
25 April 97	Intense rains, flooding	Central Valley: Cantons of Goicoechea and Desamparados	1	-	-	-	Water sanitary system	-
2-5 May 97	Tropical wave in the Caribbean, Flooding	Provinces of Limón, San José y Heredia (30 communities)	-	-	527 persons	6 destroyed 32 severe 496 light	Various parts of the road, 3 bridges, water sanitary system of Limón	- Note: Decreto Ejecutivo 26020
7-9 July 97	Flooding because of tropical wave Caribbean Sea	Province of Limón (southern part)	-	-	-	-	Damaged road	- Note: Decreto Ejecutivo 26261 MP-MOPT
16-18 July 97	Flooding because of tropospheric phenomenon associated with a cyclone system	Provinces of Limón and Alajuela: Cantons of Pococí, Guácimo, Guatuso	-	8885 persons	80 persons	70 light 26 necessity of re-location	Roads and bridges damaged	
23 July 97	Flooding because of intense rainfall in the Caribbean watershed	Provinces of Limón and Heredia: Cantons of Matina, Sixaola, Sarapiquí	-	Evacuated population Two villages without communication	N/D	-	Landslides in Roads	

Date	Type of event	Affected areas	Victims			Damaged Houses	Damaged infrastructure	Affected agriculture
			Deaths	Affected	Hostels			
4-7 August 97	Tropical wave, Flooding, desbordes, landslides	Province of Limón (Matina, Siquirres, Limón, Talamanc a, Valley of the Estrella), Province of Cartago	2 deaths 2 dis-appearances	5000	18 hostels 2424 persons	110 light	5 Water pipes, 16 bridges, 31 national and canton routes, tower of electric transmission line, Part of oleoducto	
27 October 97	Local Tornado	Cantons of Alajuela and Belén	-	279	N/D	86 damaged	Energy transmission lines and telephones destroyed	-
14 November 97	Intense rains, instability of slopes, inundations, avalanches	Province of Cartago, districts Cervantes, Pacayas, Capellades	5	3	2 hostels (54 people)	5 destroyed 22 severe (2 with urgency of relocation)	Roads, 3 bridges, acueducto (water pipe)	
26 Nov. – 2 Dec. 97	Flooding originating from cyclone system Costa Rica	Northern zone: Cantons of Upala and Guatuso	1 death; 1 dis-appear-ance		2 hostels (238 persons)		Daños en Upala paths-roads, bridges (150.000.000 colones)	IDA assigned 2.000.000 colones to attend Zona Norte
January 98 – June 98	Drought (prolonged dry days)	Pacific watershed/ Guana-caste Zone Norte/San Carlos	-	-	-	-	Dry pozos	X Decretos Ejecutivos: Ago.97: 26290 MP-MOPT-MAG Dic.97: 26608 MP-MOPT-MAG Mayo98: 27075 MP-MOPT-MAG
26 January 98	Flooding	Alajuela: Tambor	-	-	-	2 damaged		
16 March 98	Forest Fire	Punta-renas: Guabo						Approximately 200 ha burnt

Date	Type of event	Affected areas	Victims			Damaged Houses	Damaged infrastructure	Affected agriculture
			Deaths	Affected	Hostels			
26 April	Forest fire	Guana- caste: Guana- caste national parc						X Approximately 350 ha Burnt Emergency state declared
27 and 29 May 98	Flooding and landslides because of an excess of rain	San José: Gardens	-	-	-	2 houses damaged, 200 en dangered; Need for relocation of 40 families	Roads and bridges	
22 May 98	Flooding	Alajuela: Los Chiles	-	(4 commun- ities without commun- ication)	-	-	1 bridge	
30 June-6 July 98	Cyclone system- atmos- pheric instability, intense rains, inundation of rivers	Guana- caste and Northern watershed	-	-	-	-	Parts of the road damaged	
26 July 98	Flooding and avalanches	Cartago, Cantons Paraíso, Cachí	-	N/D	N/D	2 destroyed 21 damaged Need for relocation of 22 houses	Roads and damaged bridges	x Nota: Generó Decreto de Emergencia. Total damage, approximately 197 millions colones

Source: CEPAL, n.d.

Agriculture: Despite significant preparations for the El Niño, losses were registered throughout Costa Rica. Losses were caused because the forecast of El Niño was not specific enough for detailed decision-making. For example, producers are accustomed to droughts, and readjust cropping plans to their own interpretations of the impact of an ‘intensified’ drought, or slight changes in the pattern of precipitation.

The main losses due to drought were in the northern zone of San Carlos, due to dry conditions, which greatly exceeded the meteorological prediction; in fact, little drought impact was predicted, and as a result inappropriate preparations were made.

Most important effects of the “El Niño” phenomena were the extension of the normal monsoon drought by several months, with heavy rainfall at inconvenient moments affecting the flowering of certain crops and inhibiting the use of machinery in others.

The most affected regions were the Northern Pacific (Guanacaste), the Central Pacific and Huetar Norte (northern part of San Carlos) where an important part of the rice and bean production takes place. These regions also include a great deal of livestock production. The harvest of beans was not profitable due to reduced yields and cattle suffered from the extended drought, two months longer than usual. Meat production was affected and several thousand head of livestock died.

Guanacaste has traditionally been a cattle raising region with animals well adapted to the dry circumstances. However, the prolonged drought disturbed traditional operational systems and provoked the selling of cattle and reduced the reproduction possibilities.

The Huetar Norte region produces 40 – 45% of the country’s beans, and the delay of the rains damaged the bean harvest, many farmers lost their harvest or obtained poor results.

Some other very profitable export crops were affected in the northern and central pacific, Huetar Norte, including orange, palm heart, mango, melon, cassava, tequisque and ginger. Some crops were more heavily damaged than others, depending on their characteristics and their location. Economic consequences will have more impact for small farmers, for example the case in palm heart production. Citrus production is in the hands of large companies that will be able to survive lower production rates more easily.

COSTA RICA: SUMMARY OF LOSSES IN AGRICULTURE, LIVESTOCK AND

FISHERY

1997-1998
(Millions of dollars)

Sector and subsector	Damage			Increase of import	Decrease of export
	Total	Direct	Indirect		
TOTAL	52.4	34.4	18.0	22.3	6.9
Agriculture	32.8	25.6	7.2	22.0	4.9
For internal consumption	23.7	16.6	7.0	22.0	0.0
Rice	11.9	9.1	2.8	6.1	
Beans	11.1	7.2	3.9	13.1	
Corn	0.7	0.4	0.3	2.8	
For export	9.2	9.0	0.2	0	4.9
Sugar cane	3.0	3.0			2.0
Other	6.2	6.0	0.2		2.9
Livestock	16.0	8.6	7.4	0.1	2.0
Cattle	9.4	7.2	2.2		2.0
Aviculture	1.4	1.4			
Pasture	5.2		5.2	0.1	
Fishery Sector	3.6	0.2	3.4	0.1	0.0
Fishery	3.4		3.4		
Acuaculture	0.2	0.2		0.1	

Source: CEPAL n.d.

a/ reduction of export: 150 thousand dollars de malanga; 2.28 millions of mango; 280 thousand watermelon; 220 thousand of papaya. Export of juices also diminished.

Health: No major problems were detected, although there was a potential risk for sicknesses such as dengue and malaria existed.

Water supply: The sector was well-prepared and had some savings that were immediately disposable, some miscalculations on the higher rate of consuming water caused the need to ration the water in some parts of the country.

Migration: Different conditions for agriculture affect the dates of harvest; consequently seasonal workers will have to come on other than the usual time.

4. What is the reliability of those attributions?

It is hard to demonstrate that all the mentioned effects can be attributed to the El Niño. Climatic variability in Costa Rica is high, droughts and flooding occurs even in years without El Niño. It seems clear that an intense El Niño like the 97/98 event brings about an important increase in the number of the aforementioned impacts.

On a popular level, there is no question that the disasters were caused by El Niño, although this is clearly not a professional or carefully analyzed position. Nevertheless, it does drive certain policies for preparation, and is frequently cited as a justification for an increase in disaster preparation.

Responses

1. Were any government reports or statements issued before the impacts of the 1997-98 El Niño appeared?

The government responded to the El Niño in progressive stages, beginning with a series of alerts, followed by awareness meetings and action plans, and finally by decrees and legal declarations. It must be mentioned that the 'government' response was a series of fairly localized activities tied together by various coordinating committees. The CORECA/MAG group issued a series of warnings, and other government institutions responded as seemed appropriate to them; in the end, the collection of responses seemed quite appropriate, but interestingly enough did not represent a single directed activity. Some of these are listed below:

- A letter of CORECA to the Minister of Agriculture and Livestock after receiving the message from Eladio Zárate about the forecasted El Niño (May 1997).
- With the notification of CORECA and the initiation of preparation activities, there were a series of statements and meetings internal to the government ministries. There was also the initiation of a series of public awareness meetings which were especially directed toward the agricultural sector.
- A "Decreto" was issued announcing the following measures being taken from 1-5-1997 (CEPAL says August 1997):

- a) State of “necesidad y urgencia por calamidad publica” (‘necessity and urgency due to a public disaster’) because of the impacts of the El Niño phenomenon in the Pacific watershed and the Pacific Maritime Fishery Zone.
 - b) This ‘state or emergency’ makes necessary measures possible
 - c) The National Emergency Commission coordinates preventive or reconstruction activities
- The decreto mentions in March 1997 El Niño has been forecast by the meteorological service (IMN) and the regional service for oceanographic research (SERIO), and that its effect can already be felt in April 1997.
 - Most important governmental report is the mitigation “plan for the effects of El Niño in the agro sector” by MAG-CORECA that proposes a series of actions to mitigate the foreseen impacts. The plan is published in August 1997. There was close collaboration with MAG, CNP, SENARA, INCOPECA, INS and the BNCR (Banco Nacional de Costa Rica). The plan consisted of three aspects:
 - a) Early warning
 - b) Establishment of a coherent set of actions to control the effects on population, economic activities, and environment
 - c) Measurement of the impacts
 - A first workshop organized by the CNE was held in April 1997, before the decreto would become law. This workshop resulted in coordination between authorities of meteorological institutions and responsible institutions of the agricultural, drinking water and electricity sectors. A second meeting was held at the end of May 1997 where the institutions agreed on certain plans of action.
 - In June 1997 the COENOS (Comisión Técnica Consultiva Nacional del Fenómeno ENOS) Commission was installed with representatives of the parties involved, coordinated by the National Meteorological Institute. The commission had the task to evaluate and inform about the development and effects of the ENSO phenomenon as well as the planning of response measures. In September the same year a “Plan Regulador” was presented that proposed a series of measures and executive units. In December a second decreto was presented, including more areas to the state of alert.

Those actions were taken when effects of the phenomenon had already been felt, although the worst part of the impacts was still to come.

2. Were any reports issued after the impacts appeared?

The FAO/CEPAL report is considered the most complete evaluation of the impacts of the 97/98 Niño in Costa Rica, describing impacts on the different sectors and organization and response of the government. The CEPAL mission consisted of a group of international consultants: Ricardo Zapata, Roberto Jovel, Margarita Flores, Helena Molin, Alfonso Mata and Antonio Tapa, with help of Manuel Jiménez and Ezequiel Garcia of CORECA.

3. What were the major **responses** to the event?

In addition to governmental responses mentioned above, there was the formation of the COENOS commission and the release of some “decretos”, catalyzing preventive and reconstructive responses and measures to control negative impacts of the climatic anomalies. CEPAL constructed a table of the collected funds to finance the different measures. It is worth mentioning that funds of the CNE (National Emergency Commission) that were assigned to the prevention of foreseen damages related to El Niño were not approved by the Contraloría (National Controlling Office, as the CNE was legally only assigned to respond to disasters, not to anticipate them. Since October 1999, a new law permits the CNE to also execute preventive measures, giving the institution a broader range of action. The CNE changed its name to ‘Comisión Nacional de Prevención de Riesgos y Atención de Desastres’ (National Commission of Prevention of Risks and Disaster Response).

However, until today, public institutions as ICE, AyA and INVU refuse to contribute financially, as was agreed, for the institutional expenses of the CNE.

**COSTA RICA: EXPENSES OF PREVENTION, EMERGENCIES AND MITIGATION
ASSIGNED TO CONFRONT THE EL NIÑO PHENOMENON, 1997-1998**

	Amount in colones	Amount in thousands of dollars
TOTAL	3,364,732,212.0	13,458.9
Emergency funds assigned to governmental institutions through the CNE	2,045,982,212.0	8,183.9
Decreto 26020 (3-5 May 97)	990,460,331.0	3,961.8
Decreto 26261 (7-9/16-19 July)	520,726,583.0	2,082.9
Decreto ENOS 26290 (drought)	534,795,298.0	2,139.2
Expenses of the Emergency funds (first) CNE, period April 97 until July 98
Family assignments, including fishermen por veda (IMAS)	174,000,000	696.0
Reoriented loans		
Banco Nacional de Costa Rica, credit line preferentially for cattle raisers	1,000,000,000	4,000.0
BID, Reoriented credit lines for irrigation (under execution of SENARA)	550,000,000.0	2,200.0
Canal Oeste, Irrigation district Arenal-Tempisque (still to be executed, private funds)	750,000,000.0	3,000.0
Received donations		
PNUD, support to Plan Multisectoral de Mitigación (April of 1998)	18,750,000.0	75.0

Source: CEPAL, n.d.

Plans and measures of mitigation and prevention that were executed with these collected funds are described in the CEPAL report.

- A communication campaign has been released through COENOS and the Public Information Sector (SIPE) using mass media. The Costa Rican population was informed of measures to be taken to confront the heat, to control the use of water and to prevent forest fires.
- MINAE (Ministry of Environment and Energy) together with INS (National Insurance Company) started a campaign to prevent forest fires, especially in the province of Guanacaste. The campaign resulted in a quicker response to fires, which prevented them from causing major damages, although the number of fires was higher than normal.

An action plan to confront the effects of El Niño in the agricultural sector has been published in August 1997, elaborated by MAG and CORECA (Plan para mitigar los efectos del fenómeno de El Niño en el sector Agropecuario). There was close collaboration with MAG, CNP, SENARA, INCOPECA, INS and the BNCR (Banco Nacional de Costa Rica). The plan consisted of these three aspects:

- Early warning
- Establishment of a coherent set of actions to control the effects on population, economic activities, and environment
- Measurement of the impacts

In the aftermath of the 1997-98 El Niño, queries were made to MAG regarding their evaluation of the event (as specified in their action plan), but MAG reported that no information was available. However, subsequent conversations with the head of the MAG El Niño effort clarified that, in fact, information collection had begun. However, this coincided with the election of a new President of Costa Rica, the replacement of the head of the El Niño working group, and the interruption and loss of the ongoing efforts.

CNP (Consejo Nacional de Produccion) worked in the following:

- Supplementary food for the cattle, subsidizing (transport of) cattle food--molasses, hay, and other animal supplements. In the northern zone farmers received help with grassland, water and alimentation.
- Support for small productive units
- Support for projects generating employment

According to Jorge Orozco, one of the responsible persons of CNP for the El Niño campaign, support offered by the CNP was not always appreciated by the farmers, who argued the amounts of money provided were too small. Consequently, parts of the disposable funds have not been spent.

SENARA (Servicio Nacional de Aguas subterranas Riego y Avenamiento) oriented its action toward works in irrigation. One of the most concrete responses was the change in the timetable of ongoing development projects in areas potentially affected by drought, in order to give the highest priority to irrigation activities.

INCOPECA, the national fishery institute, established a plan to help reduce the negative impacts to the fishery sector. Together with IMAS (Instituto Mixta de Ayuda Social) alimentation and training were provided. SERIO (regional service for oceanographic research) distributed satellite imagery to identify zones of major fishery potential both within and outside Costa Rican national waters.

The agricultural sector requested the national banks to establish credit lines for the farmers to help them confront the impacts. Only the Banco Popular and the Banco Nacional de Costa Rica responded positively.

The health sector, with help of the OPS (Organizacion Panamericana de la Salud) focused on efforts at a Central American level in the following: analysis in risks for epidemics, preparation of action plans, integration between countries, transmitting and exchange of information and training of personal in the health sector.

Control of certain health aspects has been reinforced, especially sicknesses transmitted by water or food (i.e., cholera, salmonella) along with sicknesses transmitted through insect vectors (i.e., malaria, dengue).

Campaigns against dengue were carried out including spraying, publicity and visits to communities.

To provide drinking water in dry zones, some new wells have been constructed and sometimes water was rationed. AyA contributed with various works in Guanacaste.

The most dramatic response to the El Niño event was the campaign to reduce impacts on the cattle herd. Two areas were expected to be especially hard hit: Guanacaste and the Central Pacific region. In both of these areas, the Ministry of Agriculture recommended a reduction of the cattle herds due to the coming drought. The recommendation resulted in a massive sell-off of cattle; this caused a drop in the price of the animals due to oversupply, and a redistribution of the animals to the Northern Zone where the drought was forecast as not being severe.

Two unexpected results came of this effort. First, unexpectedly, the drought did in fact extend to the Northern zone, exceeding the forecast of the weather service. Thousands of cattle were lost which had been transferred there in response to the drought forecast and the sell-off on the west coast. The second result was the decapitalization of the cattle sector in the Central Pacific region, due to the forced sale of animals at low prices; as a result, the cattle industry has still not recovered from the drought prevention strategy; there is some question in the ministry whether the sell-off recommendation was in fact correct, over the longer term.

4. Identify (with citations, if possible) the extent of national research (in the last 20 years) in your country on:

a. El Niño

IMN, monitoring of the climate through climatologic stations in the country and through contact with international climatic institutions.

SERIO from the school of oceanography and coastal studies (UNA) has an important contribution monitoring Sea Surface Temperatures, using satellite imagery.

b. Climate-related hazards

Research in this field has been done by UCR: Escuela de Geología y de Geografía (schools of geology and geography) that both developed a MSc. program in natural disasters. The school of geology has some specialists on landslides.

CIGEFI, in close collaboration with the department of meteorology, school of physics (UCR) has been working on climate related hazards for some time.

UNA: Escuela de Geografía, which has the MADE (Applied Morfoclimatology and Exogene Dynamics) program that is focused on flooding in Costa Rica.

FLACSO: with a virtual MSc program in disasters.

CNE: as most important organization involved with disaster mitigation, keeps track of the major developments.

A good source of (national) research (in the last 20 years) in Costa Rica is: Regional Disaster Information Center Latin America and the Caribbean (CRID):

<http://www.crid.or.cr>, <http://www.crid.desastres.net>

5. Is there a national plan to respond to disasters? [IDNDR to address this question]

Within the framework of the CNE, the national emergency commission has a series of procedures and years of experiences attending emergency situations. See also www.cne.go.cr

6. Is El Niño explicitly considered to be a disaster in your country? [IDNDR to address this question]

Droughts associated with the El Niño phenomenon are considered a disaster, however, since its development is slow, it does not receive the same attention from the government as other natural disasters. The National Emergency Commission, in charge to respond to disasters is more focused on disasters causing severe problems in a short period of time. The response to droughts has a more preventive character. With the new emergency law, permitting the CNE to execute also more preventive measures, droughts might receive the same attention as other natural disasters.

7. Identify (with citations, if possible) any international research about the impacts of El Niño events on your country.

Most studies about the El Niño phenomenon in Costa Rica are done by national or regional (Central American institutions as CORECA or CRRH) (see list of consulted literature and <http://www.crid.or.cr>, <http://www.crid.desastres.net>)

Two projects on a broader scale are worth mentioning:

- Feasibility study for the prediction and amelioration of socioeconomic impacts of El Niño Southern Oscillation (ENSO) in Latin America and the Caribbean (WMO project)
- Project mitigation of disasters en Central America; improving technical capabilities to mitigate the effects of future El Niño events. (CEPREDENAC- CRRH project)

Forecasting by Analogy (i.e., using recent historical examples to plan ahead)

1. If a perfect forecast had been available as early as October 1996 (knowing what is now known about the actual impact), what could have been done differently? (Do not take into consideration at this time any restrictions on possible actions.)
 - a. About information flow?

Interinstitutional information flow has been constant and sufficient. Subsequent transmission of the information to all layers of the population, especially farmers in remote areas can still be improved. Various campaigns have been organized to inform the population through meetings and the media.

Representative organizations of the various productive sectors complain the information they receive is not specific enough; they would like more 'user friendly' information, which targets impacts on specific crops, or at specific times of the year, rather than a probabilistic prediction, which requires much interpretation. The IMN agrees it would be desirable to produce this kind of information, but has no resources to do so. The meteorological service, on the other hand argues productive sectors do not support them sufficiently; due to budget constraints, the meteorological service has turned over many meteorological stations to the Ministry of Agriculture, some of which are no longer providing information. An agrometeorological research unit was started in the IMN in 1997, and some progress in their communication with the agro sector and information provision can be expected.

Lack of precise information on the intensity of the El Niño event and its specific impacts in time and space is considered the most limiting factor for the preparation of an El Niño event. Although some progress in the forecasting capabilities and transmission of information can be expected, people will have to prepare themselves with the existing level of information.

It is argued, that, instead of investing in a modernization and improvement of the meteorological service, investigation and training is required in the possible ways and strategies for the population to adapt and prepare itself, given the existing level of climatic information.

b. About preparing for the forecast impacts?

Parts of the preparation were quite successful, especially in the northern pacific, where forecasts were accurate. In the northern zone forecasts were wrong, which resulted in major damages (as mentioned above). Assuming a perfect forecast some 6 months before the event, preparations could be improved considerably, especially if everybody knew the forecast would be a perfect one. Problems such as those in the northern zone could have been prevented, and it might have provided a mechanism for a more orderly reduction of the cattle herd, which did not cause so much economic loss among the farmers.

Another problem affecting the preparation was the lack of disposable funds. The CNE (national emergency commission) supposedly would provide the funding. However, the “contraloria” (the government office in charge of monitoring expenditures and their legality) did not approve these funds, arguing the charter of the CNE was to respond to, and not to prepare for, disasters. This element of the charter was changed subsequent to 1998.

2. What are the realistic obstacles that might have prevented these theoretical actions being taken?

The major problem with early warning response to El Niño is that there is no perfect forecast. The phenomenon is variable, and to a certain extent unpredictable. Against the backdrop of the natural climatic variability in Costa Rica, a report that there is an increased chance of drought or floods does not add significant information to what people already know. A lack of confidence by the IMN regarding the accuracy of their forecast leads them to be very cautious in issuing an El Niño warning, for fear that it will negatively affect their credibility in other contexts (where information might be more reliable). With the lack of a reliable forecast from IMN, other government agencies are less likely to mobilize scarce resources to prepare for an uncertain disaster.

3. Can El Niño considerations be added explicitly to national disaster plans?

Since the legislation for the national emergency commission recently to include efforts to prevent disasters, El Niño preparation definitely should be considered. However, El Niño still is not considered the most urgent type of disaster and it is not clear if it will be included in national disaster plans.

As mentioned above, Costa Rica is a disaster prone country. El Niño does not present any special disasters, but rather an intensification or higher probability of common disasters such as flooding and drought. It was commented by some government functionaries that in their own preparation for El Niño, they found existing (but in some cases unimplemented) plans for confronting floods and droughts to be extremely useful.

The most appropriate response to the El Niño prediction is a heightened state of preparedness for disasters, including a review of contingency plans for communications in the event of floods, local disaster response stocks (food, water, medical supplies), and the review of evacuation and response plans.

4. Identify the strengths and weaknesses in the way your country responds to El Niño-related climate anomalies.

Strengths: Coherent interinstitutional collaboration, representatives of regional organizations as CORECA, CRRH available and mainly focused on Costa Rica.

Weaknesses: Lack of a clear political structure and confusion of political responsibilities. Lack of communication to farmers that could be affected. Poor development of banking-insurance sector; no provision of alternatives for farmers. No funding available for preparation. Lack of capabilities to predict the intensity and the precise impact of an El Niño event in space and time, due to the complexity of the phenomenon and its complex effects in a country as Costa Rica with a very high climatic diversity. A dependency on models of international institutions forecasting the El Niño events, complicates a more specific forecast.

4. Did the 1997-98 El Niño have any influence on your country's response to the forecast in early 1998 of an expected La Niña event?

Although the impacts seem serious enough (hurricanes, flooding), the mechanisms applied in the preparation of El Niño, have not been applied by the onset of the current La Niña. The COENOS committee has not been activated, although it would seem logical.

Lic. Werner Stolz of the IMN does not have a clear answer for the lack of organization during the La Niña phase; he argues a permanent commission should be in charge of observing and preparing for climatic anomalies as El Niño and La Niña.

Lic. Juan Carlos Fallas of the same meteorological institute thinks climatic anomalies related to the La Niña phenomenon as flooding and landslides have more “emergency” characteristics and are consequently attended by the National Emergency Commission (CNE). Droughts related to the El Niño phenomenon are not an urgent in the sense that they are progressive over a period of months, while a flood develops over days or even hours. Therefore, other organizations in the country felt the need to respond to the problems caused by the droughts. Since the nature of the CNE has been changed from only attending disasters to also a more preventive attitude, its future activities might include a more complete response to the adverse climatic impacts caused by the El Niño phenomenon.

When discussing La Niña in Central America, the primary reference point is Hurricane Mitch; it may not be the first hurricane associated with La Niña to affect Central America, but it had the most impact of any in living memory, and is the most clearly associated with La Niña. It is noteworthy that the prediction for the intensity of the hurricane season is a major news item, and appears repeatedly, either as a report of the regional declaration from the US hurricane center, or as a commentary by the national meteorological service on that original report.

Lessons Learned

1. In some sense, the issuing of a warning raises an expectation of responsibility on the part of the warning agency. As an economic disaster, recovery is politically complex, since without a loss of life a 'disaster' takes on a different aspect in the public mind. Some parts of the economic disaster are directly caused by the lack of proper preventative measures; the forced sale of cattle in the face of drought drops the price and impoverishes the farmers. There is an expectation on the part of those warned that the warning agencies will remedy the problems which arise. The justice of this expectation is questionable, since it might be argued that the farmers were saved from greater losses; in effect, the warning allowed them to cut their losses in anticipation of a greater misfortune. Unfortunately, this is impossible to demonstrate, and one might always argue that the warning was misleading, causing an economically disadvantageous decision on the part of the farmer. The lesson learned is that the warning of a possible disaster causes a series of actions, which may be negative over the long run, and there is an expectation of responsibility for these negative impacts.
2. The level of detail of the El Niño forecast is so low that in some cases it tends to mislead rather than inform. While correct in the forecast of a drought in Guanacaste, cattle was moved to an area where no drought was forecast, but which later occurred, creating an intensified crisis. Since the forecast drought turns out to be functional rather than absolute, i.e., an effective drought as a result of rain at the wrong time rather than too little rain--the forecast of a drought may cause counterproductive water conservation measures in water control and hydroelectric facilities. If water is maintained at maximum levels in expectation of drought, short intense storms may cause flooding because of improper preparation. This type of flooding has not actually occurred, but it is a possibility.
3. The determination of the economically appropriate response to a potential El Niño event is difficult because of local variability in climate, along with uncertainty as to the extent of the drought. As a result, the proposed measures may be too extreme, thus causing more harm than good. A year after the end of the 1997-98 event, some questioned whether the recommendation to sell off cattle in fact was justified in view of the economic losses caused. The alternative of keeping the animals and having the cattle lose weight, and having some die, may have been the more appropriate response.
4. The response to the forecast of El Niño must be geared to each national situation. In Costa Rica, a simple announcement resulted in an immediate response on an official level, and the National Meteorological Agency exercised extreme caution in its announcements and advisories to avoid an extreme public reaction. In other Central American countries, the same type of announcement resulted in very little preparation, possibly requiring a more emphatic announcement of the forecast and possible consequences than that required for Costa Rica.
5. Much of the discussion regarding the forecast of El Niño uses concepts and language which are not entirely meaningful to the general public. More effort is necessary to interpret

meteorological information about El Niño and present it in language specific to different sectors: Example, agriculture, hydroelectricity, or potable water services.

6. As an occasional event, there is a tendency for a lack of continuity in preparedness for El Niño. Since governments change every 4 years and personnel in ministries change as well, the technical awareness of preparation and response methods has a tendency to dissipate.

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Acronyms

AyA: Acueductos y Alcantarillados

BNCR : Banco Nacional de Costa Rica,

CEPRENAC: Centro de Prevención de Desastres Naturales en América Central

CEPAL: Comisión Económica para América Latina y el Caribe

CIGEFI: Centro de Investigaciones Geotecnicas

CNE: Comisión Nacional de Emergencia (ahora: Comisión Nacional de Prevención de Riesgos y Atención de Emergencias)

CRRH: Comité Regional de Recursos Hidráulicos

COENOS: Comisión Técnica Consultiva Nacional del Fenómeno ENOS

CORECA: Consejo Regional de Cooperación Agrícola

FLACSO: Facultad Latinoamericana de Ciencias sociales

ICE: Instituto Costarricense de Electricidad

IMAS: Instituto Mixta de Ayudo Social

IMN: Instituto Meteorológico Nacional

INCOPECA: Instituto Costarricense de Pesca

INS: Instituto Nacional de Seguros

MADE: Morfoclimatología Aplicada y Dinámica Exógena

MAG: Ministerio de Agricultura y Ganadería

MINAE: Ministerio de Ambiente y Energía

OPS: Organización Panamericana de Salud

PNUD: Programa de las Naciones Unidas para el Desarrollo

SENARA: Servicio Nacional de Aguas subterráneas Riego y Avenamiento

SERIO: Servicio Regional de Información Oceanográfica

SIPE: Sector de Información Publica

UCR: Universidad de Costa Rica

UNA: Universidad Nacional

Appendix I

Gray literature; front-pages

Appendix II

Newspaper articles on El Niño, a selection from 1995 – 2000 of “La Nacion”.

Appendix III

Program congress “Reduction of the impact of climatic variability, the case of ‘El Niño’ 1997/1998 in Costa Rica”

Appendix IV

Addresses of Congress Participants

Appendix V

Posters