

# An unforgettable event: a qualitative study of the 1997–98 El Niño in northern Peru

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*During the 1997–98 El Niño, Tumbes, Peru received 16 times the annual average rainfall. This study explores how Tumbes residents perceived the impact of the El Niño event on basic necessities, transport, health care, jobs and migration. Forty-five individuals from five rural communities, some of which were isolated from the rest of Tumbes during the event, participated in five focus groups; six of these individuals constructed nutrition diaries. When asked about events in the past 20 years, participants identified the 1997–98 El Niño as a major negative event. The El Niño disaster situation induced a decrease in access to transport and health care and the rise in infectious diseases was swiftly contained. 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 effects of the disaster, residents needed more support. Residents' perspectives on their risk of flooding should be considered in generating effective assistance policies and programmes.*

**Keywords:** climate change, floods, El Niño, Peru, qualitative research

## Introduction

El Niño causes extreme weather events all over the world, including 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 and Dye, 1997). In Peru, the effect of El Niño is strongest in the northern coastal region, which experiences 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 event six months before the heavy rains began in November 1997; they continued through May 1998 (Glantz, 2001b). The Peruvian government responded by developing a prevention plan that centred on the preservation of infrastructure through the provision of proper drainage for the excess rainwater and distribution of aid to those most affected (Glantz, 2001b).

An El Niño event 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). The ENSO is often referred to as a ‘seesaw’ of sea surface temperatures and sea level pressure in the Pacific Ocean that includes both El Niño and La Niña events (Walker, 1924). In non-El Niño conditions, the western-moving trade winds in the Pacific basin push warmer sea surface water towards 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, eventually 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, which leads 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 towards the central or eastern Pacific basin instead of the western basin as in typical non-El Niño years (Bjerknes, 1969; Gill and 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 and Halpert, 1987). Such a reversal of normal atmospheric circulation in the eastern Pacific often wreaks havoc on the livelihood of the 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. Tumbes is a largely rural, low-income region; it received approximately 3,300 mm of rainfall during the 1997–98 El Niño episode, more than 16 times the annual average of 200 mm of rainfall.<sup>2</sup> Despite the government's disaster prevention efforts, the intense rainfall and floods reportedly led to 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 and interrupted an important source of income for many residents of these rural areas (*Correo*, 1998; Gobierno Regional de Tumbes, 2008).

The recurrent nature and disaster-inducing tendencies of the ENSO and El Niño in particular have important implications for human health (Kovats et al., 2003; McMichael, Woodruff and Hales, 2006). The best-studied health outcome of the ENSO and El Niño is its link to infectious disease outbreaks such as malaria, dengue fever, cholera and other diarrhoeal diseases.<sup>3</sup> In Peru during the 1997–98 El Niño episode, increased cases of malaria, diarrhoea and acute respiratory infections were reported (Checkley et al., 2000; Gagnon, Smoyer-Tomic and Bush, 2002; PAHO, 1998). The outbreaks of disease further complicated 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

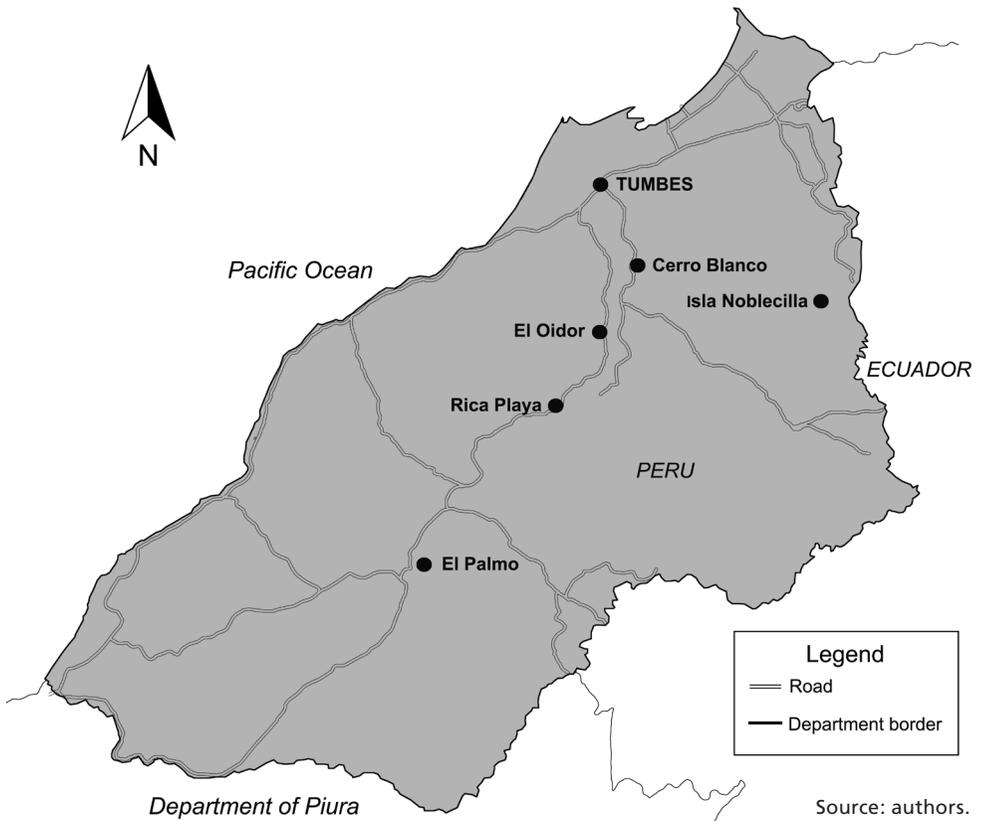
et al., 2004). During the 1997–98 El Niño event in Peru, governmental and journalistic reporting about the impact was limited; however, the direct impact of ENSO-related flood disasters on the daily lives of the most vulnerable still remains to be understood. To provide some insight, this study uses 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 to what extent these aspects changed during the flood disaster. Specifically, it examines access to vital resources—such as water, food and housing—availability of jobs and income, access to transport, health status and access to health care, in- and out-migration, and the presence of assistance and disaster prevention services.

## Methods

### Study setting and participants

The majority of Tumbes' three provinces and 12 districts are located at or just above sea level; in 2007, they were home to approximately 200,000 inhabitants, making Tumbes one of Peru's least populated regions (INEI, 2008). This research was carried out in five rural communities in Tumbes: Cerro Blanco, El Oidor, El Palmo, Isla Noblecilla, and Rica Playa.

**Figure 1.** Location of five communities within the region of Tumbes, Peru



Noblecilla, and Rica Playa (see Figure 1). An effort was made to select some communities that had been isolated from the rest of Tumbes during the 1997–98 El Niño and others that had not.

This qualitative research 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 women and men who were at least 30 years of age and had lived in their current community since at least 1997; these criteria were applied to ensure that participants would be old enough to remember the effects of the 1997–98 El Niño on the communities. Participants were chosen through purposive sampling as the main objective was to gain an in-depth understanding of the phenomenon from their perspective. Those who expressed a willingness to share their perspectives on their community’s historical experiences were invited to participate in a focus group (for which a more detailed consent process was carried out prior to implementation). A total of 45 people participated in the study.

### Data collection activities

In December 2008, five focus group sessions took place, one in each of the five communities. The focus groups comprised 8–10 participants in central, well-known locations such as schools and community centres; the two lead investigators conducted the focus groups in Spanish, the local language. First, they drew a timeline for the past 20 years and asked participants to identify important events in their community during that time period. The exact question was:

*Thinking back over the past 20 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 or any other environmental, climate- or weather-related events. Instead, they explained that they 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 episode emerged as an important community event; at that point, the researchers asked about the event itself, including the exact timing and duration, and about its impact on the community. Once the participants had shared their initial impressions, the research team asked about specific El Niño-related topics: housing, access to transport, access to water, health and access to health services, access to work opportunities, migration, the presence of assistance and prevention services, 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 prioritise these different items. The focus groups lasted 60 to 90 minutes each.

Given the importance of diet for the larger quantitative project on the El Niño event, which was carried out by the same research group, the team decided to work with community residents to develop nutrition diaries as a complement to the focus groups. The researchers returned to two communities, El Palmo and El Oidor, where they asked three focus group participants from each place to complete diaries for their daily diet prior to, during and following the El Niño event.

## Data analysis

Audio-recordings of focus groups were transcribed verbatim from digital audio recorders to a word processing programme. The data was analysed using a thematic approach. First, the lead investigators 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, the transcripts were coded using Atlas.ti; additional codes were inserted as needed as new sub-themes emerged during the coding process. Finally, an Excel matrix was designed to synthesise the data, analysing the quotations for each code both by community and across communities.

The nutrition diaries were also entered into a specially designed Excel matrix. The data was synthesised to analyse the types of protein sources in each community at the three different time points explored.

## Ethics statement

The research protocol was approved by the ethical review committees of the Asociación Benéfica Proyectos en Informática, Salud, Medicina y Agricultura in Lima and the Johns Hopkins Bloomberg School of Public Health in Baltimore. All participants provided written informed consent prior to data collection, including consent for audio-recording of the focus groups.

## Results

### Demographics overview

Table 1 lists population and elevation data of the five communities in the region of Tumbes. 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 generally able to maintain their connections to other communities.

**Table 1.** Characteristics of the five communities under study

Community	Estimated population	Elevation in feet (metres)	Isolation status in typical rainy season (non-El Niño)
Cerro Blanco	1,162	127 (39)	Not isolated
El Oidor	664	147 (45)	Not isolated
El Palmo	99	498 (152)	Isolated
Isla Noblecilla	41	177 (54)	Isolated
Rica Playa	184	341 (104)	Not isolated

Sources: population: Gobierno Regional de Tumbes (2007); elevation: Falling Rain Genomics, Inc. (n.d.).

**Table 2.** Characteristics of focus group participants in the five communities under study

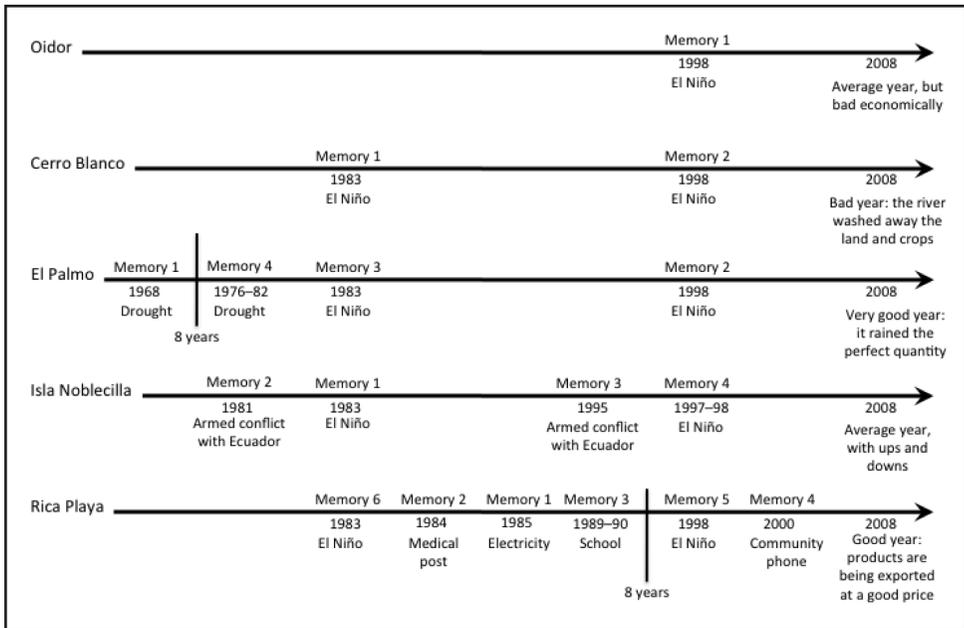
Community	Men	Women	Median age in years [interquartile range]	Number of participants missing age information
Cerro Blanco	3	6	49 [38–61]	2
El Oidor	3	7	44 [37–50]	1
El Palmo	2	8	46 [44–52]	1
Isla Noblecilla	4	3	59 [34–73]	0
Rica Playa	4	5	50 [43–52]	0
<b>All communities</b>	<b>16</b>	<b>29</b>	<b>46 [37–54]</b>	<b>4</b>

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

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 the research team's attempt to include participants who would be able to provide historical information on their respective communities (see Table 2).

### Immediate memories of El Niño events

When asked to think about important events of the past 20 years in their respective communities, participants from all five communities mentioned one or two recent El Niño events—those of 1997–98 and 1982–83 (although participants remembered it as only 1983)—among 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, in that order. The memories of the participants in El Palmo were focused around periods of drought and rain; their first memory extended back to 1968 (a drought); their second and third memories were the 1997–98 and 1983 El Niños, respectively; and their final memory was the seven-year drought that started in 1976. Participants' memories in Isla Noblecilla also centred on two types of events. Their first and fourth memories involved the El Niños

**Figure 2.** Important events in five communities under study, 1968–2008

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

of 1983 and 1997–98, respectively; their second and third memories revolved around the armed conflict with nearby Ecuador in 1981 and 1995, respectively. In the fifth community, Rica Playa, participants' initial memories were focused on community improvements such as securing electricity or a medical facility; however, their fifth and sixth memories were of the 1997–98 and 1983 El Niños, respectively. 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 the destruction of crops, mentioned in three communities. Other frequent memories, each of which emerged in two of the five communities, were animal plagues, human illnesses, the destruction of homes and isolation. Residents of El Palmo also mentioned panic and desperation; in El Oidor, participants talked about the shortage of work and the presence of assistance from outside individuals and institutions, the latter representing the sole positive memory. All quotes in this article end with the name of the community and whether it is typically isolated during non-El Niño rainy seasons.

Participants considered the El Niño event to be worse than an earthquake (which is also common in the communities under review). As a participant from Rica Playa observed: 'For us, what annihilates everything—our farms, our animals—is the El Niño phenomenon. It's much worse [than an earthquake].' Responses from participants in El Palmo are representative of how residents of all five communities recalled the nature and impact of the El Niño event:

*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 the rainy season.)

## Memories of the 1997–98 El Niño by theme

Once participants had shared their immediate memories, the focus group focused on the impact of the El Niño event—which participants referred to as ‘the phenomenon’—on housing, access to water, access to transport, health and access to health services, access to work opportunities, migration, the presence of assistance and prevention services, 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 into 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 the rainy season.)

The houses of community members who lived along the streams or rivers (15–20% of the residents) suffered severe damage. Many people who 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 raze and then rebuild them.

*Rosa: The houses were also affected.*

*José: It destroyed the houses.*

*Facilitator: And how many people lost their houses?*

*Yanet: Everyone who lived along the streams.*

*Facilitator: What happened with the streams?*

*Grimanesa: They got into the houses.*

*Yanet: They dragged the houses away.*

*Grimanesa: They [people] 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 the rainy season.)

*Flor: We had to move to higher ground since the water rose halfway up 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 event]?*

*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 the rainy season.)

Although many residents' houses suffered damage or even disappeared, study participants did not mention homelessness as an issue. Residents were able to secure temporary housing with neighbours, 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. Prior to and following the event, community members obtained their water from the river, either directly or piped into their homes or a central community location such as a well. During the event, 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 and others they knew usually did not take these preventive measures. The event had the unanticipated positive effect of promoting efforts to prevent water-related diseases and infections, since residents associated the presence of mud in river water or rust from the roof in rainwater with contamination. As a result, they were more likely to treat their 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, both of which are isolated during almost every rainy season, could leave their communities only in cases of extreme necessity, often taking risks such as crossing a chest-high river. Similarly, residents of the other communities could only leave in cases of urgency, but they had access to alternative forms of transport if they were able to allow for more extended 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 the 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 the 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 such as 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 [malaria and typhoid] at the same time. . . . Cholera, too.*

(Focus group participants, Isla Noblecilla; typically isolated in the rainy season.)

*Facilitator: So the children got sick. What caused their illnesses?*

*Noelia: Diarrhoea.*

*Esperanza: Diarrhoea, 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 the rainy season.)

Participants also described challenges accessing health services, particularly those provided by personnel with more formal training, such as university-trained midwives (*obstetras*) and doctors. In Cerro Blanco and El Oidor, only technical personnel were available at the local health establishment, with one doctor on site 1–2 days per week in the case of El Oidor. Residents of El Palmo and Isla Noblecilla 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 medicine.

*Flor: Children with fever, we had to take them . . . to the health post over there [in another community], 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 centre two hours away.*

(Focus group participants, El Palmo; typically isolated in the rainy season.)

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

*Matilde: It was in '98.*

*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 the rainy season.)

### *Access to work opportunities*

Community residents pointed out that the 1997–98 El Niño destroyed most crops, with the exception of limes, and that it caused illness in livestock. Since the economy of these five communities is driven by agriculture, this impact translates directly into lost work opportunities. In response to the loss of longer-term crops such as bananas and other fruits, community members planted short-term crops such as beans, yucca, corn and other vegetables. However, this alternative was not cost-effective for two reasons. First, transport challenges meant that they could not get the product to market or would have to do so at great risk; second, since all communities resorted to short-term crops, the competition was strong and thus 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, [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 who were chosen.*

*Gladys: Who 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 the rainy season.)

*Rosa: Here we grow bananas, but bananas take time [to grow]. I think it takes . . .*

*Several men: 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 the rainy season.)

Regarding livestock, participants estimated that people lost 50–70% 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 realising 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 the rainy season.)

People in all five communities emphasized that, despite the lack of access to food, they did not eat the meat of sick animals since they knew it could transmit disease.

### *Migration*

El Niño resulted in significant temporary migration and some long-term migration. Most people in Tumbes who were affected by the El Niño event needed some form of income and sought work opportunities in other parts of Tumbes or across the border in Ecuador; meanwhile, a few were able to wait out the rain without looking for work. Participants estimated that 5–10% of the population opted for long-term migration away from the five communities as a result of the El Niño event.

*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% [of the people from Cerro Blanco] go.*

*Facilitator: Of that 70% who 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, 15 days. The people come and go.*

*Facilitator: But are there, for example, people who 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 the rainy season.)

### *Presence of assistance and prevention services*

The amount of assistance provided 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 typically non-isolated communities receiving much more assistance. Assistance was primarily provided 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 was delivered 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 who visited their communities on behalf of these programmes.

*Luis: We the people of this town were beneficiaries. We received rice, sugar, oil, kerosene, flour... tuna.*

*Claudia: That was from PRONAA [the national food assistance programme], right?*

*Luis: No . . . PRONAA helped mainly by teaching us to use common pots (ollas comunes). There was no work so we started to cook in groups. The town got organised. 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 the 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 the rainy season.)

Regarding prevention services, it is important to note that many residents of the five communities live in areas that have been declared risk zones by the Peruvian government. Even if 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. But people are used to [keeping] things the way they are, right? Once [the rain] dries up, they come back. . . . They say that they have to come back to their homes... because the modules weren't properly constructed.*

*Luis: They [the modules] were provisional.*

*Sandra: For emergencies.*

*José: And they're also uncomfortable.*

**Facilitator: So if I look at this street now, of those fifty 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 our 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 the rainy season.)

In addition, 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 neighbours have moved their houses to a nearby community (at a 10–15-minute walking distance) and maintain only their agricultural lands in Isla Noblecilla. These participants, however, said they did not want to move.

### *Diet and access to food*

Access to food paralleled access to assistance. The typically non-isolated communities received much more assistance and food; the typically isolated communities received less assistance and food, resulting in food shortages, although individuals had stockpiled

food to the degree they were able. The start date of assistance varied across communities, but it lasted until the rains ended in May 1998 for all five communities. 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 event and their diet immediately following the end of the rains. This assistance diet, however, lacked certain animal protein sources, such as beef, goat and chicken.

*Sandra: During the phenomenon, the [price of] food goes up too much.*

*Luz María: 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 the rainy season.)

**Facilitator: What was [your diet] like before the [El Niño] phenomenon?**

*Marcos: Normal. Since nothing [agricultural] died, people had their income. If you wanted to have beef, you'd have it.*

**Inter: And during the phenomenon?**

*Marcos: Then we ate only fish . . . [canned] tuna, tuna, tuna.*

(Focus group participant, Cerro Blanco; not typically isolated in the 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, the diet was seriously limited for one month before food assistance arrived. Their diet improved significantly with assistance, although the only sources of animal-based protein were fish and milk. As soon as the El Niño-related assistance stopped, help arrived from the national food assistance programme (Programa Nacional de Asistencia Alimentaria, or PRONAA), 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. In Cerro Blanco and Rica Playa, residents 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 El Niño event. Community members recalled subsisting primarily on shrimp with some (limited) fish prior to the arrival of assistance and expanding their diet to include beans, limited amounts of

**Table 3.** Sources of protein in nutrition diaries in two types of communities

Community	Period	Beef	Goat	Chicken	Fish	Canned tuna	Shrimp	Beans	Milk
El Oidor (not typically isolated)	Before El Niño	X	X	X	X			X	X
	During El Niño, pre-help (December 1997)				X			X	
	During El Niño, with help (January–May 1998)				X	X		X	X
	After El Niño (June 1998–April 1999)				X	X		X	X
El Palmo (typically isolated)	Before El Niño	X	X	X	X			X	X
	During El Niño, pre-help (December 1997–February 1998)				X (little)		X		
	During El Niño, with help (March–May 1998)				X (little)	X (little)	X	X	X
	After El Niño (June–August 1998)				X (little)		X		X

Note: X=part of the typical diet.

Source: prepared by the authors based on information provided by nutrition diary participants.

canned tuna and milk when assistance was delivered. Assistance in this community lasted only three months, however. Residents then returned to their ‘pre-assistance’ diet for three months and estimated that they were able to reinstate their typical pre-El Niño diet around September 1998, much more quickly than in the other communities. Residents of Isla Noblecilla were able to fish more and therefore ate more fish than the residents of El Palmo.

### Discussion and conclusions

The results presented above affirm that participants’ recall of major life events can be enduring and that the El Niño 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 delivered, the immediate and longer-term natural and economic consequences of the El Niño event were underestimated.

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 taken 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 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 and Subramani, 2009) and specifically related to climate change (Su, Li and Fu, 2009; Das, Chutiya and Hazarika, 2009). In addition, 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 and 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. Finally, this 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 the protection of privacy. These issues would be important to examine in future studies, along with other mental health impacts. To date, several studies have qualitatively explored individuals' perceptions of the impact of natural disasters on their mental health and revealed important effects (Rajkumar, Premkumar and Tharyan, 2008; Carballo, Heal and Horbaty, 2006).

Although the El Niño event emerged as a prominent memory for all participants, certain communities placed more weight on it than others. In El Oidor and Cerro Blanco, the event most likely stood out more since these communities are not as severely affected by typical annual rains as the other communities and are therefore unaccustomed to isolation; hence, it was a more significant memory for them. Community members in Isla Noblecilla and El Palmo reported on other events whose impact on their daily lives was as marked as that of the El Niño episode: 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 fieldwork for the nutrition study. Community members in Rica Playa have a very positive attitude towards life and are also very organized as a community; for example, they all worked together to form a community organisation that advocates community improvement projects. These types of projects 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, as opposed to community leaders or non-governmental or governmental representatives. A study in Ethiopia interviewed 14 leaders from the government and from

non-governmental organisations and surveyed 35 flood victims about multiple issues, including the impact of typical yearly flooding (Wakuma, Mandere and Ewald, 2009). Participants cited deaths, diseases (primarily malaria and diarrhoea) and crop destruction as the main effects, the latter two similar to the findings of 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, a lack of sanitation services, a lack of safe water, reduced food intake, scarcity of work and wages and increased family tensions and domestic violence; coping strategies included community mobilization and relief assistance (Rashid, 2000). Overall, the circumstances described by participants in Dhaka were similar to those cited by residents of Tumbes in this study, 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 were able to secure work elsewhere. With regard to 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 signalled an increased prevalence of numerous infectious diseases as the primary impact of the El Niño event on health. Given the limited access to health services, it is difficult to know whether this impact was perceived or real. However, it is important to note that a study on the ENSO and malaria epidemics in South America finds that there was a 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 and Bush, 2002).

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 and Allen, 2003). In the Tumbes 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 that 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. 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 event, 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 the labelling of El Palmo and Isla Noblecilla as 'more severely affected by the El Niño' during recruitment for this study; in fact, they were 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 the 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 that were not normally isolated since the former 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 and Routray, 2009). One of the coping strategies of community members in the typically isolated communities in Tumbes was preventive food storage. However, respondents indicated that they should have stored more food (as well as basic medicine) but were unable to do so both due to a lack of resources and to a lack of motivation, which may reflect the community members' low perceived vulnerability to floods.

Indeed, 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 designated as flood-risk zones. As a result, they may never have access to property titles and will probably 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 and labour—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 co-operation agencies minimized certain effects of the 1997–98 El Niño in rural Tumbes. Despite advance warning of the event, however, this assistance did not begin until a state of emergency had been declared; moreover, it lasted only through the end of the rains, despite community members' need for continued support to re-build their lives and livelihoods by replanting crops, re-invigorating livestock supplies and rebuilding homes. More 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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<sup>3</sup> See Bouma and Dye (1997); Bouma and van der Kaay (1996); Checkley et al. (2000); Colwell (1996); Gagnon, Bush and Smoyer-Tomic (2001); Gagnon, Smoyer-Tomic and Bush (2002); Gil et al. (2004); Hales et al. (1999); and Pascual et al. (2000).

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