

**REDUCING THE IMPACT OF
ENVIRONMENTAL EMERGENCIES
THROUGH EARLY WARNING AND
PREPAREDNESS - THE CASE OF EL
NIÑO-SOUTHERN OSCILLATION
(ENSO)**

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**IMPACTS OF THE 1997-98 EL NIÑO EVENT IN
PERU**

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[**Acronyms:** CU: Columbia University; FEO: Fishmeal Exporters Organization; IMARPE: Instituto del Mar del Perú; FAO: United Nations Food & Agriculture Program; LDEO: Lamont-Doherty Earth Observatory of Columbia University; NASA-JPL: National Aeronautics and Space Administration, Jet Propulsion Laboratory; NCAR: National Center for Atmospheric Research; UC Davis: University of California at Davis; USC: University of Southern California]

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The El Niño Phenomenon in Peru: 1997-99

Socioeconomic description of the country

(See Appendix A for general economic statistics)

a. The Economy

During the 1990s, an advanced process of neo-liberal reforms was implemented, radically transforming the Peruvian economy. A significant part of public sector enterprises were privatized and the market became the dominant mechanism determining the allocation of resources and earnings. Twenty years of populism paved the way to one of the freest economies in the world. During most of the decade, Peru was able to attract significant foreign capital contributing to the equilibrium of the balance of payments, counteracting a trade balance historically and consistently in the red. Indeed, imports continue to significantly outpace exports because the neo-liberal policies have not transformed the structure of production.

Peru continues being an exporter of raw materials. During the 1990s the mining industry and fishmeal exports made up to three fourths of Peruvian exports, echoing the last forty years. The worldwide financial crisis of 1998 was born in Southeast Asia, moved on to Russia and finally reached the shores of Latin America, plunging Peru into a deep recession which cripples it still, into the new millennium. El Niño aggravated that recession, but its cause can be traced to the limitations of the neo-liberal economic reforms of the 1990s.¹

The government of Alberto Fujimori has made substantive modifications in the public sector economy in the 1990s. Public revenues have increased. The 1992 budget amounted to 5,000 million soles, while the 1999 budget exceeds 32,000 million soles. In constant terms, the state has tripled its revenue, a fate not shared by the citizenry.

Thus, the state continues being a significant economic agent, albeit not working through public enterprises, as was the case during the previous decades. At present, the state has returned to the condition of “great contractor”, whose requirements energize a large group of companies and sectors, which are therefore at the forefront of national economic activity. The economic reforms have privatized earnings, but public investment is still a transcendental economic factor.

b. The Government and El Niño

Members of the scientific community in Peru issued a forecast about El Niño in June 1997, prompting the central government to set in motion a plan of preventive measures. It was the first time that a plan of this nature had been implemented in Peru. In all the previous El Niño events, the government reacted in the midst of the El Niño-related Southern Hemisphere summer rains.

¹ Refer to Efrain Gonzales for a treatise on the Peruvian economy in the 1990s, *Neoliberalismo a la peruana: economía política del ajuste estructural*, Lima: Instituto de los Estudios Peruanos (IEP), 1998.

This time there were six months of lead-time to implement a structured plan whose main merit was, in fact, the timeliness of its preventive measures.²

This plan accurately defined how to handle the approaching problem. It established the goal of facilitating the drainage of the excessive rainwater into the ocean. A series of riverside levees to contain the surging river waters were constructed; water-pumping equipment was acquired, in order to alleviate the inevitable flooding of the very low-lying areas. The response of the central government was, perhaps, incomplete because it ignored the issue of financial assistance to enterprises battered by El Niño. The response did, however, include an exact definition of how to face the main problem.

The government's stumbling block proved to be a flawed consideration of the "how," because the central government wanted to do everything itself without the assistance of other governmental agencies or of society at large. The central government was interested in highlighting its importance as a guarantor of the security and prosperity of Peruvians. In addition, the government of President Alberto Fujimori wanted to highlight its efficiency and start paving the way for a third term in office without the interference of another agency that might question or dilute its leadership.

The executive branch doesn't want to share authority and, in addition, doesn't want to be supervised by other agencies. This distrust did not begin yesterday but rather, follows a long historical tradition. The government tends to concentrate resources and power in the hands of officials, hand picked by the executive branch because these people are highly dependent and their obedience is guaranteed.³

In Peru, lamentably, the state machine is centralized, and its core is afflicted with disorder and dispersion. There are too many public entities and their operational areas are ill-defined. So, turf wars, conflict, and competition are the daily bread, even in the inner sanctums of the executive branch. During El Niño, this conflict became apparent in light of the government's inability or unwillingness to designate a team leader to execute the work of riverside levees; keystone of the master plan set in motion by the government itself. In addition, a coordinator was not designated to manage the overall plan, resulting in a general chaos featuring a big corruption scandal. Peruvians have been afflicted with the authoritarian aspects of centralization, without enjoying its potential advantage for orderliness.

The central government's predisposition towards self-perpetuation leads it to trust only those who are beholden to it. It is suspicious of anyone elected independently, anyone who might enjoy a measure of personal autonomy. This tradition leads it to undertake projects whose real

² We have explored the government's preventive plan in a book; Antonio Zapata y Juan Carlos Sueiro, *Naturaleza y política: el gobierno y el fenómeno del Niño en el Perú*, Lima: IEP, 1999.

³ Refer to "La economía política del ajuste y la reforma estructural en el Perú: el estado de la cuestión y la agenda pendiente" By Martin Tanaka on Public Finances during the 1990s, in Elsa Bardalez et al. *Repensando la política en el Perú*, Lima: Red de Fomento a las Ciencias Sociales, 1999.

purpose is to lock in allegiance and loyalty; therefore, political objectives define the nature of the programs executed by the central government.⁴

c. National Institute for Civil Defense (INDECI)

INDECI is a specialized institution of the executive branch in charge of civil defense against acts of nature. The Peruvian government in the 1930s first adopted the concept of civil defense. It was initially seen as an extension of the military's duties into the area of civil society at large. In a sense, it was merely an extension of the notion of total war developed by the perpetrators of World War One. After several cycles and interruptions we come to the military government presided over by Juan Velasco, that established the basis of a legal regime of civil defense that continues to this day.⁵ In 1972 the system of civil defense was enacted into law, having been modified in the 1980s and again in the 1990s, but that continues being the bedrock of the government's policy in the face of natural disasters.

The system of civil defense of the seventies was seen as an integral part of the national defense system. Its purpose was the protection of the population in case of disasters, providing timely assistance and assuring its rehabilitation.

INDECI is currently allied to the Presidency of the Council of Ministers, which oversees a grab bag of public institutions, which do not have a direct relationship with the ministries or other formal sectors. A small bureaucracy integrated by officials of the Peruvian army directs INDECI, in Lima as well as the provincial capitals. The system also determines the district wide and local levels of responsibility of the mayors. This is a curious arrangement; ill-designed to work as part of a cooperative effort. The military is in charge of the mayors. This system has proved unworkable in Peru because the military is the representative of the central government and the mayors represent local government, which is often independent of the central government.⁶ There has always been serious strife and its organizational limitations have made the system of civil defense weak and of very limited influence. In addition, the military is unaccustomed to consensus seeking and dialog, while the mayors require consensus to carry out their initiatives.

Furthermore, INDECI feels that implementing preventive measures is the responsibility of the Ministry of Education. This concept posits that prevention is a cultural matter, and has to do with education, to be imparted mainly during the school years. Therefore, INDECI believes that its specific mission is of humanitarian aid in case of a natural disaster. Their idea is to arrive with assistance after the disasters occurs. Some attention is given to what happens before a catastrophe, but it is more in order to be prepared on the issues of supply and storage, without

⁴ Cynthia McClintock, "Es autoritario el gobierno de Fujimori?", in Fernando Tuesta Soldevilla, ed. *El juego político: Fujimori, la oposición y las reglas*, Lima: Fundación Friedrich Ebert, 2000.

⁵ Eduardo Franco y Linda Zilbert wrote a very complete article entitled "El sistema de defensa civil en el Peru o el problema de la definición del campo de los desastres," in Allan Lavell y Eduardo Franco, eds. *Estado, sociedad y gestión de los desastres en América Latina*, Lima: Flacso, 1996.

⁶ The influence of the military on Latin American politics has been studied extensively. There is a very thorough global compilation by Brian Loveman and Thomas Davies: *The Politics of Anti-politics: the Military in Latin America*. Lincoln: University of Nebraska Press, 1989

much thought given on how to avoid or diminish the risk to begin with. These serious structural and conceptual limitations make INDECI an institution with scant professional preparedness.⁷

d. The Municipalities

In provincial Peru, local power is concentrated in the municipalities. All those interested in directing local affairs converge into that political arena. The municipalities are the last echelon of the state apparatus, and are therefore accessible to social institutions and the general populace. In 1980 they reclaimed their democratic roots, having been until then, and for most of the century, minor authorities hand picked by the central government. Its responsibilities have evolved from an exclusive focus on public services to an involvement in topics dealing with local development.⁸

On one hand, the spatial distribution of the Peruvian population is very uneven. Two thirds of the population lives in cities and one third in rural communities. On the other hand, four fifths of the municipalities are located in these rural communities. Thus, in the geographical spaces where most of the population lives and works, there are relatively few municipalities, while most of the municipal town councils are in enormous, almost empty spaces, with land to spare, but with a sparse human population. This majority of rural municipalities has very limited resources and low political exposure; their local influence is, nevertheless, decisive.

There are a great number of municipalities in Peru, a fact that has significant political consequences. The ratio of municipalities per inhabitant is much higher than that of our neighbors. This high municipal density is due to the existence of municipalities at the district level. This is not the case in other countries of the region. In Colombia there are five hundred municipalities and in Chile there are two hundred, while in Peru, adding both the district and provincial level municipalities, there are over two thousand. There are two opposite dimensions to this excess of municipalities. On one hand, society has easier access to this type of government, because municipalities are situated close to the civilian population. Thus, it is the favored environment for participation and cooperative efforts among citizens interested in local progress.

The other side of this coin reveals that more municipalities mean more fragmentation and less synergy of interests. Seen in this light, a higher number of municipalities enhance the ability of the executive branch to tame municipal authority in the tradition of “divide and conquer.” It comes as no surprise then, that this highly fragmented municipal system has been unable to organize solid institutions for collective bargaining. The Association of Peruvian Mayors (AMPE), in addition to changing its political affiliation regularly, is little more than a periodic congress of aldermen. It lacks the organizational structure to be an institution of effective collective representation.

⁷ Refer to Romeo Grompone, *Las nuevas reglas del juego: transformaciones sociales, culturales y políticas en Lima*, Lima: IEP, 1999 on notions of order and efficiency in Peruvian political culture.

⁸ Inés García de Chu and Maria del Carmen Piazza have recently done research work on Peruvian municipalities: *Sociedad y gobierno local: espacios de concertación y democracia*, Lima: Desco, 1998.

Municipal resources are quite scarce and their economic wherewithal is minor. Historically these resources have always been very limited. In 1999, the budget allocated to them amounted to the ridiculous sum of the 3.8%, while the executive branch fed on 94% of the budgetary pie.⁹

Throughout the El Niño cycle, the mayors constantly pointed out that their constituent's impoverished condition prevented them from adopting personal measures to protect their homes. Likewise, the mayors made it perfectly clear that their meager budgets did not allow them to carry out important and necessary projects. Instead, they must attempt to negotiate for economic assistance with members of the executive branch. The typical Peruvian mayor is a negotiator, not an executive. Under such restrictions, municipalities were unable to carry out major infrastructure projects during El Niño. They left that responsibility to the central government.

The municipalities' main merit was their capacity to organize forums dealing with preventive measures and reconstruction. Lacking the resources to carry out public works, they specialized by organizing meetings to debate plans, coordinate initiatives and summon the citizenry. Their initiatives in this area were very significant throughout the El Niño cycle, enhancing their political influence. The municipalities are the only Peruvian institutions with the capacity to summon the civilian population. They foster the democratic procedures that permeate political life at the local level, in opposition to the centralism that dominates the sphere of high politics.¹⁰

e. The Armed Forces

One of the major achievements of the Peruvian government in the 1990s was a definitive border settlement with Ecuador. The last in a series of border disputes with Chile was also taken care of. These diplomatic arrangements make possible a reassessment of the role and budget of the military. Their political clout is, however, enormous and during the last decade this de facto power was made evident. Due to the fact that the 1980s and early 1990s were years of internal warfare, even though this situation no longer exists, the military still retains the function of guarantor of the stability of the government and the nation. Its responsibilities with regard to preventive measures and acts of nature are handled through INDECI.¹¹

In Peru, unfortunately, the army lacks a civil defense specialty. Consequently, the officers put in charge of INDECI lack specific training for their new job. After two years, these officers are rotated to new assignments and the new arrivals are, once again, lacking in the proper skills.

⁹ Refer to Mercedes Araoz y Roberto Urrunaga on municipal finances: *Finanzas municipales: ineficiencias y excesiva dependencia del gobierno central*, Lima: Universidad del Pacífico, 1996.

¹⁰ The local arena has been a hotbed of democracy because it provides a more favorable environment. It has been recently researched by Carlos Vargas, "Liderazgos locales y nuevos estilos de hacer política bajo la sombra del fujimorismo," in Martín Tanaka, ed. *El poder visto desde abajo: democracia, educación y ciudadanía en espacios locales*, Lima: IEP, 1999

¹¹ Research into the role of the military in the defeat of the Shinning Path uprising as well as its role in the definitive solution of the boundary dispute with Ecuador, includes the outstanding work of Carlos Tapia, *Las Fuerzas Armadas y Sendero Luminoso: dos estrategias y un final*, Lima: IEP, 1997.

Therefore, the INDECI has problems of management and stability, in spite of being overseen by the most solid institution in the Peruvian government.

Additional natural non-climate related threats that affect the country

Peru is part of the Pacific's Ring of Fire, an intensely seismic region of the planet. In addition, there are numerous active volcanoes. These phenomena are evidence that we are in a region where nature is still in intense activity, confronting Peruvians with numerous threats of natural disasters. These include:

a. Huaycos: Peruvian terminology descriptive of avalanches and mudslides. Huaycos are caused by torrential rains, soil erosion and earthquakes, and in areas heavily laden with snow (avalanches). The last centuries have been witness to an intense deforestation of the Andean highlands, contributing mightily to the avalanches. Likewise, the agricultural terraces, in disuse after the Spanish conquest, had at one time helped, not only to increase arable land, but also to control erosion and consequently to control the huaycos.

b. Drought: period of deficient moisture in the ground, caused by an insufficiency of the water supply required for plants, animals and human needs. Droughts bring about malnutrition, epidemics and population displacements. The Southern Sierra is a Peruvian macro-region prone to dry spells. Prior to the last El Niño, it was known that its rainy cycle in the northern coast had a simultaneous period of intense drought in the Southern Sierras. However, the 1997-98 El Niño did not follow this pattern because the rainy season in the Southern Sierras was close to normal, while the northern coast was being flooded.

c. Earthquakes: sudden rupture of the upper layers of the Earth, that sometimes extends to the surface, producing ground vibrations, and if strong enough, cause buildings to collapse, destroying property and life. The magnitude of an earthquake is measured on the Richter scale and its intensity on the Mercalli scale. In its five hundred years of existence the city of Lima has been leveled twice by devastating earthquakes. Before Columbus, and in the Christian era alike, the most exalted Peruvian divinity has been the "Lord of the Tremblors."

d. Tsunamis: series of powerful ocean waves generated by the sudden displacement of sea water, caused by earthquakes, volcanic eruptions or a slippage of the ocean floor; and able to propagate over vast distances. The great earthquake of 1746, the strongest on record, was followed by a devastating tsunami that erased the port city of Callao.¹²

Government sponsored scientific institutions

There are four government-sponsored scientific institutions entrusted with activities related to the weather. They are SENAMHI (The National Meteorological and Hydrological Service),

¹² The effect of natural disasters on Latin America throughout history has been explored lately in *Historia y desastres en América Latina* by Virginia Acosta, Colombia: Ciesá, 1996.

IMARPE (The National Oceanographic Institute of Peru), IGP (The Peruvian Geophysical Institute), and DHNM (The Hydrographic and Marine Directorate of the Navy). All these organizations belong to the executive branch, and are overseen by various agencies. They have a stable, coordinating organization dedicated to El Niño called ENFEN (National Study of the El Niño Phenomenon).

The **Peruvian Geophysical Institute** (IGP) has a department for climatic investigation. They have a well-established public image thanks to the professional standing of its members. The climate department of the IGP has been forecasting annual rainfall levels since 1984. The Ministry of Agriculture provides crop and planting guidance using these forecasts. The IGP has state of the art equipment and is very well connected internationally. It is institutionally allied to the Ministry of Education.

The **SENAMHI** (National Meteorological and Hydrographic service) also has a well-defined public image. It is much better known than the IGP, although its reputation is not as lofty. Its specific mission is the day-to-day weather forecast. It also does longer range forecasting. It has very close ties to the Peruvian Air Force (FAP).

The common perception is that SENAMHI always guesses right when conditions are normal, but abrupt changes catch them by surprise. Their public image improved substantially when they correctly predicted the magnitude of the “Mega Niño” of the summer of 1998. Thanks to this success, SENAMHI is undergoing an upbeat stage in their relationship with public opinion.

IMARPE (The National Oceanographic Institute), on the other hand, has a tangential approach on the topic of the weather. This institution defines its mission as the protection of the national fish biomass. They study ways to regulate the fish industry and conduct research on marine resources to maximize their exploitation. The public image of IMARPE is diffuse because they carry out research and issue recommendations, while it is the Ministry of Fisheries that makes the decisions. They are mostly out of the public's sight. IMARPE is the only state-sponsored scientific institution that deals with living beings, because their mission is linked primarily to marine biology, with the weather being a secondary, if closely related, issue. It is institutionally part of the Ministry of Fisheries, with the important participation of the Navy on its board of directors.

IMARPE is well aware that news of an impending El Niño leads to diminished investment in fishing. It is a time of panic for the various industries related to the harvesting of marine resources. Conscious of the importance of the fishing industry to the Peruvian economy, IMARPE is habitually cautious in the handling of information. For example, during the last El Niño, Marco Espino, the director of research in IMARPE told us that they had information of substantial fluctuations of marine resources as early as the Southern Hemisphere summer of 1997, but had waited until April before releasing information which amounted to a description of the initial (onset) phase of an El Niño without explicitly mentioning the name. It was only later on, after SENAMHI in June of 1997 explicitly used the term “El Niño,” that IMARPE began to speak out on the topic openly.¹³

¹³ El Comercio, June 6, 1997, p. 1.

Scientific leadership in weather issues is held by the IGP, because its forecasting abilities offer significant advantages. Indeed, the IGP can issue forecasts that extend out for a full year, while SENAMHI's forecasts are for the following day.¹⁴

IMARPE and IGP have arrived to the Internet era, posting well laid out web pages that are updated regularly. IMARPE displays the information obtained by its research ships, lab analysis, and the statistical abstracts that they produce. IGP's web page also offers abundant specialized information. In addition, IGP offers numeric weather forecasting models for the specialist in nature sciences, and a special section dedicated to El Niño. The web pages of these Peruvian meteorological institutions offer ample information. Any journalist could put together a good meteorological section, accompanied by informative illustrations, by simply going to the web page and using the posted information. The problem is that there aren't any journalists with even a modicum of meteorological training that might allow them to understand the information on the web. This training should be carried out because of its key importance in the development of a national plan to disseminate for the purpose of making available weather information.

An evaluation of Peruvian scientists reveals the standout presence of a group of local experts that, in general, have been more accurate in forecasting than the big centers in Lima. It is the case of the meteorologists of SENAMHI in Huancayo and Puno, who clearly understood the signs that the rains would be normal in the Sierras, while the famous mathematical models so laboriously worked up by the institutes in Lima, had estimated a one hundred percent correlation between the flooding in the northern coast and the expected drought in the southern Sierras. The meteorologists in the provinces have taken advantage of the Internet to maintain a relationship with scientific research centers abroad. The increased communications with the international scientific community enhance the superior capability that researchers in the provinces have to observe changes in nature over time. In Lima the sky is always cloudy. The result is that some local scientists have been more accurate than the highly reputed investigators of the capital.

The Media and the El Niño phenomenon

(See Appendix B for chronology of media coverage of forecast information)

In May of 1997, radios and newspapers began to announce the possible arrival of El Niño. Specialists held meetings and there was extensive press coverage in Piura in the second half of May. The public took notice when SENAMHI officially forecast El Niño on June 6 of 1997 (see APPENDIX B for a detailed chronology of media coverage of climate forecast information).

In order to understand the stance of the media regarding the El Niño phenomenon, it is first necessary to consider three issues. First, Peru is extremely centralized - a topic that we have already mentioned, and we will now emphasize. Lima, the capital of the country, has eleven times more inhabitants than Arequipa, the second city. Likewise, the economy is so centralized

¹⁴ The scientific activities of the IGP are described interestingly in its annual report. IGP, *Ciencia en Sociedad*, 50 years. Lima: IGP, 1997.

that bank deposits in Cusco, a high profile department in the country's interior, barely reach 1% of the deposits in San Isidro, one of the more opulent districts of the city of Lima.

Secondly, we must keep in mind that the weather in Lima is very stable and very boring. There never are extraordinary events and, although humid, it is always basically temperate throughout the year. It never rains: no thunder or hailstorms or hurricanes or any event to stir human curiosity. Consequently, the press has no interest in the weather. In other latitudes there is keen interest in the weather due to the occurrence of meteorological events of short duration and high impact. Given the high degree of centralism, the apathy in Lima regarding the weather is reflected in the media in general. In spite of the enormous diversity in the country, the decisions of the programming executives are weighted in favor of the sparse weather culture of the audiences in Lima.¹⁵

In contrast with the high quality of weather programs in other countries, our lack of interest in the weather has made our underdevelopment in this area evident. Weather reporting in Lima is a minor and unelaborated subject.

A third element that must be considered is: the political value of El Niño and the intense *partisan* struggle that it unleashed. In effect, the government tried to showcase the efficiency of its plans and highlight its efforts, while the opposition pointed out the opposite. The opposition media characterized the government's plans to deal with the very serious threat of El Niño as weak and flawed. The official media, in stark contrast, published the same news headlining the speed and notable efficiency of the government. The political posturing of the media, on both sides, relegated the scientific and engineering realities surrounding this issue to the back seat. Inevitably, political considerations had a major impact on strategic decisions regarding El Niño.

A lot of media coverage, often contradictory, was given to El Niño during the preventive phase, between June and December 1997. A multitude of experts engaged in a somewhat confused public debate on the weather. The topic was the magnitude of the coming rains. The entire country was listening in on the debate between the scientists, including the elite and the decisions makers, on this increasingly important matter. The memory of the highly destructive “Mega Niño” of 1983 was still fresh in their minds, and the concerns of the public and of the government were justified.

SENAMHI was right as to the total magnitude of the rains, but they overestimated their duration, having predicted that they would begin earlier and would finish later. On the other hand, the Geophysical Institute of Peru (IGP) led by Ronald Woodman, along with IMARPE, optimistically predicted a moderate El Niño without dramatic climatic alterations. This state of affairs thoroughly confused public opinion. None of the official scientific institutions got it completely right. The confusion of the experts accounts for some of the media's inability to depict the future course of events with any clarity. In spite of the fact that the IGP was better

¹⁵ The first scientific study of the climate in Lima is the 18th century work by Hipolito Unanue: *Observaciones sobre el clima de Lima y sus influencias*, Barcelona, La Académica, 1914.

prepared in the area of weather forecasting, it was SENAMHI that accurately forecasted the magnitude of the rains that, after all, was really the most important subject.

Exasperated by the complexity of the debate on the intensity of the future rains, in September 1997, the executive branch reacted. President Alberto Fujimori ordered the state-sponsored scientific institutions to speak through one official spokesman. It was agreed that ENFEN would be the only entity authorized to release an official opinion on behalf of the government.

This debate bombarded the public with scientific opinion and speculation. The focus of the debate was correct, because it was important to forecast as accurately as possible when and where the rain would fall, how much, etc. The problem was that the debate was limited to abstract scientific speculation, without embracing the concrete problems facing the citizenry. The citizenry did not receive guidance on what to do to protect itself under any of the scenarios contemplated by the experts. During the preventive phase, the scientists were not focused on formulating practical advice for families. They took refuge in their theories, many of which did not agree with each other.

Television coverage improved during the course of El Niño. In December 1997, a TV program directed by Abraham Levy and broadcast from America Satel used visual techniques showing weather variations over time, a first for Peruvian television even though it is widely used in North America.¹⁶

During El Niño, America Satel leapfrogged even the official meteorological agencies. Levy showed satellite images in motion. These images can be downloaded at no cost in Peru. A software package allows these images to be serialized and projected on television. Thanks to this, America Satel had up-to-date imagery on the rains and their progress.

The America Satel experience demonstrates that TV has the technical means to make weather information available, and it could offer very attractive weather programming which would be particularly welcome in the provinces. This has not yet happened, however, because everything revolves around Lima. Not only is the government centralist, but so are the national television networks. Perhaps the advertisers, aware that the only significant Peruvian market is in the capital, orient program production to more lucrative ends. Unfortunately then, these improvements have not been continued. Two years after El Niño, the entire effort that went into meteorological programming on television has returned to the unattractive flat format.

According to Lourdes Palacios, information manager for the "24 Hours" news program of Panamericana Television, prior to the 1997-98 Niño the weather was not news. Only the irruption of this extraordinary event was able to change attitudes for a while. Now, with the event behind us, there has been a return to the usual monotony. The owners of the TV networks believe that the low ratings do not justify the cost of making good and dynamic weather programs.¹⁷

¹⁶ A preliminary overview of the role the media played during the 1997-98 El Niño can be found in "Medios de comunicacion, sensacionalismo o doctrina" by Angela Zelada, *Prevención*, año 5, # 11, mayo 1998.

¹⁷ Interview of Lourdes Palacios in Lima, August 1998.

This bias toward the extraordinary in the selection and treatment of information is one of the key characteristics of Peruvian TV. It is newsworthy only if it translates into higher ratings. This attitude dominates the decision makers in the media and naturally determines the treatment of weather-related news. This explains the scarcity of programs and journalists specialized in the weather. In Lima there is no dramatic weather to feed into this conception that is so prevalent in most TV stations.

In Peruvian TV, excepting the short episode with America Satel, all of the meteorological information that was issued from the preventive phase of El Niño remained bottled up in a somewhat fruitless trilogy. That triad was made up of the flat news format, the confused debate on the magnitude of the rains, and the sensationalist intent of the producers.

The radio-listening audience is quite large in Peru, especially in the blue-collar sectors. In a survey carried out by the Institute of Peruvian Studies (IEP) it was found that 74% of the Peruvian workers from these sectors regularly turned to the radio as a source of information. The same survey found that 82% of the workers watched TV frequently as a source of information. The audiences are thus pretty even, making it clear that both media compete and that radio has not lost its vitality.

When it comes to news, the blue-collar audience in Peru tunes in very narrowly. When asked which radio station they got information on El Niño from, fully 60% of the people interviewed by the IEP answered “Radio Programas del Peru” (RPP). The rest of the audience prefers “Cadena Peruana de Noticias,” (CPN), “Radio Cadena” and other minor stations.¹⁸

The radio programs dedicated to El Niño were a mixed bag; nevertheless, they were usually more interesting than those seen on television. There were interesting spots during El Niño, but this has not fostered the formation of permanent programs dealing with the weather, its variations, or its economic and social effects. These radio broadcasts featured reports and interviews and call-in segments that allowed the public to talk directly with the experts. The abundance of these talk shows and call-in segments gave the listening audience a sense of participation in the process. However, as in the case of America Satel on TV, the increased creativity during the crisis did not carry over into permanent weather programs on the radio.

The press is a singular domain whose rules are, in part, different from those that govern TV and radio. Excepting the so-called “chicha” dailies, most of the newspapers are directed to the middle class. The influence of the press, therefore, is of key importance in that it targets diverse elites, albeit lacking reach into the larger population mass.

In keeping with their own journalistic traditions, the newspapers in Lima had different approaches to El Niño. Pictures and diagrams emphasized the visual. “El Comercio” published pictures proper to the Internet era. This was the main innovation of the press, an appropriate use

¹⁸ The Instituto de Estudios Peruanos conducted a survey in six coastal cities immediately after the 1997-98 El Niño.

of images that created a visual experience for the public. This visual experience is what has remained in our memory representing the dynamic El Niño.

We must also consider the effect of the lack of specialized journalists or of regular sections in the newspapers. Although “El Comercio” has a Spartan weather section, in the other dailies it is nonexistent. The weather is not featured regularly in the political press like “La Republica” or “Expreso,” or in the newspapers that focus on the economy, like “Gestion” and “Sintesis.” You will not find anywhere in the written media, not even in “El Comercio,” news on the weather, other than a daily note containing a terse communiqué from SENAMHI.

The experience of the last El Niño burst upon a communications media ill-prepared to handle weather-related news, suddenly taking on major proportions. When this happened, El Niño became headline news for almost two years, even though it was highly politicized. In the end, however, it did not bear permanent fruit: Peru continues to be without professional reporting of meteorological issues in the news media.

When was the phenomenon last featured in the news media, prior to the 1997-98 El Niño?
(See Appendix D for additional bibliographic references)

Except for the occasional article in a scientific journal, the topic of El Niño had been absent for several years, at least in the mass media. El Niño had ceased to be news of current relevance in spite of the prolonged, if moderate, El Niño of 1992 and of 1994 that had only sporadically been mentioned in the press. In the early 1990s, El Niño was perceived as a potential threat that had not materialized.

There was abundant official information on the El Niño of 1983, including a volume summarizing all the data, titled *Statistics of a Critical Biennium: El Niño of 1982-1983*, published in 1997 by the National Statistical Institute (INEI). The El Niño of 1983 was still fresh in the memory of many officials who had battled the floods in their youth. So, when Fujimori ordered them to get ready for a possible repetition of 1983, the government officials gave priority to the same areas impacted previously, assuming that the effect would be similar. This explains why a good portion of the government's preventive strategy implemented in 1997 is based on the collective memory of the remnants of the state apparatus that dealt with the 1983 El Niño.

Two good bibliographies of Peruvian publications on El Niño have been published. The first specializes in natural sciences research and is entitled *Bibliography on the phenomenon of El Niño from 1891 to 1985*, published by IMARPE in 1985. The authors are Jorge Mariátegui, Aurora de Vildoso and Juan Vélez. The second bibliography focuses on research in the social sciences and is a chapter of a monumental compendium on regional studies of Piura and the northern coast. This volume is entitled *Piura: region and society*, published in 1996 by Cipca, an important local NGO. The author of the chapter is the noted researcher of El Niño, Manuel Vegas Vélez. A researcher undertaking a study of El Niño in Peru will find any and all Peruvian publications on the subject in one of these bibliographies.

The legacy of the 1982-83 El Niño was a heightened awareness and interest in the phenomenon, which has resulted in considerable institutional commitments and long term research. In addition to those official organizations mentioned several times in this report, it is necessary to highlight the work of the RIBEN (Red de investigación biológica universitaria sobre El Niño). They count with monitoring laboratories and have participated outstandingly in the organization of debating seminars among biologists. In addition, they have been a major promoter in the organization of interdisciplinary events. RIBEN's ties with the universities allow for a close relationship with the student body and access to an abundance of case studies and applied research. These characteristics are the hallmarks of an institution with a sustained record of achievements, which promises to continue enriching the field of scientific research.

The El Niño phenomenon of 1983, stirred up what has proven to be a sustained level of interest in nature within the social sciences community. Eduardo Franco has studied this juncture in an article prepared for the latest Seminar on Agrarian Research, which brought together a panel of specialists. Franco argues that the 1983 El Niño focused the attention of researchers on natural disasters. This field of research first came to life during the 1970s, centering on the study of earthquakes, with two very strong earthquakes occurring during that decade. The yearly huaycos (mudslides) symbolize the unstable and ever changing natural environment, which make Peru an area that is especially vulnerable to disasters. Franco's article points out that during the seventies two specialized NGOs were established and research in this area began in earnest. The last El Niño ushered in a new age in the study of the relationship between nature and society. The social sciences now include notable researchers specialized in this area.¹⁹

Teleconnections to the Southern Sierras

It was a well-known fact that El Niño, in addition to its direct effects on the northern coast caused by the increased ocean temperatures in the eastern tropical Pacific, had an indirect effect, due to atmospheric alterations, on the high Sierras - far from the sea. These teleconnections seemed to bring about droughts in the Southern Sierras every time that the northern coast received heavy rainfall. The drought during the 1982-83 El Niño was a notorious fact. A less severe drought had occurred during the moderate 1972-73 El Niño. In 1998, however, a drought in this region did not materialize, disparaging news to more than one noted Peruvian scientific institution.

Many seminars and professional debates were held during El Niño. They were usually organized by the municipalities and could also count on the collaboration of the NGOs. Not surprisingly, the quality of these forums was very uneven, with some having been very productive and others quite the opposite. One of the most significant was an event organized in Cusco by the Arariwa NGO, with the purpose of evaluating pro-active measures vis-à-vis the most likely teleconnected scenario of El Niño.²⁰

¹⁹ A study has been published by Edgardo Cruzado, "Políticas sociales y desastres naturales: el caso del fenómeno del Niño en Piura", in Felipe Portocarrero, ed. *Políticas sociales en el Perú: nuevos aportes*, Lima: Red para el Desarrollo de las CCSS, 2000.

²⁰ The article by Pedro Ferradas "Enfoques y estrategias de las ONGs" *Sepia VIII*, Lambayeque, agosto 1999, provides a good overview of the preventive plans studied by the NGOs.

It was assumed that the Southern Sierras would suffer a teleconnected drought during the coming El Niño and the people of the region prepared to face a potential threat that, in the end, didn't arrive. The Arariwa seminar was host to many specialists from academia and other NGOs of the Southern Sierras along with several provincial representatives of the central government. A coherent strategy was developed involving the construction of reservoirs, canals, and the sowing of fodder. The concern was that the natural grasses would be dry and the livestock would starve to death or be sacrificed by the peasants.

The central government also participated in these issues, independently deploying a program to grow grass in the department of Puno. One of the goals of the government's drought response plan was to sow 15,000 hectares of fodder (i.e., grass) before January 1998 in Puno. Given that the drought did not occur, it would seem that, logically, these programs died out. On the contrary, they have proven to be quite successful. It so happens that the scarce amount of land devoted to fodder and the heavy overgrazing of natural pastures is a perennial problem of the cattle industry in the Sierras. Therefore, although the plan was developed to confront a drought crisis that did not materialize, it was successful because its goals addressed structural problems that needed to be confronted.

Main effects of the 1983 El Niño

(See Appendix C for additional information on prevention, impacts, and comparison with the 1983 event as well as other years)

The severe impact of the 1983 “Mega Niño” produced a flurry of significant research work. From paleo-climate studies to research into the historical record, there were numerous contributions focused on trying to understand the past behavior of the natural event and attempting to reconstruct its previous incarnations. The most important articles to appear in the Peruvian press were collected by Hernán Peralta in a book entitled *El Niño in Peru*, published by the José María Arguedas Institute in 1985. The social impact of El Niño was researched principally by Eduardo Franco and Pedro Ferradas who gave rise to a series of studies that are, fortunately, still ongoing. This research points out the connections between social development and preventive measures in the face of disasters and has helped to raise awareness on these issues. Nevertheless, explosive and haphazard urban sprawl has made the nation more vulnerable. The 1983 Niño was the starting point for a multiplicity of ecological and biological research work. Juan Tarazona and Edgard Valdivia of Peruvian nationality and foreigners Wolf Arntz and Eberhard Fahrback produced outstanding research.²¹

The 1983 El Niño caused a major shakeup in the Peruvian political establishment. This fact is obviously a prominent topic discussed in the many political science articles to appear in the 1980s. The second government of the architect Fernando Belaunde can be split in two, before the natural phenomenon of 1983, and after. The first half was absolutely tepid while the second half

²¹ Wolf Arntz y Eberhard Fahrback provide a very solid study of the physics of the phenomenon, *El Niño, experimento climático de la naturaleza*, México, Fondo de Cultura Económica, 1996.

was decidedly downhill. El Niño caught the country by surprise and the government reacted hesitantly during the floods. The emergency severely affected the daily life of half the country. Later on, the reconstruction stage proceeded under pressures from all quarters without proper planning, management, or coordination.

The severe economic crisis brought about by El Niño was the backdrop to the political shakeup in Peru. The GNP shrunk 12% that year, the worst outcome in the twentieth century. Many businesses collapsed because the natural phenomenon coincided with the explosion of the foreign debt crisis that shook all of Latin America during the 1980s. In 1982 Mexico declared itself insolvent and starting from that moment the whole region was under pressure from the banking institutions and multilateral organizations to tighten their economies in order to reschedule the debt payments. During the decade of the 1980s Latin America exported capital to the rest of the world at an unprecedented rate. The confluence of the foreign debt problem and El Niño created a crisis of spectacular proportions in Peru.

The common people of the northern coast suffered the consequences of the torrential rains. The 1983 El Niño was a period of hunger and social chaos followed by severe epidemics in 1984. Every level of society was aware of El Niño as a disaster of great magnitude. The northerners suffered considerable damage and were collectively ruined. Lima lived through the general political and economic effects, while the Southern Sierras experienced an unprecedented drought. The whole country was thrown into a recession, unparalleled in the century, seriously undermining confidence in the central government.²²

Social impacts linked to the climate impacts of the 1997-98 El Niño in Peru

a. Agriculture

Agriculture was one of the sectors strongly affected by El Niño. It was one of the first economic sectors to feel the negative effects of the event in 1997, because a series of products, like olives and mangoes, didn't develop appropriately due to the unusually high temperatures and the virtual disappearance of winter.

The small-scale farm, rural poverty and low agricultural productivity are perennial problems that the Fujimori government did not face up to with the same vigor shown for other economic sectors. The new millennium inherits from the 1990s, a package of unsolved problems that constitute an obvious mandate for the revitalization of the agricultural base, an element crucial to the nation's development.

Peruvian agriculture has been confronted with two main topics since the 1950s. On one hand, a sustained fight in rural areas for land ownership came to a head in the seventies with a victory for the peasants, paving the way for an era of small-scale farming. The regime of landlords and centuries of discrimination and contempt for the Andean population were swept away. The small

²² There is notable research on the perceptions of the average rural peasant done by Luis Rocca Torres, "Impactos del Niño en el sector rural", Sepia VIII, Lambayeque, agosto 1999.

farm, however, doesn't foster the accumulation of wealth or the progress of the rural family. In addition, the rural Andeans did not really own their parcel, but could only enjoy its use. The small plot was considered communal property and could not be sold. In this manner, the unexpected result of a long and victorious rural struggle was the generalization of rural poverty.

On the other hand, the government tried to control prices and to control the behavior of the markets politically. More than twenty years of intense populism, from the late sixties and continuing on throughout the eighties, were marked by state intervention into the national marketplace and the price fixing of products important to the popular economy, specially agricultural products. This deepened the unequal exchange between the rural and the urban economies. The mechanism was an accelerated process habitual to capitalist societies, in which the agricultural community sells products at ever diminishing prices, while the urban centers offer products at ever increasing prices. The military government of the seventies assumed that given the agrarian reform, the peasants were owners of the land and should collaborate with the urban centers by sending food at accessible prices. In this way and in short order, farming in Peru was ruined.

El Niño has, therefore, laid out a very tough challenge to Peruvian agriculture. An impoverished sector has had to support the embattlement of nature by whatever means. Farm losses have multiplied and have many causes, including the destruction of arable land. Thousand of hectares of farmland were washed away by swollen rivers, leaving deserts where farms used to be.

El Niño also silted up canals and drainage systems, and generally wreaked havoc on the system of irrigation. Consequently, agricultural output for the 1998-99 season was poor. During this period, however, the main irrigation systems of the coastal basins were rebuilt. The government's expenditures on reconstruction have been evident in that area.

Throughout 1997, the Ministry of Agriculture (MINAG) followed a pro-active policy to protect the irrigation and drainage infrastructure, undertaking several civil engineering projects. The MINAG did not, however, address two important problems facing pre-El Niño 1997-98 agriculture: agricultural credit and technical orientation. Some products were doomed at the outset, but the northern farmers believed that rice would be a viable crop. Unfortunately, the farmers could not conduct a massive rice campaign in 1997, due to the lack of available credit to purchase supplies. They were finally able to do so in 1998, after arduously scraping up some capital. The results were not good. There was overproduction in 1999 and rice prices plummeted. To top it off, the Fujimori government, ever faithful to its neo-liberal politics, allowed rice to be imported from Southeast Asia at a time when they were exporting all that they were able to in order to alleviate its own economic crisis. Everything went wrong in the Peruvian rice business. The producers were harmed by the fall in prices and the importers were equally harmed by the same phenomenon that all the parties had inadvertently created.²³

²³ Overproduction and falling prices continued to affect Peruvian agriculture in the post 1997-98 El Niño era. This resulted in a dramatic fall in the price of potatoes, engendering significant rural rebellious activity. The latest agrarian strike in Andahuaylas clearly bears this out.

Next to El Niño, plagues have been one of the principal problems facing Peruvian agriculture. The elevated temperatures that “tropicalized” the winter season along the coast gave rise to new pests and crop stress starting in 1997. In 1996, a very cold winter and a very dry summer had distressed the Peruvian coast. After the 1997-98 El Niño, the plagues returned with a vengeance. Vermin decimated crops in the 1998-99 season and continue being dangerous into the year 2000, affecting many valleys and a variety of crops.

The availability of credit constitutes another of the major problems facing Peruvian agriculture that El Niño exacerbated considerably. From the 1930s until the early 1990s, there was an agricultural bank linked to the state. This bank was the great enabler and was well managed for many years, making it an effective economic agent that granted the minimum of credit necessary for the continuity of business. During the five-year government of Alan García, 1985-1990, this bank was managed very poorly and was used extensively to further political ends. In the early 1990s, the credit institution was technically bankrupt and the government opted to liquidate it.

Since then the government has stumbled hesitantly on the issue of agrarian credit. First they tried a system of credit institutions associated with the MINAG that failed quickly. Later on they formed savings and loan institutions that continue operating on a small scale. Agriculture is seen as not very profitable by the private banking system that, consequently, offers no real credit to the sector. During the last El Niño, this precarious system collapsed.²⁴

Given this state of affairs, in 1999 the government has had to step in and refinance some debts, condone others, resolve bad debt issues of the rural savings and loan institutions, etc. At the end of 1999, the government announced that it intended to establish a new agrarian bank that would consolidate the S&Ls and operate with private capital. In this way, the government ends the decade by establishing institutions that were disassembled at the beginning of the decade and were accused of representing mammoth state projects ruinous to the treasury.

On the other hand, there are no known private investors interested in financing Peruvian agriculture, even as the government proclaims its intentions. As I write this, Peru is in the midst of a presidential electoral campaign and Fujimori is vying for a third term in office. The issue of the future agrarian bank belongs to the twilight zone of campaign promises and only time will tell what will become of this matter. It is clear, however, that after the previous “Mega Niño” of 1983, there was an agrarian bank that financed the crop campaigns in 1984 resulting in a faster recovery of the sector. This time around, however, Peruvian agriculture had to face the aftermath of an El Niño without the presence of a solid credit institution. The 1997-98 El Niño has deepened the problem of agrarian credit, one of the structural weaknesses of Peruvian agriculture.²⁵

²⁴ The various incarnations of the agrarian banking system have been researched by Carolina Trivelli: *Crédito rural: coexistencia de prestamistas formales e informales*, Lima: IEP, 1999.

²⁵ Both Alberto Fujimori and Alejandro Toledo, candidates in the May 2000 Peruvian presidential runoff elections, made public their decision to rebuild the agrarian bank, if elected.

b. Highways

The infrastructure of highways and roads was directly and negatively impacted during the last El Niño. This network extends for 75,000 km in Peru. A great majority, 50,000 km, are little more than dirt roads and trails. Only a third of Peruvian highways are either gravel or asphalt. Most of the 10,000 km of asphalt roads are in the Pan-American Highway that runs along the coast. Seen as a group, this network is very inadequate because its extension is limited compared to the size of the country. In addition, 80% of the merchandise in Peru makes use of the highways and roads. In that regard, the economic importance of the road network is immense, in spite of its inadequate size. Unfortunately, that same limited road network was severely battered during the last El Niño.²⁶

Transportation companies and merchants have been hit hard by the vulnerability of the Peruvian highway system. The most affected, however, have been the towns and villages that were left isolated by El Niño. For example, the Solidarity Bulletin of Chiclayo noted dozens of cases, among which was a testimony published from Canchachalá in the mountains of Ferreñafe. Seven small villages found themselves cut off without adequate food or supplies. The experience of Canchachalá was dramatic because they struggled to communicate and maintain the roads open so as not to starve and fall prey to illness. All the while there was food and medicine not too far away. Fifteen hundred people were in danger, according to the report of Professor Floro Sánchez that told of the difficulties imposed by nature and of the struggle of the people to survive. In pre-Hispanic times the logic would have been to gather everything necessary to survive some months of isolation. In our days the logic has changed, now the inhabitants tried to maintain communication because the population had lacked the money to provision itself in advance.²⁷

During 1997, the government went ahead with a prevention effort, during which the Ministry of Transportation (MINTRAN) worked with diligence. This ministry was key in the government's strategy of adequate drainage and had the responsibility of cleaning out the drainage systems, ditches and all overflow channels. The task was immense and they faced structural problems of great magnitude that were impossible to solve in the short term. The highways cross a multitude of riverbeds inappropriately termed "dry," which they are in a normal year. In an El Niño year, however, these "dry" riverbeds channel an avalanche of water and mud, cutting the highway at several points. The solution of the highway engineers to deal with the "dry" beds that cut across highways is to build a pontoon. During an El Niño, the pontoons overflow and the water runs beside the highway eroding it. This explains the television images during El Niño showing a line of trucks traveling single file over severely eroded highways that had become but a thin shred of asphalt.

The strategy to protect bridges faced still graver problems. In effect, the bridges of the Pan-American Highway had been designed for relatively minor flows of water, much less than those that a "Mega Niño" would bring. For example, the famous Bolognesi Bridge in Piura collapsed

²⁶ A report on the impact of El Niño on the highway infrastructure was published by the Colegio de Ingenieros del Peru, *Informe del fenomeno del Niño 1997-1998*, Lima, CIP, 1999.

²⁷ Solidaridad, Chiclayo, year 1, # 5, March 1985.

when it was subjected to a flow four times greater than the maximum for which it had been designed. The magnitudes are so high that it is easy to understand that this type of problem could not be solved with a few months of warning and that it was not just a question of trying to gain a few extra months. The cleaning of riverbeds and drainage channels and shoring up the foundations are certainly useful operations, but insufficient if the bridges are designed for very low water volumes. Thus built, the bridges will inevitably collapse.

The structural problems of Peruvian highways show that the decisions made in preparation for the next El Niño occur during the reconstruction phase of the previous one. The key decisions are those of the post-El Niño reconstruction because they define the infrastructure characteristics with which the following El Niño will be faced. For example, as we mentioned before, the basic engineering parameters for bridges cannot be radically altered after the bridge is built. The maximum water flows during a “Mega Niño” can be up to one hundred times greater than a normal year. It would seem unreasonable to spend lavishly on mega bridges that would be white elephants for most of their useful life. But if bridges are not capable of withstanding these increased flows then you run the risk that they will collapse during the next El Niño. In 1998, for example, in the Department of Lambayeque six bridges collapsed, five of which had been reconstructed after the 1983 “Mega Niño.” There are no easy answers and it is necessary to find intermediate solutions that might even include the altering of the course of some highways in order to avoid very low depressed areas where the “dry” riverbeds pose a heightened threat to bridges.

Some positive cases also point out that the most important decisions were those made during the reconstruction phase of the 1982-83 event. The highway that joins Piura with the port city of Paita, a fifty-kilometer stretch, is a triumph of forward thinking. The torrential rains of the 1983 El Niño created a lagoon that completely submerged this highway, cutting off Piura from its supply route. A period of famine and desolation ensued. Later on, the highway to Paita was rebuilt on a high embankment and rerouted around the lagoon-prone area. Thanks to these well-learned lessons, the 1998 El Niño did not isolate Piura from its port, and the highway stayed open in spite of the inclement weather. Coastal marine trading was enough to stave off another famine.

The reconstruction of the highway system has been slow because it was done in two stages. The first was called "recovery of usability" and it consisted of civil works designed to improve the immediate state of the Pan-American Highway, assuming dry or normal conditions. But, it rained heavily in February of 1999 and most of the provisional work didn't hold up. Consequently, in 1999 the effort was restarted practically from scratch and there has been steady progress along most of the Pan-American Highway. The \$300 million loan from the World Bank and the Inter American Development Bank have been used primarily for highways, consuming 60% of the total. The government is planning to privatize the administration of the toll roads when the works is done.²⁸

²⁸ Representatives of the government and private industry discussed this plan in a meeting that took place in Lima in August 1998.

c. Fisheries

The effects of El Niño on the fishing industry were as bad, if not worse, than in agriculture. Not forgotten was the El Niño of 1973 that demolished the first Peruvian Industrial fishery, even though it was only accompanied by moderate rains. IMARPE managed the 1997-98 El Niño in a more prudent manner than it had done in earlier events. It did not allow over-fishing in 1997, before the warmer temperatures had set in. The marine biota withstood the trauma with enough vitality left over to bounce back after only two bad years. Biological normality returned to the seas by the third year. Actually, the two bad years were not really terrible because the catch still amounted to half of pre-El Niño levels. Its management of the marine biota during this El Niño has enhanced IMARPE's reputation.²⁹

The Ministry of Fishery (MIPE), unlike the Ministry of Agriculture (MINAG), was left relatively untouched by the neo-liberal reforms of the 1990s. There was the experience of the 1973 collapse. The state knew that the fisheries market could not be left completely unrestricted and that it was its job to regulate it. While the other ministries involved in industrial development suffered cutbacks, the MIPE was empowered to exercise tighter regulation and management of marine resources. Therefore, in this sector the state has not lost its bearings but rather has continued a technical function to which experience has been added. IMARPE carries out research and issues recommendations and the MIPE makes the decisions.

A system of open and closed seasons and quotas are the mechanisms of regulation. The latter determine the maximum catch (broken down into species) allowable in a semester for the entire industry. The quotas have been the objects of considerable debate in the last period. It is argued that a more efficient system would be a regime of individual transferable licenses because it would allow fleet owners to know their individual limits beforehand and better anticipate their investments. It is posited that the current over investment in the sector is a direct consequence of the global quota system because whatever you don't catch, your neighbor will take. Therefore the global quota fosters ferocious competition to capture as much as possible in only three or four months requiring the big expense of putting together a high capacity fleet.

The fleet owners and industrialists oppose the proposal on the grounds that the government cannot be trusted to dole out individual quotas. This extraordinary power is simply too susceptible to political favoritism and would jeopardize economic issues of a transcendent nature. The industry leaders believe that economically important decisions would be subject to all manners of shady, under-the-table deals.

Even though the catch of anchovies and sardines, the main species, has rebounded in 1999, this has not been the case for the hake catch, currently in its worst crisis. This is a particularly sensitive issue because hake was spearheading Peru's effort to diversify its fishing industry. Hake is packed frozen, and along with canned fish, constitutes the high value-added segment of an

²⁹ The Fisheries Research Director of IMARPE, Marco Espino, was intensely involved in the scientific debate on the impact of El Niño. An example of his work can be found in "El Niño de 1997 y los recursos pesqueros: una propuesta de analisis," Lima: setiembre de 1997.

extensive, but not very sophisticated, industry. The Peruvian fishmeal industry must process nine million tons of fish in order to produce one and a half tons of fishmeal. Fishmeal does not command high prices in the world market. This situation creates a paradox in that Peru is the top world producer according to the size of its catch, but is ranked 22 in sales in the world market. A very cheap product is produced in great quantity. In other words the Peruvian Sea is not being exploited to its best advantage. The exceptional plight of the frozen hake fish industry is the more tragic because they are part of the solution to this predicament: a segment that attracts investment in state of the art products of high added value for export to international markets.³⁰

The financial difficulties facing the fishing industry are daunting, and El Niño has aggravated them considerably. These difficulties are a consequence of the privatization process. This privatization process consisted in the auctioning off of the state-owned enterprises that were in turn formed by the expropriations of the sector in the early 1970s. The fishing industry was sold piecemeal, that is, each plant was sold separately which translated into a cost of entry that allowed many Peruvian industrialists to participate. In sharp contrast to all the other economic sectors that were privatized at that time period, the fishing industry stayed in the hands of nationals with new, as well as the reappearance of old, managerial groups.

How did all this participation of national capital in the privatization of the fishing industry get financed? The answer is simple: thanks to a borrowing spree from the national banking system. The total industry debt load came to one thousand two hundred million dollars in 1999 with the top three companies claiming half of that. When the deals were made, the size of the debt didn't seem too problematic because the fishing industry during the 1990s (including 1997) had done quite well.

During this boom period, the fishing industry acquired new bank debt to modernize newly acquired factories and install urgently needed environmental protection equipment. The industrialists had not finished repaying their original debt, but rather went deeper in debt with the banks. To make matters worse, three good years were followed by two very bad years. And so we have arrived to 1999, a year in which the catch has all but regained its normal levels. In 1999, however, sales income took a beating because of depressed fishmeal prices as a consequence of the abundance of soy bean, the main competitor and protein source in the international cattle feed market. In effect, the fishing industry has had a third bad year, only slightly better than the previous two, and not the full recovery they were expecting. The bottom line is that the entire fishing industry is riddled with unpaid debts, which collectively constitute a significant portion of the banking industry's bad debt load that led to the quasi-crisis of liquidity in 1999.

If the fleet owners have not gone bankrupt and their properties been confiscated it is because the banks have decided that it is not in their best interest to exercise their rights. The banks prefer to reschedule payments because they assume that the fishing industry is better suited than they are to extract wealth from the Peruvian ocean. Technically the whole industry is in bankruptcy and

³⁰ The current system has been put into question in the last few years. An alternative viewpoint has emerged from several international agencies like the World Bank and the FAO. The chief analyst of the latter is Jorge Csirke, who granted *El Comercio* a series of interviews. One example can be found in the April 28, 1998 edition.

some analysts maintain that El Niño has caused their financial situation. Another point of view, however, is that El Niño has merely revealed the fragility of a privatization process that favored Peruvian industrialists who had leaned heavily on Peruvian private banks. The debt was based on an excessively risky calculation that only contemplated a continuum of good years and made no provisions for safeguarding against the lamentably confirmed possibility of three bad years in a row.³¹

Governmental options during the prevention phase, 1997

The Minister of the Presidency, Daniel Hokama, in the opening statements of an important speech to Congress in September 1997, outlined the government's principal options to deal with the arrival of El Niño. A rosy forecast was initially presented averring that "its appearance in front of the Peruvian coast in the month of April and its progressive intensification in the months of June and July had been providential, because it would prevent the sequel of rains and destruction that would have occurred had the phenomenon arrived in the summer, which was the usual case." Hokama concluded that the worst anomalies would coincide with the coldest part of the year, which would fortunately inhibit the rise in temperatures necessary for torrential rains. This optimism coincided with the forecast issued by the scientists of the Peruvian Geographical Institute (IGP), predicting moderate summer rains for 1998.

Later on in his speech this moderate forecast began to fall apart. The minister's concerns came to the forefront when he affirmed that the rains expected in the summer of 1998 could reach levels similar to 1983. Having said that, the thrust of the minister's presentation was inverted as he proceeded with an analysis of the regions damaged by the 1983 El Niño and the specific details of the resulting disasters.

The minister informed Congress that the worst scenario was a repetition of 1983, and, consequently, the plan should contemplate measures to avoid a disaster of that magnitude. The political prognosis was not based on a logical calculation of the evolution of certain parameters, but on a very interesting evocation of bureaucratic memory. The state, faced with a forecast of disaster, reacts by dusting off its old reports and proceeding as if the coming event will be a carbon copy of the past. This historically minded government proceeds empirically, recalling its previous steps. Scientists, on the other hand, formulate their forecasts based on weather patterns and logical analysis of the behavior of relevant variables. These two groups can only be reconciled by understanding how each one of the parties involved acquires information, formulates plans, and handles the concept of a forecast.³²

As previously noted, the government's preventive plan consisted of civil engineering projects of riverbank fortification. Infrastructure protection was the government's *leitmotiv*. This strategy

³¹ Juan Carlos Sueiro has written several articles tracking the development of the financial crisis of the fisheries sector for *Análisis Económico* magazine. A somewhat different reading can be found in *Pesca*, a publication headed by Alejandro Bermejo.

³² Daniel Hokama speech to Congress, Congressional documents found on the Peruvian Congress website at: <http://www.congreso.gob.pe/index-e.htm>.

had virtues and defects, the main drawback being the absence of a plan directed at revitalizing production, which fell into severe recession. The preventive strategy itself, however, was very poorly implemented due to a centralist and individualist mindset abetted by a high degree of bureaucratic disorder. Overlapping areas of responsibility are one of the endemic secular afflictions of Peruvian bureaucracy that only got worst during the last El Niño.

Topping this state of affairs were the many delays in getting the civil engineering projects going, thereby diminishing their timeliness. The president acted quickly, but even he had to contend with the slow-moving wheels of the executive branch. For example, the drainage projects for El Niño in Piura did not get started until August 9. These high-priority projects for the area that was going to be hardest hit still had not commenced as the emergency rolled into its seventh week. Other projects designed to beef up the drainage system were finished after the rains had already begun and became dikes that actually dammed the water causing major flooding. Fujimori showed great dynamism, but the central apparatus is slow and although it is true that on this occasion it moved somewhat faster than usual, its traditional laziness was still evident.

The government during the emergency and reconstruction

The emergency phase in the summer of 1998 was the critical period, when all the proverbial Horsemen of the Apocalypse visited Peruvian territory. The government's strategy during that period was to run in the face of each difficulty. At first, President Fujimori wanted to personally witness each one of the situations as they arose. Late, he understood that this was impossible and divided his attention among the various ministries. Fujimori did not include provincial mayors or other local authorities in the committees entrusted to carry out the daily fight of the provinces during the emergency. On the contrary, the president simply delegated his personal authority to his ministers. Again, the government persisted in its attitude of doing everything itself.

During the emergency there were many necessities and many anxieties, but the facts can be summarized with ease. The period remembered as crucial is the one in which the main characters lived through many personal adventures. From the political point of view, however, all the actors performed more or less efficiently as assistance givers to the needy, in a situation of extreme social anxiety generated by a natural disaster. The central government, as well as the municipalities and society at large, worked at weathering the storm as best they knew how. Even individuals and families behaved similarly. Only a difference of magnitude differentiated the roles.

The government's reconstruction efforts have been considered a continuation of the civil engineering projects of prevention. The government saw itself as simply restoring the lost infrastructure at what was perceived to have been a very slow pace. The government formed a committee entrusted with the reconstruction effort called CEREN (National Reconstruction Committee) in June 1998. This committee is presided over by the engineer Alberto Pandolfi, a minister that has held many positions in several of the cabinets of the Fujimori government and that has been a key figure in the adoption of policies on El Niño.

President Fujimori defined the role of the government during the reconstruction as that of a contractor and has denied other possibilities. The government's efforts have been so slow that they aren't even restoring the destroyed infrastructure, not to mention the linking of these efforts with regional development.

What actions might have been taken given a forecast in October of 1996

It is difficult to suggest because it deals with assumptions and not an analysis of facts. I am inclined to believe that nothing different would have occurred. The central government would have applied a similar plan, based on prevention with the same established goal, that is to say, facilitate drainage through a civil engineering project to shore up and protect the riverbanks. The problems that plague the inner workings of the central government would have been intact, as well as the tensions with the other institutions that represent local interests. These dynamic relationships define the structure of society and of the government in Peru. Six months of extra time to prepare would not have altered these old, strongly rooted political habits.

The only significant probable change is that scientists would have had extra time to organize their debates. But, as we mentioned, their lines of communication with the politicians were very weak. The latter make decisions, without bothering to listen to the scientists. None of this would have changed with an earlier, even perfect, forecast.

The most pro-active institute in promoting a relationship between the scientific community and society has been the IGP. For example, in November 1997, the IGP organized an important seminar with Piura's managerial community to debate new investment opportunities that might open up with El Niño. This seminar was well attended and the managers were eager to participate. Likewise, Dr. Woodman's interventions repeatedly revealed his intent to establish a commonality of language and of shared interests in regional production and its potential. The forecast of the IGP director, however, called for a moderate El Niño with rainfall levels less than 1,000 mm, when in reality they exceeded 4,000 mm. What frustrated this interesting experiment was not the lack of time to implement the IGPs recommendations, but a forecasting error by the scientists.³³

Main strengths and weakness of the Peruvian government's response to El Niño-related problems

The study of the last phenomenon of El Niño in Peru has allowed us to x-ray the attitudes of society and of the government when confronted with natural disasters. We have been witnesses to the reactions and the plans of actors located on different stages. First, we have the government's analysis, seemingly very quick to respond to the early warning signals and poorly organized for long-term prevention. Indeed, after receiving the forecast for El Niño, the state developed an integrated plan in short order and the presidency of the republic displayed unusual

³³ Interview with Ronald Woodman, May 1998.

energy to implement it. However, the inertia of the Government to face natural emergencies derives from the lack of an efficient organization and the tensions that exist with other domains of political and social power.

The northern coast's business community that was severely battered by El Niño has yet to receive the priority attention that it deserves from the government. Its capacity to react has also been limited. The weakness of the regional bourgeoisie in the provinces was confirmed when they were unable to participate in the economic effort of prevention and much less in that of reconstruction. This economic effort has fallen almost entirely on the central government.

The dialogue between the scientists and the politicians is inadequate or non-existent. The scientists lack the means to make themselves heard by the politicians. Only when the latter summon them can they converse, but no political decision of the government is subject to the input or opinion of the scientists, who are employed by the same government to study those same issues. The politicians consider the scientists to be *rara avis*, which don't deserve any measure of attention.

The government's reconstruction policy implemented during the post-Niño does not seem to be the most adequate. The government created CEREN, the ad hoc entity that evaluates projects, requests bids, and then contracts out reconstruction work to private industry. Most of its financial resources come from loans made by the World Bank and the Inter-American Development Bank in addition to Peruvian sources. The dominant characteristic of their work has been slowness and inadequacy causing numerous frustrations in the affected provinces. Reconstructing the irrigation and highway infrastructures has been the *leitmotiv* of the government in this period. Bids have recently been requested to reconstruct urban sanitation facilities of the principal affected cities. The government has yet to consider the notion of financial aid to affected business enterprises.

Lessons Learned

- The ENSO warm event should be considered as a recurrent event in national planning (e.g., in civil defense, urban zoning, construction codes), rather than as an anomalous and unusual condition.
- Increased coordination among governmental scientific agencies concerned with the dissemination of El Niño information would result in a more coherent message for the public to act upon.
- Scientific institutions and government agencies must engage and educate the media so that they can convey more clearly their messages and minimize misinterpretation of ENSO information.
- It is misleading and dangerous to base preparations for an El Niño event that has been forecast solely on the impacts of the last event (regardless of its magnitude).
- The centralization of early warning and response activities in Lima, Peru hinders effective action in the provinces during crisis situations.

- Early warning of El Niño events will not enable the prevention of negative impacts and the exploitation of positive impacts if larger (i.e., more basic) structural changes related to economic and political development are not undertaken during non-El Niño periods (e.g., credit availability, transportation and health infrastructure, education).
- With the exception of Peru's northern coastal areas, there is inadequate scientific understanding of El Niño's teleconnections to different geographical regions within the country.
- Dialogue between decision makers and scientists ranges from inadequate to nonexistent, in large measure because of the poor opinion they have of their scientists.
- Financial assistance from the central governments to the regions that have been adversely affected must be improved upon in order to remove delays.
- The parts of the country that are usually affected by El Niño must receive priority attention from the central government. They must be directly involved in the planning of preventive, mitigative, and adaptive responses to El Niño-related hazards.

Appendix A

Socioeconomic Statistics

Appendix B

Chronology of media coverage of forecast information ³⁴

Several aspects of the constraints on the use of climate information for societal benefit are apparent in the public statements, which were later confirmed by observations and interviews. These include: a widespread recognition of the possible onset of the event early in 1997 (March); a lack of agreement on the forecasted intensity of the event; the use of the 1972-73 or the 1982-83 El Niño as the measure against which to forecast and prepare for the impacts of the 1997-98 event; the multiple sources of information about the event; contradictory information about the event; and the awareness of information generated outside the region. These points have been drawn from the representation of climate information in the media which are presented below, and do not account for filters on the information resulting from individual perceptions of the media, the institutions represented in the articles, or El Niño itself.

December 1996: IMARPE makes a prediction in *El Comercio*, the most widely read newspaper, of normal weather conditions for 1997, attributed to the cool waters that still linger off their coastline.ⁱ In the same newspaper on the same day, the head of the Laboratorio de Física at the Universidad de Piura, who is also the president of the *Consejo Consultivo Científico y Tecnológico de la Región Grau*, predicts that 1997 will be a dry year, again based on the fact that sea surface temperatures are about 1°C below average, that the high altitude winds are flowing from east to west, and that the condition of the southern oscillation and the atmospheric conditions in general do not indicate the presence of El Niño for 1997.ⁱⁱ

March 14, 1997: The Lambayeque Regional director of MIPE declares that the presence of the El Niño current is not confirmed, and that IMARPE and SENAHMI should report on variations in the climate for the upcoming weeks. Water temperature in the region is warming and new species are arriving with the warm water.ⁱⁱⁱ

April 30, 1997: IMARPE establishes a seven-day ban on anchovy and sardine in April-May as a result of sharply increased catch. It recognizes that these high catches are a result of a 2°C anomalously warm pocket of water along the coast. At this rate, the quotas will be reached before August, the target date set by MIPE six months earlier.^{iv}

April 30, 1997: Four fishing boat owners associations react against the ban declared by MIPE, claiming that it is the illegal fishing activity that leads to over fishing and that the ban should be lifted.^v

May 27, 1997: The director of SENAHMI states that not until August can a definitive statement be made of whether 1997-98 would be an El Niño year. Claiming that if August temperatures exceed 2°C, there will definitely be an El Niño.^{vi} This article is accompanied by another about a strong earthquake in the north, implying that there is some relationship between the two.

May 27, 1997: The Central Reserve Bank of Peru (*Banco Central de Reserva*) states that given the confirmation of El Niño, productivity in the fishing sector will decrease, inhibiting the ability to pay back loans, primarily among the artisanal sector and the firms in the north that have recently built large vessels and are more heavily indebted.^{vii}

June 6, 1997: Fishermen in northern Chile report the entrance of tropical species into their waters.^{viii}

June 6, 1997: The executive director of the IGP declares that it is too early to forecast the consequences of El Niño. Furthermore, he claims that this event will not be as severe as the 1982-83 event, since events of this magnitude only occur every 200 years. Thus, he does not see the need to invest an extraordinary sum in prevention, though some efforts such as cleaning storm drains are advisable. Only in October can one predict El Niño with a low margin for

³⁴ This section quotes extensively from Broad, K. 1999. *Climate, Culture, and Values: El Niño 1997-98 and Peruvian Fisheries*. Ph.D. Dissertation, Columbia University, pp. 108-145.

error, he states. More attention should be placed on taking advantage of its benefits such as increased rain, which will allow cattle grazing in normally dry areas.^{ix}

June 7, 1997: The director of SENAHMI officially announces that El Niño has arrived at the Peruvian coast, based on sea surface temperatures which are 4°C above normal and the changes in wind patterns. He predicts rain in the north and drought in the south of Peru and says that it is difficult to predict the intensity of the phenomenon.^x

June 7, 1997: The regional director of MIPE in the north announces that industrial catch is about half of what it normally is (9-10,000 metric tons versus 25,000 metric tons per day) and that the situation may worsen if El Niño really occurs, which is still not confirmed. He also notes the presence of exotic species due to the warmer waters.^{xi}

June 9, 1997: The *Instituto de Ingenieria Hidraulica e Ingenieria Sanitaria de la Universidad de Piura* (UDEP) proposes the building of a drainage system to mitigate El Niño's impacts.^{xii}

June 11, 1997: El Niño is blamed for the frosts in the altiplano region.^{xiii}

June 12, 1997: The director of SENAHMI announces that due to the effect of human activity on the environment (in reference to the Greenhouse effect), the frequency of El Niño will increase, switching from eight- to four-year intervals between events. He comments that this event is still in its early phase and it needs to be further studied to evaluate its possible consequences.^{xiv}

June 20, 1997: The Fujimori government allots U.S.\$19 million for the creation of a multisectoral government commission to organize mitigation efforts in the face of El Niño. It is reported that the U.S. government agency, NOAA, has confirmed the abnormal rise in ocean temperatures and that it predicts drastic weather changes in the U.S.^{xv} SENAHMI says satellite images confirm that El Niño is on the Peruvian coast, and it recommends checking sewage and drainage systems, as well as reforestation efforts both to mitigate and to take advantage of the phenomenon. Artisanal catch has dropped considerably, causing an increase of prices (up to fourfold) in the local market. Fishermen claim that if El Niño occurs, it will bring exotic species, which they do not have the equipment to capture.^{xvi}

June 24, 1997: The Minister of the Ministry of the President (MIPRE), Daniel Hokana, claims that there is sufficient scientific evidence that El Niño will present itself in September, October, November, and that the preventive efforts should start immediately. Efforts to clean riverbeds and drainage systems will begin the following day.^{xvii} The government organization in charge of civil defense is not included in the multisectoral commission, but instead is working with experts from the United Nations on disaster simulation to evaluate the capacity to respond in northern Peru.^{xviii} Based on recommendations by a non-governmental association (*Asociación de Promoción Agrícola*), cotton farmers are planning on planting one to two months early.^{xix}

June 29, 1997: In spite of the fact that the government has the tools to prepare for El Niño, it is predicted that severe consequences will occur nonetheless, such as unemployment in the fisheries sector, with an estimated 5 percent drop in GDP.^{xx} The severe bad weather that forces the closing of ports in Pisco is attributed to El Niño.^{xxi}

July 2, 1997: Executive Director of IMARPE states that El Niño is in a moderate state and that there is not clear evidence as to whether the phenomenon will effect the adult anchovy. In October the dimension of the event will be known. Growth and the reproductive phases of the anchovy could, however, be affected, and the schooling behavior is showing a slight tendency toward migration to the south. They also state that if the government takes necessary preventive measures, El Niño could be beneficial, though further details are not given.^{xxii}

July 1997: Given the persistence of the warm conditions, and the intense rains already being attributed to El Niño in central Chile, the CPPS calls an emergency meeting at IMARPE in Callao for the first week in July: "Emergency Meeting of the Scientific Committee for the Regional Study of El Niño" (July 2-4).^{xxiii} The statement made by the committee is that there is a high probability of El Niño, but that a better forecast could be made towards the start of spring (September). The commission also confirms changes in the migration patterns of the anchovy, jack mackerel, and sardine from north to south, into deeper waters, and closer to the coast.^{xxiv}

July 4, 1997: Dr. Marcone, the Scientific Director of IGP, says that even though it is possible to begin to adopt certain measure to prevent the negative effects of El Niño, major investments in prevention should not take place until there is certainty as to the magnitude of the event which will not be until October. He goes on to state: "If the scientific conditions continue as they are now, we may have an event of intermediate magnitude - stronger than 1972, but weaker than 1983 - and the rains will probably not arrive before December which will give adequate time to prepare for the situation."^{xxxv} Another newspaper, citing the same well-known scientist described predictive capabilities: "Based on the experiences of past events [El Niños], a diverse group of scientists have developed numeric models describing the evolution of the phenomenon. The dynamics of the ocean and its temperature have been predicted two to three months in advance, as Dr. Marcone showed in the recent conference. Predictions more than three months in advance are weak. Despite the efforts and powerful computers, in every conference the experts raise more questions than answers."^{xxxvi}

July 4, 1997: The Executive Director of IMARPE announces that El Niño is affecting the reproductive phase of anchovy and certain drastic measures will have to be taken in order to maintain the population of this valuable species.^{xxxvii}

July 4, 1997: Dr. Stilman, the President of IGP announces that the forecasts of devastating consequences that this El Niño will have are "alarmist, given that an event like the one that occurred in 1982-83 only recurs every 500 years." He continues: "But this El Niño, which can be classified as special, has manifested in winter rather than summer, the period of rains in the departments of Piura and Tumbes" and that only in September and October may the true dimensions of the event be known, and it may disappear at the end of December of January of 1998 as the climatic conditions necessary for its formation will not exist."^{xxxviii}

July 7, 1997: INDECI estimates that based on the 1982 event, this El Niño may cause displacement of 1,365,200 persons, but with prevention efforts, this can be reduced to 408,560 persons.^{xxxix}

July 10, 1997: Amidst rumors of MIPE declaring a ban in the south of Peru, industrial fishing firms take out an ad in the paper arguing against this act. They claim that over 76 percent of the stock is in Chilean waters and that it is not fair that the Chileans continue fishing if Peruvians are not allowed to, since the Peruvian fish will migrate to Chilean waters and get caught.^{xxx}

July 11, 1997: In Chile, following an oceanographic cruise in the North, IFOP confirms the presence of El Niño due to SST about 2.5°C above normal, deepening of the thermocline, and increased catches of anchovy in the north.^{xxxi}

July 12, 1997: The IMARPE Chief of Oceanographic Cruises (and former director) says El Niño will be moderate until October, although it will have a duration of approximately ten months.^{xxxii}

July 16, 1997: MIPE announces that based on the recommendations of IMARPE, and taking into account the fact that the quotas for capture have already been completed, a ban will be placed along the entire coast beginning July 18 until September 7, 1997. Further reasons are stated: the development of the El Niño event which began in March 1997, and can now be classified as strong, led to a mixing of the southern stock with the north-central stock, causes physiological changes in the fish which threaten reproduction and the stocks' general well-being, and concentrates the stocks which threatens their future.^{xxxiii}

July 20, 1997: Editorial column declares that ban should be declared for technical reasons, not for political reasons, and that IMARPE information should be available to the public, and that Chileans are currently benefiting from the ban.^{xxxiv}

July 23, 1997: Mayor in the southern town of Ilo declares that the Chileans are illegally fishing just a few miles from the coast.^{xxxv}

August 12, 1997: High air temperatures (31°C) and cloudiness in northern Chile indicate the beginning of El Niño and the end of winter for northern Chile. According to the oceanographic expert at the Universidad Arturo Prat in Iquique, it is going to be a strong event.^{xxxvi}

August 15, 1997: The Japanese Meteorological Institute announces that this El Niño will be the longest one in history.^{xxxvii}

August 17, 1997: INDECI declares that this El Niño threatens the lives of approximately 6,000 persons in Peru.

August 20, 1997: INPESCA announces revenue losses of U.S.\$4,500,000 since the ban was implemented on July 18, 1997. It asks that taxes and customs export dues be postponed 18 months, that discussions be had with financial sector to refinance short- and medium-term loans, and for a modification of regulations to allow the industry to fish other species.

August 23, 1997: The executive director of the IGP declares that as of now there is not any indication of heavy rains in northern Peru. Even if water temperatures increase five degrees above normal, this is not necessarily cause for worry, as the very strong El Niño events only appear about every 400 years.^{xxxviii}

August 24, 1997: In an open letter to President Fujimori, the mayors of the principal towns in southern Peru denounce the ban in the south on several grounds: there has never been a ban in 30 years in the south; the Chileans are going to catch the fish if Peruvians do not; the landings in the south are statistically insignificant in comparison with the rest of the country; and there will be extreme economic damage done to their towns which are dependent on fishing.^{xxxix}

August 25, 1997: A thirty-day ban is declared in northern Chile to allow reproduction and to protect the species in the presence of El Niño.^{xi}

August 25, 1997: The Minister of Fisheries announces that the mayors of the southern towns used fallacious arguments in their letter to President Fujimori.

August 25, 1997: The Peruvian industrial fishing sector owes over U.S.\$600 million to the banks, with much of this investment having been made in modernizing equipment in order to comply with new environmental regulations. Industry claims that there are too many fishing regulatory restrictions preventing them from making money to repay these loans.^{xli}

August 28, 1997: The *Instituto de Medio Ambiente* in Geneva, using elaborate models, states that if the current El Niño continues in the same manner, it would be stronger than the 1982-83 event. A congressman proposes the suspension of fees and interest on outstanding loans for farmers whose activities could be affected by El Niño. The president of the *Sociedad Nacional de Industrias* says that 30 percent of the cotton industry has shut down due to El Niño.^{xlii}

August 28, 1997: In response to complaints by mayors of the southern towns, MIPE declares that ban in the south is a result of IMARPE reports on biological and oceanic conditions resulting from El Niño and refers to the collapse of the fishery in 1973 when there was no ban.^{xliii}

September 1997: Four boat owners associations declare that ban in the south is a mistake, referring to the 1982-83 El Niño when anchovy catches did not harm reproductive capacity of the stock and saved the national fishing industry. They claim Chile is taking 75 percent of the fish biomass in the South.^{xliv}

September 6, 1997: MIPE declares that the ban in the south will be lifted on September 8, based on recommendations by IMARPE. The report indicates that the north-central and southern stocks are separate, that anchovy reproduction period is nearly finished, and that the ban declared on July 18 was successful in preserving the stock.^{xlv}

September 8, 1997: President Fujimori emphasizes the potentially negative impacts of El Niño on the economy and social situation in the country if preventive measures are not taken. He rejects the idea of seeking external loans and of giving financial help to the agricultural and fishing industries, which may be damaged by this El Niño. He says that "the fishing industry will experience almost no growth this year, nonetheless, the ban in the south will be lifted the eighth of September."^{xlvi}

September 15, 1997: The Department of Geophysics at the Universidad de Chile states that the effects of this El Niño will be felt until April 1998, and that Ecuador and Peru will receive heavy rains. Chile's fishery may be negatively affected by the event.^{xlvii}

September 15, 1997: NASA has released a report that the intensity of this El Niño-Southern Oscillation will be comparable to the 1982-83 "El Niño of the Century". SENAHMI adds that this El Niño will cause great losses to the textile, fishing, and agricultural industries.

September 18, 1997: The executive director of IMARPE (retired Navy Vice-Admiral) is put in charge of ENFEN/CPPS, and the INDECI is included in the group.^{xlviii}

September 24, 1997: Based on the results of an IMARPE cruise, the Minister of Fisheries announces that impacts of El Niño will be known October 15, and an announcement will be made in early November. In general terms, he declares that he "thinks the country is much better prepared than in 1983 to confront this problem [El Niño]".^{xlix}

October 1, 1997: SENAHMI announces that losses due to El Niño in agriculture and fisheries are expected to be around US\$1 billion. The director of SENAHMI declares that this El Niño will be intense. The director of SENAHMI declares that this El Niño will be intense.¹

October 2, 1997: IMARPE declares that climatic changes due to El Niño did not have a significant effect on the fisheries. In general, resources are in good condition. Sardine and jack mackerel are concentrated 30 miles offshore, and anchovy have been detected within 20 miles from shore, and sardine have begun their reproductive phase.^{li}

October 8, 1997: Government announces that inflation will not surpass 8.5 percent in 1997 and 8 percent in 1998. Final results will depend on the impact of El Niño for the last three months of 1997, and increased prices for food and drinks and decreased prices for clothing and shoes are expected.^{lii}

October 10, 1997: The president of the Central Reserve Bank states that 1998 trade deficit will increase to U.S.\$1700 million due to effects of climate on fishing, with exports of fishmeal dropping by 43 percent.^{liii}

October 12, 1997: SENAHMI announces that the next temperature peak in oceanic waters should occur between November and December.^{liv}

October 16, 1997: Vice-Director of INDECI declares that there will be an 80-90 percent reduction in negative effects caused by El Niño this year in relation to 1983 due to government efforts.

October 17, 1997: The Minister of the Economy declares that growth of Gross Domestic Product for 1997 will be at least 6 percent, with an increase of 19 percent in exports and 6 percent in imports. Climate alterations will affect the fishing sector.

October 26, 1997: ERFEN declared that sea surface temperature anomalies are decreasing, but still strong in Colombia and Ecuador.^{lv}

October 29-30, 1997: The Inter American Institute for Global Climate Change (IAI), NOAA, WMO, INPESCA, and a number of banks and large fishing firms hold a climate outlook forum in Lima with the intent to produce a consensus climate forecast for the region and to forecast potential impacts of this event for various sectors (including fisheries) based on the climate forecast. The event is called: "Is this the El Niño of the Century?"

October 31, 1997: the director of IGP reports that the findings of the IAI conference (29-30 October) indicate that this El Niño will be less intense than the 1982-83 event, and that February and March will be the critical months. He also claims that while NOAA has a good model for predicting El Niño on a global scale, individual countries must evaluate the local impacts based on their local knowledge. As a consequence of this event, the Peruvian and Chilean governments agree to work together to protect fisheries from the consequences of El Niño.^{lvi}

October 30, 1997: SENAHMI declares that the heavy rains expected for Peru will begin in December.^{lvii}

November 1, 1997: A scientific piece in the newspaper discusses the benefits brought by El Niño, including its contribution to the growth of new plant and flower species, growth of forests and grasslands up to two years after the event, and delaying the production of carbon dioxide in the atmosphere.^{lviii}

November 5, 1997: According to a professor from the Universidad de Piura, (in northern Peru) the lack of rain in the north, heat waves in the west, rains in the south, and decreasing SSTs indicates that this El Niño will not be as strong as the 1982-83 event.^{lix}

November 5, 1997: The World Bank promises to give a loan of U.S.\$150 million to Peru to take preventative measures for an event estimated to be at least as damaging as 1982-83, which resulted in economic losses of about one billion dollars.^{lx}

November 11, 1997: SENAHMI states that this El Niño will have about 50 percent of the intensity of the rains of the 1982-83 event, but the rains will be most intense in December and January.^{lxi}

November 11, 1997: Cleaning of the drainage systems in the north is almost complete.^{lxii}

November 12, 1997: MIPRE has spent approximately U.S.\$165.5 million dollars on preventive actions for this event.^{lxiii}

November 13, 1997: The Food and Agricultural Organization of the United Nations (FAO) estimates that El Niño will decrease fisheries and agricultural production by 15 percent compared to a normal year.^{lxiv}

November 13, 1997: Peruvian scientists conduct a workshop to design a research strategy for studying the terrestrial and marine effects of this El Niño.^{lxv}

November 15, 1997: Severe weather affecting several regions in Peru is attributed to El Niño.^{lxvi}

November 28, 1997: Banks stop loans to farmers in the South in expectation of drought, even though there is currently plenty of water.^{lxvii}

December 22, 1997: El Niño will influence the economic growth of the country in 1998, reducing growth in the agricultural sector from 5-6 percent to 1-2 percent.^{lxviii}

December 30, 1997: The *Asociación de Empresarios Agrícolas* (AEA) estimates that Peru will lose U.S.\$120 million in exports due to El Niño, but the internal market will not be affected. The general impact on the GDP will be 1.5 percent.

January 11, 1998: Based on data from their coastal stations and oceanographic cruises, IMARPE states that this El Niño can be categorized as "severe". According to the SNP, November of 1997 showed a 52 percent decrease in landings in the fishing sector compared to the same month in 1996. However, the sector still grew in terms of profit by 1.4 percent. The President of the SNP believes the decline in landings will continue into the first months of 1998 and that "optimistically, I hope that conditions will begin to reverse beginning in April of this year; meanwhile I fear that the results [of fishing] are going to be as bad or worse [than the present]."^{lxix}

January 11, 1998: The President of the Peruvian Stock Exchange comments that El Niño and the Asian financial crisis will affect the national stock exchange in 1998 and there exists a direct relationship between El Niño and willingness to invest in the country.^{lxx}

January 19, 1998: The main highway connecting the north and south of the country is cut in several spots because of heavy rains.^{lxxi}

January 20, 1998: United Nations reports that Peru and Ecuador have suffered enormous losses from this El Niño event, with Peru's fisheries reduced by 52 percent of normal, and 3,145 hectares destroyed, 30 persons dead, 9,684 homeless, 200 cases of malaria, and outbreaks of cholera.^{lxxii}

January 22-23, 1998: MIPRE sponsors a meeting in Lima, "The Phenomenon El Niño 1997-1998: Evolution, Forecast, and Mitigation", intended to give an overview of work performed by the ENFEN/ Comité Multisectorial and an outlook for the upcoming months. The meeting is organized by IMARPE and the United Nations Development Program. International experts are also invited as the keynote speakers.

January 25, 1998: Doctors, nurses, and other employees of the Fishermen's Benefits Fund (*Caja de Beneficios Sociales del Pescador* - CBPS) will receive a third of their normal salaries due to lowered catches resulting from El Niño.^{lxxiii} IMARPE states that oceanic conditions will return to normal around March to April, and that even though it is difficult to forecast, they hope for improvements in the fisheries from the current crisis situation.^{lxxiv}

January 22, 26, 31, 1998: President Fujimori declares that (1) the rapid repair of highways will avoid a fall in the GDP, (2) El Niño is under control even though it is 50 percent stronger than in 1983, and (3) the country will not declare a state of emergency due to the effects of El Niño.^{lxxv}

February 2, 1998: The unpredictable consequences of El Niño will alter the country's economic variables this year. Every day the climate event continues it will bring more death and destruction.^{lxxvi}

February 4, 1998: The former minister of MIPRE admits that the intensity of El Niño has gone beyond expectations.^{lxxvii}

February 5, 1998: According to SNP, ESAN, and the *Asociación de Exportadores*, El Niño has turned out to be larger than all the predictions, and will result in losses as great or greater than 1982-83. The fishmeal plants are working at only 5 percent of the installed capacity.^{lxxviii}

February 16, 1998: President Fujimori declares that the final stage of El Niño will at the latest begin in May 1998.^{lxxix}

February 18, 1998: Fifty million dollars will be given to Peru by the Inter American Development Bank for reconstruction of damage caused by El Niño.^{lxxx}

March 1, 1998: Marco Peluffo, the Scientific Director of IMARPE, declares that the true impact of El Niño on the marine resources, especially those species utilized for fishmeal and canning, will be known in the beginning of May. A study being initiated March 20 will identify the location of the thermocline, and in general, the impact of El Niño on the marine biomass.^{lxxxi}

March 11, 1998: The ex-Minister of the Economy says that there will be macroeconomic fluctuations in 1998 due to the severe impact of the combination of the crisis in Southeast Asia and El Niño.^{lxxxii}

March 11, 1998: President Fujimori declares that "El Niño will not affect the country's macroeconomic situation . . . the Peruvian economy has a positive outlook in spite of all the problems caused by El Niño, likely the most intense of this century."^{lxxxiii}

March 11, 1998: According to a survey of residents of Lima, the majority answered that the main impact of El Niño was felt in the increased food prices and that the agricultural sector was harder hit than the fisheries sector.^{lxxxiv}

March 12, 1998: The General Director of SENAHMI says that according to NOAA, there currently exists a tendency indicating a weakening El Niño, and normal oceanic and atmospheric conditions should return in June.^{lxxxv}

March 12, 1998: The rector of the Universidad Nacional Agraria announces that El Niño will remain until the month of August, according to studies conducted at the university. It will have the same intensity up to April, at which time it will decline slowly between then and August or September, and a mild winter is predicted. In this context the temperatures this year can be expected to be similar to 1997.^{lxxxvi}

March 17, 1998: The Minister of Fisheries declares that at the end of April, the fishing activity will return to normal.^{lxxxvii}

March 29, 1998: The Minister of the Economy reports that the government is preparing taxation measures to cope with El Niño, but reiterates that there will be no exoneration of taxes whatsoever.^{lxxxviii}

April 16, 1998: The Chief of the Dresder Bank of Germany states that El Niño will have a bigger impact on the Peruvian economy than the "Asian Crisis", but that this effect will be temporary.^{lxxxix}

April 27, 1998: Chief of the Division for Climate Prediction at the Argentinean National Meteorological Service says that El Niño will last through October though at a lower intensity as its influence is weakening every day.^{xc}

June 30, 1998: The Minister of Fisheries estimates that the production by the fishing sector will decrease by 30 percent this year, and beginning in October the recuperation of the fishery will be observed.^{xcii}

August 18, 1998: Marco Peluffo, the Scientific Director of IMARPE, states that conditions do not predict an alteration in the marine ecosystem and affirms that the water temperature along the entire length of coast has returned to normal, and, as a result, the end of El Niño can be declared.^{xciii}

August 22, 1998: According to James Lawrence Lawler from the University of Utah, sun spots trigger El Niño and La Niña. Archaeological studies can determine the exact years that important natural events occurred, thus giving us an idea of the cycles of their recurrence. This will allow measures to be taken to mitigate these disasters.^{xciv}

September 1, 1998: The Viceadmiral of IMARPE denies the existence of La Niña along the Peruvian coast. He says that the five principal scientific agencies that forecasted its arrival have issued an advisory of moderate cooling of the water. Another El Niño could present itself beginning in the Year 2000.^{xcv}

September 2, 1998: The Vice minister of the Economy says 1999 economic growth is projected to be 6 percent, based principally on the rise of fishing and manufacturing. The increase in exports will be sustained primarily by fishmeal and mineral products.^{xcvi}

September 2, 1998: The Minister of Fisheries expects positive results in the extraction of sardine and anchovy will continue the rest of the year. Fishing related exports will surpass U.S.\$30 million between September and December 1998. Fishing will return to normal in October when the effects of El Niño have concluded.^{xcvii}

September 3, 1998: The President of the Central Reserve Bank states that fishmeal sector will be one of the leaders in 1999 economic growth of the country.^{xcviii}

September 7, 1998: Headlines of major newspaper read "Chimbote is a beggar with a view of the ocean" referring to the situation of massive unemployment in the largest fishing port in Peru (population of 500,000) due to the decline in fish catches and additional non-fishing days due to the closed season. Over the past month, the government, through the National Program for Food Assistance, has given out 27,000 bags of food (22 kilogram bags containing rice, soup, and canned tuna). The newspaper reports complaints by fishermen's wives that the boat owners have not been paying their quotas to the Fishermen's Benefits Fund (CBPS) over the past few years, that there are no funds to help the fishermen, that many businesses in town are closing down due to the economic impact on this city, and that delinquency is rapidly on the rise. The Vice-President of CRC complains that the Minister of Fisheries should declare an emergency to help the firms avoid judicial proceedings against them (for loan defaults), allow flexibility in repayment schemes (e.g., refinancing debts).^{xcix}

October 15, 1998: The Banco Bilbao Vizcaya says Peru will lead regional growth in Latin America during the next year and will be the only country to register a significant increase in production levels compared to 1998. The economic situation will improve in 1999 to the degree that fishing exports are re-established.^{cx}

Appendix C

Additional information on prevention, impacts, and comparison with the 1983 as well as other years

Appendix D

Additional bibliographic information

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- ^{vi} Expreso, May 20, 1997, A11
- ^{vii} Gestión, May 27, 1997
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- ^{ix} El Comercio, June 6, 1997, A23
- ^x El Comercio, June 7, 1997, A1, A8
- ^{xi} El Comercio, June 7, 1997, A17
- ^{xii} El Comercio, June 9, 1997, A20
- ^{xiii} El Comercio, June 11, 1997, A17
- ^{xiv} El Comercio, June 12, 1997
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- ^{xvii} El Comercio, June 24, 1997, A1
- ^{xviii} El Comercio, June 24, 1997, A10

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xx Expreso, June 29, 1997
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xxiii La Estrella, June 18, 1997, B1
xxiv El Comercio, July 5, 1997, A23
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xxix Expreso, July 12, 1997
xxx El Comercio, La Estrella, July 10, 1997
xxxi La Estrella, July 11, 1997, A18
xxxii Expreso, July 12, 1997
xxxiii El Peruano, July 16, 1997
xxxiv La República, July 20, 1997.
xxxv Síntesis, July 23, 1997
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xlii Expreso, August 28, 1997, 10
xliii El Comercio, August 28, 1997
xliv El Comercio, September 1997
xlv El Comercio, September 6, 1997
xli Diarios de Circulación Nacional, September 8, 1997
xlvii La Estrella, September 15, 1997
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xlix El Comercio, September 24, 1997
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lxvi El Comercio, November 15, 1997, A22
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lxviii El Comercio, December 22, 1997, E8
lxix Gestión, January 11, 1998
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xci La República, June 30, 1998
xcii El Comercio, August 18, 1998
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xcvii Gestión, September 3, 1998
xcviii El Comercio, September 7, 1998, A8
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