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The 1997–1998 *El Niño* as an unforgettable phenomenon in northern Peru: a qualitative study

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Abstract

During the 1997–98 *El Niño* Southern Oscillation (ENSO), Tumbes, Peru received 16 times the annual average rainfall. We explored how Tumbes residents perceived the ENSO's impact on basic necessities, transport, healthcare, jobs and migration. Forty-five individuals from five rural communities, including those that were isolated and not isolated from the rest of Tumbes during this ENSO, participated in five focus groups and six individuals constructed nutrition diaries. When asked about events in the past twenty years, participants considered the *El Niño* as a major negative event. Negative effects that were ameliorated quickly were decreased access to transport and healthcare and increased infectious diseases. Residents needed more time to rebuild housing, recover agriculture, livestock and income stability, and return to eating sufficient animal protein. Although large-scale assistance minimized the ENSO's effects, residents needed more timely support. Residents' perspectives on their risks to flooding should be considered to generate effective assistance.

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Authors' Contributions

HED conceived and led all aspects of this research with mentorship from RHG and AMB. The field work was led by HED with support from AMB, MG, GG and MA. MG carried out the initial data analysis and AMB prepared the draft manuscript. All authors contributed to the interpretation of the data and the preparation of the manuscript.

Keywords

El Niño Southern Oscillation; Climate change; Floods; Peru; Qualitative

Introduction

The *El Niño* phenomenon causes extreme weather events all over the world, often evoking disasters such as floods and droughts. During an *El Niño* year, 35 per 1,000 people globally are affected by natural disasters, more than four times the rate of those affected during non-*El Niño* years (Bouma & Dye 1997). In Peru, the effect of *El Niño* is strongest in the northern coastal region, which suffers heavy rainfall and severe flooding during an *El Niño* episode. The year 1997 marked the first time that Peruvian scientists were able to provide an early forecast of a severe *El Niño* episode six months before the heavy rains began in November 1997 and continued through May 1998 (Glantz 2001b). The Peruvian government responded by developing a prevention plan that centered on the preservation of infrastructure through provision of proper drainage for the excess rainwater and distribution of aid to those most affected (Glantz 2001b).

The *El Niño* phenomenon is an unusual warming of sea surface temperatures in the equatorial Pacific that occurs every 2–7 years as part of the *El Niño* Southern Oscillation (ENSO) (Glantz 2001a). ENSO is often referred to as a "seesaw" of sea surface temperatures and sea level pressure in the Pacific Ocean (Walker 1924). In non-*El Niño* conditions, the western-moving trade winds in the Pacific basin push warmer sea surface water toward Indonesia and the Philippines, leaving the eastern basin with an upwelling of comparably cooler waters off the coast of South America and differences in sea level pressure (Walker 1924; Bjerknes 1969). Due to the higher sea surface temperatures, the atmosphere in the western Pacific basin is warmed and picks up moisture, in turn leading to cloud formation and rainfall in Indonesia, northern Australia, and the Philippines (McPhaden et al. 1998). The resulting rainfall largely contributes to the normal wet season in this region (Glantz 2001a). Subsequently, dense cooler air descends in the eastern Pacific basin, through a phenomenon called subsidence, leading to the suppression of cloud formation and little or no rainfall in the coastal region of Ecuador and northern Peru (Walker 1924). The normal atmospheric circulation patterns in the Pacific Ocean during non-*El Niño* years result in an arid climate in this area of South America.

At the start of an *El Niño* event, the western-moving Pacific equatorial trade winds weaken and the warmer sea surface waters move toward the central or eastern Pacific basin instead of the western basin as in typical non-*El Niño* years (Bjerknes 1969; Gill & Rasmussen 1983). This results in warmer waters off the coast of Peru, a reversal of sea level pressure in the eastern and western Pacific basins, and heavy rainfall in Peru and drought conditions in the western Pacific region (Ropelewski & Halpert, 1987). Such reversal of normal atmospheric circulation in the eastern Pacific often wreaks havoc on the livelihood of coastal population of Peru because of the excessive precipitation in this normally arid environment (Glantz 2001b).

Peru is divided into 25 regions or administrative divisions. Tumbes, the northernmost region on the Peruvian coast, is bordered by Ecuador to the east, the Pacific Ocean to the north and west, and the region of Piura (Peru) to the south. A largely rural, low-income region, Tumbes received approximately ~3300 mm of rainfall during the 1997–98 *El Niño* episode, more than 16 times the annual average of <200 mm of rainfall (authors' calculation using data from the Servicio Nacional de Meteorología e Hidrología del Perú). Despite the government's prevention efforts, the intense rainfall and floods led to reports of extensive damage to homes, schools, and health facilities (Gobierno Regional de Tumbes 2008). Overflowing rivers destroyed bridges and roads, cutting off transport and isolating many rural communities. The destruction of crops and livestock contributed to the inflation of local food prices (Comercio e industria afectados por lluvias 1998) and interrupted an important source of income for many residents of these rural areas (Gobierno Regional de Tumbes 2008).

The recurrent nature and disaster-inducing tendencies of the ENSO have important implications for human health (Kovats et al. 2003; McMichael, Woodruff & Hales 2006). The best-studied health outcome of *El Niño* is its link to infectious disease outbreaks such as malaria, dengue fever, cholera, and other diarrheal diseases (Bouma & Dye 1997; Bouma & van der Kaay 1996; Checkley et al. 2000; Colwell 1996; Gagnon, Bush & Smoyer-Tomic 2001; Gagnon, Smoyer-Tomic & Bush 2002; Gil et al. 2004; Hales et al. 1999; Pascual et al. 2000). In Peru during the 1997–98 *El Niño* episode, increased cases of malaria, diarrhea, and acute respiratory infections were reported (Checkley et al. 2000; Gagnon, Smoyer-Tomic & Bush 2002; PAHO 1998), further complicating the disaster situation in Tumbes given the inaccessibility to and decreased functionality of the health care system (Gobierno Regional de Tumbes 2008).

Globally, people who are most vulnerable to the impact of flood disasters are of low socioeconomic status and tend to live in rural areas (Brouwer et al. 2007; Few et al. 2004). During the 1997–98 *El Niño* episode in Peru, there was limited governmental and journalistic reporting about the impact. However, the direct impact of ENSO-related flood disasters on the daily lives of those most vulnerable still remains to be understood. Therefore we used qualitative methods to explore how residents of affected rural communities in Tumbes perceived the impact of the 1997–98 *El Niño* episode on the different aspects of daily life and how these aspects may or may not have changed during the flood disaster. Specifically, we examined access to vital resources (i.e. water, food, housing), availability of jobs and income, access to transport, health status and access to health care, in- and out-migration, and presence of assistance and prevention.

Methods

Study setting and participants

The majority of Tumbes' three provinces and 12 districts are located at or just above sea level and were home to approximately 200,000 inhabitants in 2007, making Tumbes one of Peru's least populated regions (Instituto Nacional de Estadística e Informática 2008). We carried out this research in five rural communities in Tumbes: Cerro Blanco, El Palmo, Isla Noblecilla, El Oidor and Rica Playa (see Figure 1). We selected communities that, according

to historical reports, had been both not isolated and isolated from the rest of Tumbes during the 1997/98 El Niño.

This qualitative study was conducted as part of a larger study investigating the long-term effects of the 1997/98 *El Niño* episode on the nutrition and growth of children in Tumbes. Field workers from the larger nutrition-related research project – all of whom were familiar with the communities and their residents – served as "gatekeepers" for recruitment. Prior to study implementation, they sought out females and males who were 30 years of age or older and had lived in their current community of residence since at least 1997, in order to ensure that they were old enough to remember the effects of the 1997–98 *El Niño* on the research communities. Those who expressed willingness to share their perspectives on their community's historical experiences together with other community members were invited to participate in a focus group (where a more detailed consent process was carried out prior to implementation). A total of 45 people participated in the study.

Data collection activities

We carried out five focus group sessions, one in each of the five study communities, during December 2008. The focus groups were held with 8–10 participants in central, well-known locations (schools, community centers) and were conducted in Spanish, the local language, by AMB and MG. First, we drew a timeline for the past twenty years and asked participants to identify important events in their community during that time period. The exact question was, "Thinking back over the past 10–15 years, has there been any event that has been important for your community? It could be something positive or something negative. Has anything happened that affected the people who live here?" It is important to note that during both the informed consent and timeline construction processes, the research team did not mention the *El Niño* phenomenon or any other environmental, climate- or weather-related events. Instead, we explained that we were interested in learning about the events that the participants – as representatives of the broader community – perceived to be the most important in their respective communities. Brainstorming continued until the *El Niño* emerged as an important community event; then, we asked about the event itself (exact timing, duration) and about its impact on the community. Once the initial impressions of the *El Niño* were complete, the research team asked about specific related topics: housing, access to transport, access to water, health and access to health services, access to work opportunities, migration, presence of assistance and prevention, and diet and access to food.

All sessions were audio-recorded and participant responses, including the timeline and the responses about the specific topic areas, were also recorded on large sheets of paper that were hung on the wall and visible to all participants. The use of paper that was visible to everyone enabled the research team to ask about similarities, differences and possible contradictions between the items mentioned and to work with participants to prioritize these different items. The focus groups, which lasted 60 to 90 minutes each, were conducted by two of the authors (AMB and MG).

Given the importance of diet for the larger quantitative project on the ENSO, carried out by the same research group, we decided to work with community residents to develop nutrition diaries as a complement to the focus groups. We returned to two communities, El Palmo and

El Oidor, where we asked three people in each place to complete diaries for their daily diet prior to, during and following the phenomenon.

Data analysis

Audio-recordings of focus groups were transcribed verbatim from digital audio recorders to a word processing program. The data were analyzed using a thematic approach. First, AMB and MG read all of the transcripts and independently identified themes and sub-themes. Then, they met to discuss the sub-themes and established an initial codebook. Next, MG coded all of the transcripts using Atlas.ti (Scientific Software Development GmbH, 2005), adding additional codes as needed if new sub-themes emerged during the coding process. Finally, AMB and MG synthesized the data by creating a matrix in Excel in order to 1) summarize the data by code and 2) analyze each code by community and across communities.

The nutrition diaries were entered into Excel. AMB, HED and MG synthesized the data by creating a matrix in Excel in order to analyze the types of protein sources in each community at the different time points explored.

Ethics statement

The research protocol was approved by the ethical review committees of the Asociación Benéfica PRISMA and the Johns Hopkins Bloomberg School of Public Health. All participants provided written informed consent prior to data collection, including consent for audio-recording of the focus groups.

Results

Demographics overview

The geographic location of the five study communities within the region of Tumbes is shown in Figure 1 and population data (Gobierno Regional de Tumbes 2007) and elevation data (Global Gazetteer 2.2, Falling Rain Genomics Inc.) are shown in Table 1. These communities differ in terms of the degree to which they are isolated from the rest of Tumbes during the annual, non-*El Niño* rainy season: El Palmo and Isla Noblecilla are typically completely isolated; Cerro Blanco, El Oidor and Rica Playa are typically able to maintain their connections to other communities.

The 45 focus group participants were fairly equally distributed across the five communities, with 7–10 participants from each place. Their median age was 46 years, with an interquartile range of 37 to 54 years, reflecting our attempt to include participants who would be able to provide historical information on their respective communities (see Table 2).

Immediate memories of the *El Niño* phenomenon

When asked to think back over the past twenty years about important events in their respective communities, participants from all five communities mentioned one or two recent *El Niño* phenomena (in 1997–98 and in 1982–83 – although participants remembered it as only 1983) within their first five memories (see Figure 2). In El Oidor, the first event

mentioned was the *El Niño* of 1997–98 and in Cerro Blanco, the first two events were the 1983 and 1997–98 *El Niños*, respectively. The memories of the participants in El Palmo were focused around periods of drought and rain: their first memory extended back to 1968 (drought); their second and third memories were the 1997–98 and 1993 *El Niños*, respectively; and their final memory was the 7-year drought that started in 1976. Participants' memories in Isla Noblecilla also centered on two types of events, in their case the *El Niño* (memory 1, 1983; memory 4, 1997–98) and armed conflict with nearby Ecuador (memory 2, 1981; memory 3, 1995). In the fifth community, Rica Playa, participants' initial memories were focused on community improvements (electricity, medical facility, etc.); however, their fifth and sixth memories were of the 1997–98 and 1983 *El Niños*, respectively. In all five communities, participants estimated that the rain lasted from five months in Cerro Blanco and El Oidor to seven or eight months in the other three communities.

After sharing their memories of important community events, participants discussed the impact of the "incessant rains" (as participants from El Oidor termed them) on their communities. The most common memory was destruction of crops, mentioned by three communities. Other frequent memories, each of which emerged in two of the five communities, were animal plagues, human illnesses, destruction of homes and isolation. Residents of El Palmo also mentioned panic and desperation and in El Oidor, participants talked about shortage of work and presence of assistance from outside individuals and institutions, the latter representing the sole positive memory. All quotes in this section end with the name of the community and whether or not it is typically isolated during non-*El Niño* rainy seasons.

Participants considered the *El Niño* to be worse than an earthquake (which is also common in the study communities) since, as a participant from Rica Playa described: "For us, what annihilates everything – our farms, our animals – is the *El Niño* phenomenon. It's much worse." A quote from participants in El Palmo is representative of how residents of all five communities perceived the nature and impact of the *El Niño*:

> Edgardo: There was one day that it rained …
>
> Maria: And it was frightening because you couldn't see the sun.
>
> Edgardo: It was frightening, you couldn't see the sun… it was all rain, rain and more rain.
>
> Armando: I'll tell you that women cried and men cried too because of the thunder. I saw people cry.
>
> (Focus group participants, El Palmo, Typically isolated in rainy season)

Memories of the *El Niño* phenomenon by theme

Once participants had shared their immediate memories, the focus group centered on the impact of the 1997–98 *El Niño* on housing, access to water, access to transport, health and access to health services, access to work opportunities, migration, presence of assistance and prevention, and diet and access to food.

Housing—Across communities, most people's houses were minimally affected, typically with damage to the exterior or lost roofs. People recalled some rain coming in to their homes, but what they remembered as much more destructive to the majority of houses was the wind.

> Flor: [There were] winds, [like] twisters… I remember that in my house, they blew off the corrugated metal and left me without a roof.
>
> (Focus group participant, Cerro Blanco, Not typically isolated in rainy season)

The houses of the smaller number of community members who lived along the streams or rivers (approximately 15–20% of residents) suffered severe damage. Many people that lived very close to – and usually alongside – water sources described how their belongings and often large pieces of their homes or their entire homes were literally washed away. Others stated that the water damaged their homes to such a degree that they needed to destroy and then rebuild them.

> Female 1: The houses were also affected.
>
> Male: It destroyed the houses.
>
> Facilitator: And how many people lost their houses?
>
> Female: Everyone that lived along the streams.
>
> Facilitator: What happened with the streams?
>
> Grimanesa: They got into the houses.
>
> Yanet: They dragged the houses away.
>
> Grimanesa: They had to take their things out quickly.
>
> Rafael: The rains were usually at night. You'd be resting and the water would come… it would come into the house.
>
> (Focus group participants, El Oidor, Not typically isolated in rainy season)
>
> Flor: We had to move to higher ground since the water rose up to half of the house.
>
> José: The entire street [main street of the community] was damaged by water.
>
> Flor: The whole street was evacuated.
>
> Facilitator: How many people lived on this street back then [during the El Niño phenomenon]?
>
> José: Fifty families.
>
> Facilitator: So the fifty families lost their homes…
>
> Flor: They didn't fall down. It's just that you could no longer live there since everything was mud, water.
>
> (Focus group participants, Cerro Blanco, Not typically isolated in rainy season)

Although many residents' houses suffered damage or even disappeared, study participants did not mention homelessness as an issue. Residents were able to seek temporary housing with neighbors or in community buildings such as schools or in tents and housing modules provided in a timely manner through national and international assistance.

Access to water—Access to water changed in a parallel manner in all communities during the 1997–98 *El Niño* phenomenon. Prior to and following the phenomenon, community members obtained their water from the river, either directly or piped into their homes or a central community location like a well. During the phenomenon, participants continued to use river water and rainwater became an important additional source.

> Facilitator: Did you have water during the [El Niño] phenomenon… water for your houses?
>
> José: The river was there and we had to make it clearer with bleach and then store it.
>
> Hilda: An agency brought us bleach… a Spanish or European agency… that would give it out house by house to treat the water.
>
> Facilitator: How did you get the water in order to treat it?
>
> Hilda: … We would take it from the river and put it in a container. Then we would add in what they gave us [the bleach].
>
> Lilia: But some people also got it from the roof.
>
> Hilda: … From the rain.
>
> Lilia: That water was very clear. We would boil it and then use it because they say that the corrugated [zinc] roof has…
>
> Hilda: Rust.
>
> Lilia: Also, instead of drinking the [river] water that has a lot of mud and dirt, we prefer to put it into a container and boil it, to be able to drink it…
>
> Facilitator: Prior to the phenomenon, did you boil the water?
>
> Hilda: Well before we didn't have to boil it, but looking at it closely then [during the phenomenon], seeing that it was really dirty, then we got used to boiling it.
>
> (Focus group participants, Cerro Blanco, Not typically isolated in rainy season)

When asked about water treatment, participants affirmed that although the importance of boiling or adding bleach to water was common knowledge even prior to the 1997–98 *El Niño*, they usually did not take these preventive measures. The phenomenon had the unanticipated positive effect of promotion of water-related prevention since residents associated presence of mud in river water or rust from the roof in rainwater with contamination; therefore, they were more likely to treat this water.

Access to transport—All participants expressed how difficult it was to reach any location outside of their communities. The quotes from the study participants showed that

residents of El Palmo and Isla Noblecilla (which are isolated almost every rainy season) could leave their communities only in cases of extreme necessity, often taking risks such as crossing a chest-high river, while residents of the other communities could also only leave in cases of necessity but had access to alternative forms of transport if planning for longer transport times.

> Facilitator: Normally for how long are you isolated and can't leave [the community]?
>
> Guillermo: For about half a year.
>
> Enrique: Six to seven months. For example, vehicles can come in from August… to December… or sometimes January.
>
> Facilitator: And during the [El Niño] phenomenon, was it the same?
>
> Guillermo: During the phenomenon it lasted one year. For all of 1998, there was no access.
>
> Facilitator: And what would you do then if someone needed to get out?
>
> Rosa: If the river went down, the tallest person would go out…
>
> Guillermo: For example, at the time Mr. [Name] [was] more or less tall… We would go and knock on his door so that he would take us across [the river] since he was strong…
>
> Facilitator: And how did he take the people across…?
>
> Guillermo: By hand… He would hold their hand and guide them as they walked.
>
> Enrique: Sometimes they would swim.
>
> (Focus group participants, Isla Noblecilla, Typically isolated in rainy season)
>
> Facilitator: Could people access transport during the [El Niño] phenomenon? For example, if they needed to leave El Oidor…
>
> Several: By foot, by foot.
>
> Yanet: We'd also cross to the other side of the river [to another town] in canoes.
>
> Silvia: To get there more quickly.
>
> Facilitator: For example, how long would you have to walk to get to where there were vehicles?
>
> Oscar: Three to four hours.
>
> Facilitator: … And if you went by canoe to the other town, then what would you do?
>
> Yanet: There they did have transport.
>
> (Focus group participants, El Oidor, Not typically isolated in rainy season)

Health and access to health services—The main health-related issues that emerged in the focus groups were an increase in infectious diseases like malaria, typhoid fever, dengue and cholera, as well as in acute respiratory infections, the latter primarily among children.

> Facilitator: Of the 25 families that lived here during the [El Niño] phenomenon, how many people had malaria?
>
> Guillermo: Almost everyone.
>
> Several: The majority…
>
> Guillermo: Yes. For example, my father had malaria and typhoid [fever].
>
> Blanca: We also had everything…
>
> Guillermo: Both at the same time… cholera too.
>
> (Focus group participants, Isla Noblecilla, Typically isolated in rainy season)
>
> Facilitator: … So the children got sick. What caused their illnesses?
>
> Noelia: Diarrhea.
>
> Esperanza: Diarrhea, vomiting, fever.
>
> Facilitator: Why do you think this happened?
>
> José: Because of the change in climate.
>
> Esperanza: Because there weren't health posts for vaccinations like they have now.
>
> Noelia: [Because of] the water. The water was really contaminated.
>
> Rafael: Primarily with illnesses that are common during winter…
>
> Noelia: Colds.
>
> (Focus group participants, El Oidor, Not typically isolated in rainy season)

Participants also described challenges accessing health services, particularly health services provided by personnel with more formal training such as university-trained midwives and doctors. In Cerro Blanco and El Oidor, only technical personnel were available at the local health establishment, with a doctor available 1–2 days per week in the case of El Oidor. In El Palmo and Isla Noblecilla, residents had to travel to nearby communities where, in many cases, they were still unable to obtain more specialized care. They confronted similar challenges when seeking out medicines.

> Flor: Children with fever, we had to take them… to the health post over there, in order to get medicine… Take them by donkey.
>
> Sandra: Horse.
>
> Flor: Hoist them up… I took my son through the river, that's why I can tell you…
>
> Sandra: With the water at her chest.
>
> Flor: Risking our lives…
>
> Armando: To get to the health center two hours away.

(Focus group participants, El Palmo, Typically isolated in rainy season)

One exception was Rica Playa, where a university-trained midwife and doctor were flown in to live in the community for the duration of the 1997–98 *El Niño* phenomenon. Despite the presence of skilled providers, residents still had to go to the city of Tumbes for more specialized care.

Matilde: It was in [nineteen] ninety-eight…

Carlos: When they brought him in a helicopter. Do you remember the doctor?

Matilde: They brought a doctor and a midwife.

Facilitator: Did the two of them stay to live here?

Matilde: Yes, they stayed.

Facilitator: Okay. Did they stay all of those months?

Matilde: Yes, for the entire phenomenon. They would only go back at the end of the month to be paid.

Carlos: When people got sick, they could no longer be treated here because this was only for first aid… so what they could do was transfer them to the hospital.

(Focus group participants, Rica Playa, Not typically isolated in rainy season)

Access to work opportunities—As seen in the immediate memories of the 1997–98 *El Niño,* the phenomenon destroyed most crops, with the exception of limes, and causes illness in livestock. Since the economy of these five communities is driven by agriculture, these phenomena translate directly into lost work opportunities. In response to lost longer-term crops like bananas and other fruits, community members would plant short-term crops like beans, yucca, corn and other vegetables. However, this alternative was not cost-effective for two reasons: transport challenges meant that they couldn't get the product to market or would take large risks to do so; and since all communities resorted to short-term crops, the competition was strong and therefore, caused prices to drop.

Facilitator: You said that all of the agriculture died, that everything you'd planted died.

Ricardo: Until the entire phenomenon was finished, it [the agriculture] remained dead… Before the phenomenon, not everything died and there was something to take [to the market]. But how did we transport things to Tumbes [during the phenomenon]? At that time [there were] limes. We used the river to transport them to Tumbes, to the market in Tumbes.

Gladys: And with the risk that they [the transporters] would drown.

Ricardo: Risking their lives.

Carlos: Going by raft.

Ricardo: The only product we could take was the lime.

Facilitator: Who usually took the limes? Certain people? Everyone?

Ricardo: There were certain people that were chosen…

Gladys: That knew how to swim.

Ricardo: Strong swimmers [who were] young.

Gladys: They didn't have any money and they were paid to take them [the limes].

Ricardo: The farmers paid them.

Renán: But if the product got away, [they were told to] let it go.

Gladys: Exactly. They should save themselves.

Ricardo: 'That's it,' we'd say, 'save yourself, even if the product gets away.' They couldn't [always save it] because the river was big. It rose above the boardwalk in [the city of] Tumbes.

(Focus group participants, Rica Playa, Not typically isolated in rainy season)

Rosa: Here we grow banana, but banana takes time [to grow]. I think it takes…

Several males: One year.

Rosa: When the winter is strong like the phenomenon… you plant whatever you can, corn, sweet potato, all that you can, but after, there's no market. Once you have sufficient corn, its price goes down and no one wants it.

(Focus group participants, Cerro Blanco, Not typically isolated in rainy season)

Regarding livestock, participants estimated that people lost 50–70 percent of their animals during the 1997–98 *El Niño*. Their animals were either literally washed away by the rains or died due to illness.

Ana: The animals didn't eat well… they didn't have anywhere to sleep. They would try to sleep in the sand, but it was all destroyed. They would go to the area right next to the streams. The stream would come and it would take the animals away… [with the animals] running.

Renán: With the rain, the hills get green and the shrubs grow… the only part that is clean is the streams so the animals go there to sleep… without realizing that the stream comes straight through…

Ana: And takes them…

Renán: It takes them at night while they're sleeping.

(Focus group participants, Rica Playa, Not typically isolated in rainy season)

It is important to note that in all five communities, despite lack of access to food, people emphasized that they did not eat the meat of sick animals since they knew that that could bring human illness.

Migration—The *El Niño* phenomenon resulted in significant temporary migration and minimal long-term migration. Most population members needed some form of income and sought work opportunities in other parts of Tumbes or across the border in Ecuador while a

minority of population members were able to wait out the rain without looking for work. Long-term migration away from the study communities due to the phenomenon was estimated by participants to be 5–10 percent of the population.

> Luis: Here when the phenomenon comes, the farms are clean… that is, without any plants. People go to Ecuador to work.
>
> Marcos: More or less 70 percent [of people] go.
>
> Facilitator: Of that 70 percent that went to Ecuador for work, how many came back?
>
> Luis: Everyone. They go for eight days and come back with their money… or for seven days, fifteen days… The people come and go.
>
> Facilitator: But are there for example people that left Cerro Blanco during the [El Niño] phenomenon and didn't come back?
>
> Luis: Maybe there are some families that went looking [for work].
>
> Marcos: But they're few.
>
> Rosa: Yes, few.
>
> Marcos: To transport yourself, you also need to have the economic means. To go to Lima, wow!... you'd have to spend.
>
> (Focus group participants, Cerro Blanco, Not typically isolated in rainy season)

Presence of assistance and prevention—The amount of assistance during the 1997–98 *El Niño* varied by the degree to which the communities are isolated during the typical, non-*El Niño* rainy season, with the traditionally non- isolated communities receiving much more assistance. Assistance was primarily in the form of food, tents and housing modules and came from the Peruvian government and cooperation agencies from Spain and other parts of Europe. This assistance came soon after the strong rains began (within one month and only once a state of emergency had been declared), was brought in by land when possible and by helicopter in most cases, and was so meaningful to participants that many remembered the complete names of the individuals that visited their communities on behalf of these programs.

> Luis: We the people of this town were beneficiaries… We received rice, sugar, oil, kerosene, flour… tuna fish.
>
> Claudia: That was from PRONAA [the National Food Assistance Program], right?
>
> Luis: No… PRONAA helped on one side, by using "common pots" (*ollas comunes).* There was no work so we started to cook in groups. The town got organized.
>
> Luis: There were "common pots" in different places and they had food… with support from the European Community. So overall during that phenomenon, we didn't suffer with food.
>
> (Focus group participants, Cerro Blanco, Typically not isolated in rainy season)

Facilitator: How long did it take for help to arrive?

Rafael: It didn't take long at all.

Facilitator: For example, the rains started in December. How long did it take?

Several: Until January.

Oscar: They declared an emergency.

Flor: Then the food would arrive by helicopter.

Facilitator: During that time, did you have sufficient food?

Oscar: No. It was just to survive.

Flor: To sustain ourselves.

(Focus group participants, El Oidor, Not typically isolated in rainy season)

Regarding prevention, it is important to note that many residents of the five study communities live in areas that have been declared by the Peruvian government to be risk zones. Even when they are relocated to higher, less risky zones during floods, most residents move back to the risk zones.

José: … This street was relocated to the [prefabricated housing] modules. The mayor put up modules… for everyone living on this street.

José: But people are used to things, right? Once it [the rain] dries up, they come back… They had to come back to their homes… because the modules weren't well-constructed.

Luis: They were provisional.

Sandra: For emergencies.

José: And they're also uncomfortable.

Facilitator: So if I look at this street now, of those 50 families, how many are back living on this [main] street?

José: The majority.

Facilitator: Of the fifty, how many?

José: About thirty.

José: … Right now, we've rebuilt out homes but they didn't give us a property title like they gave to other people.

Facilitator: Why not?

Sandra: It's a risk zone.

(Focus group participants, Cerro Blanco, Not typically isolated in rainy season)

Additionally, participants in Isla Noblecilla mentioned that the government has recommended the relocation of the entire community due to its small population size and multiple months of flooding and complete isolation every year. Many of their former

neighbors have moved their houses to a nearby community (approximately 10–15 minute walking distance) and maintain only their agricultural lands in Isla Noblecilla. These participants, however, do not want to move.

Diet and access to food—Access to food paralleled access to assistance: the traditionally non-isolated communities received much more assistance and food; and the traditionally isolated communities received less assistance and food, resulting in food shortages, although individuals had stock-piled food to the degree they were able. Despite presence of assistance in all five communities, the start date varied across communities and uniformly lasted until the rains ended in May 1998. Participants described higher consumption of any type of protein during the times they had food assistance support, as compared to their pre-assistance diet during the *El Niño* and their diet immediately following the end of the rains. This assistance diet, however, lacked certain animal protein sources like beef, goat and chicken.

> Sandra: During the phenomenon, the [price of] food goes up too much.
>
> Luz Maria: They bring it by donkey, on trucks.
>
> …
>
> Laura: That's why it was expensive, because they made sacrifices [to bring it].
>
> Armando: Food was scarce. At that time, during those days, food was scarce.
>
> Sandra: We ate only once a day.
>
> Edgardo: People cried, even men [cried].
>
> (Focus group participants, El Palmo, Typically isolated in rainy season)
>
> Facilitator: What was [your diet] like before the [El Niño] phenomenon?
>
> Marcos: Normal. Since nothing [agriculture] died, people had their income. If you wanted to have beef, you'd have it.
>
> Facilitator: And during the phenomenon?
>
> Marcos: Then we ate all fish… [canned] tuna, tuna, tuna.
>
> (Focus group participant, Cerro Blanco, Not typically isolated in rainy season)

The data from the focus groups was confirmed by the information gathered in the nutrition diaries (see Table 3). In El Oidor, which is representative of the three communities that are not isolated in non-*El Niño* years, their diet was seriously limited for one month before food assistance arrived. Their diet improved significantly with assistance, although the sole source of animal-based protein was fish and milk. When the *El Niño*-related assistance stopped, help from the National Food Assistance Program (PRONAA in Spanish) began immediately, allowing the "assistance diet" to continue for a total of approximately 16 months. Participants said that they returned to their pre-*El Niño* diet around May 1999, one year after the rains stopped. The one contrast between El Oidor, Cerro Blanco and Rica Playa is that the latter two communities were not able to go fishing and therefore ate less fish than the residents of El Oidor.

The situation in El Palmo, which is representative of the two communities that are typically isolated in *El Niño* years, was more limited by the phenomenon. Community members recalled subsisting primarily on shrimp with some (but limited) fish prior to the arrival of assistance and expanding their diet to include beans, limited amounts of canned tuna and milk when assistance came. Assistance in this community, however, lasted only three months. Residents then returned to their "pre-assistance" diet for three months and estimated that they were able to achieve their typical pre-*El Niño* diet around September 1998, much more quickly than in the other communities. An important contrast between El Palmo and Isla Noblecilla is that residents of Isla Noblecilla were able to fish more and therefore ate more fish than the residents of El Palmo.

Discussion and Conclusions

Results presented here affirm that participants' recall of major life events is enduring and that the *El Niño* Southern Oscillation figures prominently as a major life event for residents of rural communities in Tumbes. Findings also demonstrate that although significant government-administered, nationally- and internationally-supported assistance was present, it underestimated the immediate and longer-term natural and economic consequences of the *El Niño*.

The primary limitation of this study is that participants were asked to recall events that had happened ten or more years prior to study implementation. Numerous measures were implemented to facilitate this recall. The first was the use of focus groups, to provide the opportunity for group memory about important community events. The second was the use of timeline analysis, which enabled participants to physically visualize the years that make up the history of their community. This methodology has been used in the context of participatory research to explore the livelihood experiences and resource management of communities both in general (Strele et al. 2006; Ogato, Boon & Subramani 2009) and specifically related to climate change (Su, Li & Fu 2009; Das, Chutiya & Hazarika 2009). Finally, the timeline analysis in this study started with questions about the current year (2008) and the quality of that year for the overall community (good or bad). This in turn facilitated thinking back over prior years. It is important to note that in a previous study that used qualitative methods to examine climate change in villages in China, participants had a difficult time recalling droughts and floods (Su, Li & Fu 2009). This was certainly not the case in the current study, where these memories emerged spontaneously and quickly, affirming the strong impact of such events on community members.

Although the ENSO emerged as a prominent memory for all participants, it was viewed with greater priority in certain communities. In El Oidor and Cerro Blanco, the *El Niño* most likely stood out more since these communities are not as severely impacted by typical annual rains as the other communities and are therefore unaccustomed to isolation; hence the *El Niño* was a more significant memory for them. Community members in Isla Noblecilla and El Palmo had competing interests that had similar impacts on their daily lives as the *El Niño*, armed conflict in the case of Isla Noblecilla and drought in the case of El Palmo, although it is important to note that the latter also relates to rains. Finally, Rica Playa is a marked exception to the typical rural community in Tumbes, as noted during the focus group

there and during extensive field work for the nutrition study. Community members in Rica Playa have a very positive attitude to life and are also very organized as a community; for example, they all worked together to form a community organization that actively advocates for community improvement projects. It is those projects that emerged on the timeline.

Overall, there has been limited qualitative work to explore the perceived impact of flooding in developing countries from the perspective of community members (versus community leaders or non-governmental or governmental organizational representatives). A study in Ethiopia interviewed 14 leaders from government and non-governmental organizations and surveyed 35 flood victims about multiple issues, including the impact of typical yearly flooding (Wakuma, Mandere & Ewald 2009). Participants cited deaths, diseases (primarily malaria and diarrhea), and crop destruction as the main effects, the latter two similar to the findings from the current study. Another study interviewed 32 community members from urban areas of Dhaka, Bangladesh about the challenges they faced and coping strategies they developed during two months of atypical severe flooding. Immediate challenges that emerged included homelessness, lack of sanitation services, lack of safe water, reduced food intake, scarcity of work and wages and increased family tensions and domestic violence while coping strategies included community mobilization and relief assistance (Rashid 2000). Overall, the circumstances described by participants in our study were parallel, but not as severe in some cases: participants in Tumbes lost access to their typical source of "safe" river water, but were able to collect some river water together with rainwater; they lost homes, but were able to find alternative temporary housing; and they lost agriculture and therefore income, but many could seek work elsewhere. In the case of mid- and long-term stable housing, viable agriculture and livestock and income stability, however, residents of rural Tumbes needed time to recover. Another important area that warrants mention is infectious disease. As shown in the results, participants in all five communities signaled increased prevalence of numerous infectious diseases as the primary impact of the *El Niño* on health. It is difficult to know whether this impact was perceived or real given limited access to health services. However, it is important to note that a study on the ENSO and malaria epidemics in South America found much higher malaria prevalence in northern Peru (including Tumbes) during the 1998 *El Niño* (48%) compared to 1996, a non-ENSO year (7%) (Gagnon, Smoyer-Tomic & Bush 2002). Finally, our study was unable to explore family tensions and domestic violence in greater depth given that addressing sensitive issues in a group setting can challenge confidentiality and privacy protections. These issues would be important to examine in future studies, along with other mental health impacts. Several studies have qualitatively explored individuals' perceptions of the impact of natural disasters on their mental health and revealed important effects (Rajkumar, Premkumar & Tharyan 2008; Carballo, Heal & Horbaty 2006).

An area of participants' lives that was significantly impacted across the five communities was diet and nutrition; more specifically, participants uniformly reported decreased consumption of animal protein. Past studies have shown that consumption of animal protein is an important contributor to development and growth (Hoppe et al. 2004; Murphy & Allen 2003). In the current context, while pre-*El Niño* diets consisted of beef, goat, chicken, fish and milk, communities had access only to fish, canned tuna, milk and in limited cases

shrimp during and following the *El Niño* rains and flooding. It is important to highlight an important contrast: the three communities that were not typically isolated during normal rainy seasons received greater food assistance and continued on the "*El Niño* diet" – which excluded beef, goat and chicken – for about 16 months; and the other two communities, which are typically isolated, had significantly reduced consumption of all animal protein for the three months before and three months after the *El Niño,* but were able to integrate beef, goat and chicken on their own about eight months before the other communities reported doing so. These results run counter to our labeling of El Palmo and Isla Noblecilla as "more severely affected by the *El Niño*" during recruitment since they were actually "less severely affected" in this key area of nutrition and later growth. The impact of *El Niño*-related diet changes on child growth in a large sample across multiple communities in Tumbes is forthcoming from our research group.

These nutrition contrasts reflect an interesting difference in the two types of study communities: communities that were used to isolation were able to cope better than those who were not normally isolated since they were better prepared for the flooding and isolation. This positive relationship between increased exposure to floods and increased ability to cope was also found in Bangladesh (Paul & Routray 2009). One of the coping strategies of community members in the typically-isolated communities in Tumbes was preventative food storage. However, they described that they should have stored more food (as well as basic medicines) but were unable to do so both due to lack of resources and to lack of motivation, which may reflect community members' low perceived vulnerability to floods. For example, participants in all communities described how they and other residents continue to live in – and even return to – houses that are situated in government-designated flood-risk zones or, in the case of El Palmo and Isla Noblecilla, entire communities that have been named as flood-risk zones. This means that they will most likely never have access to property titles and will continue the cycle of original house destruction, temporary relocation to alternative housing, and original house re-construction. It is crucial for local, regional and national leaders from different sectors (housing, health, nutrition, water and sanitation, transport, labor) to engage in participatory discussions with community members to jointly explore and develop individual, community and broader prevention efforts that would be appropriate for Tumbes and, most importantly, that would be accepted and adopted by the residents of these communities.

Concerted prevention efforts by the Peruvian government and international cooperation agencies minimized certain effects of the 1997–98 *El Niño* Southern Oscillation in rural Tumbes. However, despite forewarning of the event, this assistance did not begin until a state of emergency was declared and lasted only through the end of the rains, despite community members' need for continued support to re-build their lives and livelihoods by re-planting crops, re-invigorating livestock supplies and re-building homes. More timely support prior to and during flooding and continued support following flooding needs to be considered. Results should be used to develop short-, mid- and long-term prevention and assistance efforts that directly involve community members and are sensitive to and appropriate for their everyday livelihood needs as members of poor, rural, marginalized communities that are vulnerable to yearly light rains and periodic heavy rains and flooding.

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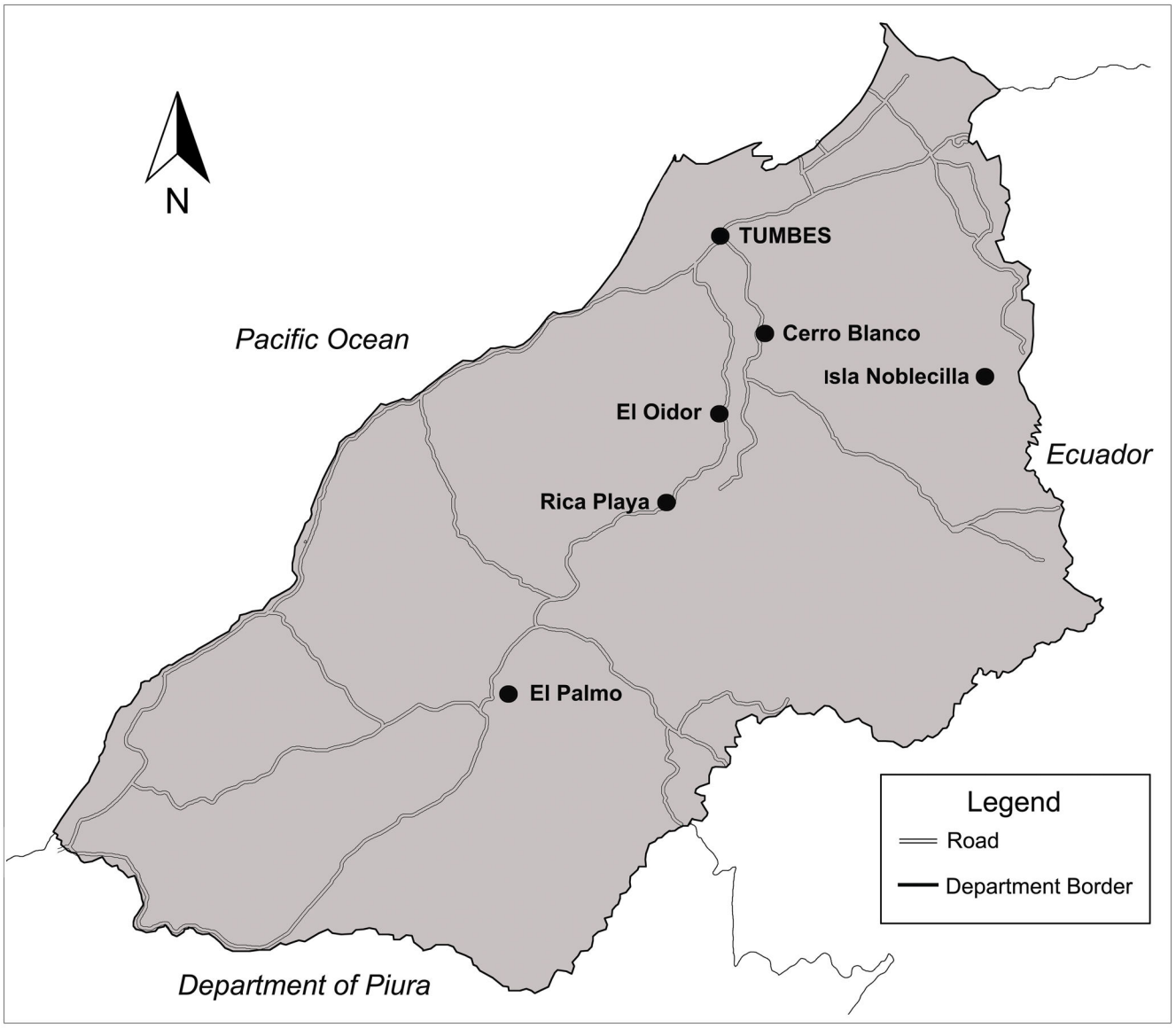

Figure 1.
Location of five study communities within region of Tumbes, Peru
Source: Prepared by authors.

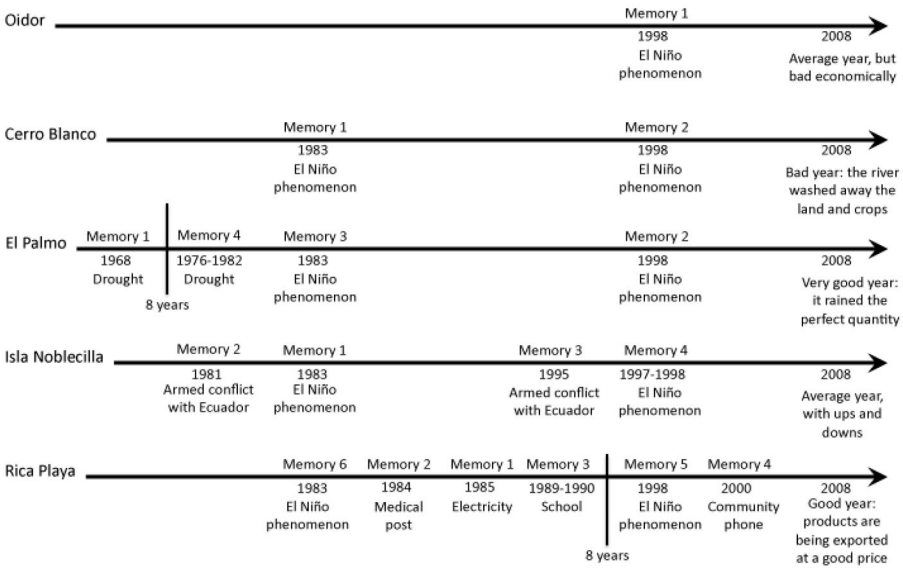

Figure 2.

Important community events in five study communities, 1968–2008

Source: Prepared by authors based on information provided by focus group participants.

Table 1

Characteristics of five study communities

Community	Estimated Population	Elevation (in feet)	Isolation in Typical Rainy Season (non-*El Niño)*
Cerro Blanco	1,162	127	Not isolated
El Palmo	99	498	Isolated
Isla Noblecilla	41	177	Isolated
El Oidor	664	147	Not isolated
Rica Playa	184	341	Not isolated

Table 2

Focus group participants in five study communities

Community	Males	Females	Median age in years [IQR]	Missing age data
Cerro Blanco	3	6	49 [38–61]	2
El Palmo	2	8	46 [44–52]	1
Isla Noblecilla	4	3	59 [34–73]	0
El Oidor	3	7	44 [37–50]	1
Rica Playa	4	5	50 [43–52]	0
All communities	16	29	46 [37–54]	4

Table 3

Sources of protein in nutrition diaries in two types of communities

	Beef	Goat	Chicken	Fish	Canned tuna	Shrimp	Beans	Milk
El Oidor (not typically isolated)								
Before *El Niño*	XX	XX	XX	XX			XX	XX
During *El Niño*, pre-help (12/97)				XX			XX	
During *El Niño*, with help (1–5/98)				XX	XX		XX	XX
After *El Niño* (6/98-4/99)				XX	XX		XX	XX
El Palmo (typically isolated)								
Before *El Niño*	XX	XX	XX	XX			XX	XX
During *El Niño*, pre-help (12/97-2/98)				XX (little)		XX		
During *El Niño*, with help (3–5/98)				XX (little)	XX (little)	XX	XX	XX
After *El Niño* (6–8/98)				XX (little)		XX		XX

XX = part of typical diet