Communicating the Risks of Natural Hazards: The World-At-Large Is At Stake

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Note: This case is a true and ongoing story containing personal, scientific, and reference data that was gathered by the author with the generous assistance of two faculty members at Michigan Technological University (Dr. William Rose, Jr. and Dr. Ciro Sandoval) in Houghton, Michigan USA. The three of us traveled to Guatemala from 22-28 November, 1998, on a grant to Michigan Technological University from the US National Science Foundation, Office of International Programs, to study volcanic hazard communication efforts, specifically those regarding the Santa María volcano. This case study tells the story of our field trip to this "Land of Contrasts" and its broader context within a United Nations' program called the Decade Volcano and within the global issues that volcanic hazard communication raises. The central question in this case study is what can international technical communicators contribute to this complex, disturbing, and simultaneously local and global tale.

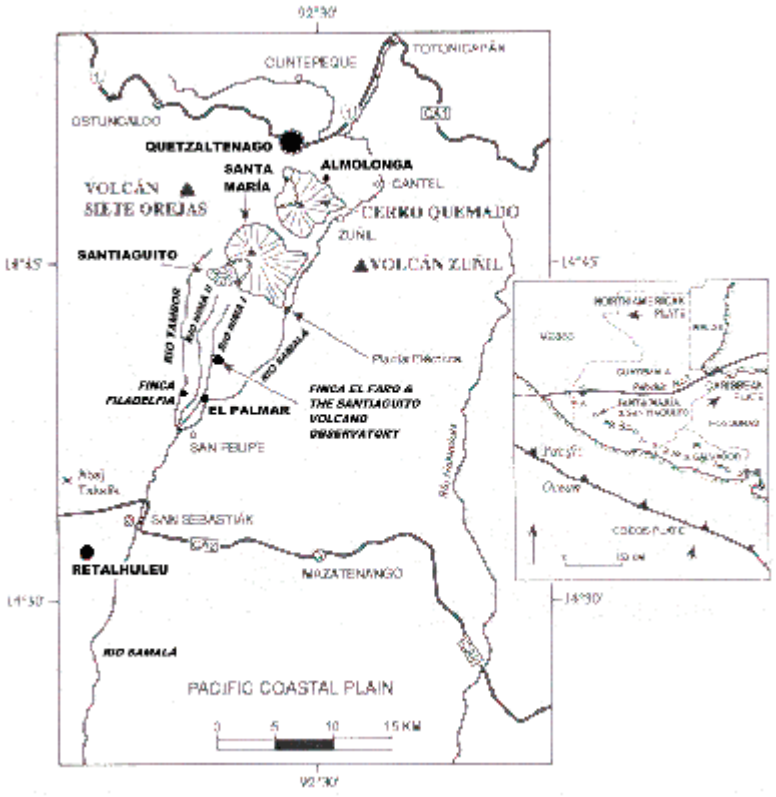

Figure 1 Map of Guatemala that features many of the places described in this case study.

October 24, 1902 marked the beginning of "one of the ten largest historic eruptions in the world." This eruption produced 10 km^3 of volcanic debris--enough to cover an area approximately ten times the size of Guatemala with 1 cm of ash, or, enough to cover all of Guatemala with 10 cm of ash--and originated from Santa María, which as a result, became "the most notorious volcano in Central America." The volcano Santa María (latitude: 14.758 N, longitude: 091.548 W) is located in southwestern Guatemala, near the country's second-largest city, Quezaltenango, about 105 kilometers/65 miles northwest of

Guatemala City (see Figure 1). A series of earthquakes, ranging in intensity, shook southwestern Guatemala, Belize, Nicaragua, El Salvador, and Mexico in the ten months preceding the October 24th eruption, foretelling the disastrous event to come. One of these earthquakes caused a pacific tidal wave, which killed over 150 people in El Salvador. Although documentation about the 1902 eruption is not complete, since most people died in the eruption, it suggests that well over five thousand people died from one or more of these related natural disasters and several villages throughout Central America were destroyed or heavily damaged. The volcanic debris from the 1902 eruption is known to have caused worldwide atmospheric effects. Significant amounts of ash fell as far away as Acapulco, Mexico (approximately 900 kilometers/559 miles away). Even San Francisco, California (approximately 4000 kilometers/2,485 miles away) reported a fine white ash falling in a light rain on January 25, 1903, which is believed to originate from Santa María. The damage to coffee *fincas* (the Spanish word for *plantations*) alone in Guatemala is estimated to have been in the millions of US dollars.

A Recent Trip to Santa María: Gathering Data on the Progress of Volcanic Hazard Communication in Guatemala

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I arrived in Guatemala on Sunday, November 22, 1998 with travel companions, Dr. William Rose, Jr., and Dr. Ciro Sandoval. Rose is a volcanologist and professor at Michigan Technological University (MTU) who is known throughout the world for his 30 years of research about Santa María. Sandoval is an associate professor at MTU; he teaches courses in Spanish, intercultural communication, and comparative studies. I have worked as a technical communicator for over 15 years with a specialty in international technical communication and I am now doctoral student in the Rhetoric and Technical Communication program at MTU. In short, we comprised an interesting interdisciplinary team with a shared interest in volcanic hazard communication.

We had just spent six days traveling throughout southeastern El Salvador, where we met with various people from the government, universities, and the private sector, as well as with villagers in remote areas that flanked active volcanoes, to discuss national volcanic hazard communication efforts. The timing of our visit was disturbingly serendipitous. From October 22 to November 06, 1998, Hurricane Mitch--a Category 5 hurricane and the third deadliest on record--ravaged Central America with 155-180-mph winds, causing terrible flooding, mud flows, and landslides, among other products of natural disasters. (Figures 2, 3, and 4 offer glimpses of the flooding damage in Guatemala by Hurricane Mitch.) The estimated amount in US dollars to rebuild Central America after Hurricane Mitch is $4 billion, adding to an estimated death toll of over 10,000 people. Needless to say, our reception in both countries was quite welcome, since national interests in natural hazard communication, an umbrella category within which volcanic hazard communication falls, was quite pronounced.

Figure 2 Picture denotes where the river came up and took everything within a mile of its usual course. Photo courtesy of USAID.

Figure 3 River bed in Guatemala. Note the land that has been scraped away by the tremendous amount of water that rushed through this channel. Photo courtesy of USAID.

Figure 4 Repaired bridge and swollen river underneath. Photo courtesy of USAID.

We were met at the airport by Mr. Otoniel Matías, the section chief of volcanology at the Instituti Nacional de Sismología, Vulcanología, Meteorología e Hidrología (INSIVUMEH), a Guatemalan government agency that is similar to the US Geological Survey. Matías is the only professional

volcanologist in Guatemala. Guatemala is home to over seven very active volcanoes. He was our guide for the next six days.

Our mission in Guatemala was to follow up on the four recommendations made in 1993 by seventy-three professionals representing thirteen countries at the Santa MaríaVolcanic Hazard Workshop. Rose and Sandoval organized this workshop. The four recommendations were:

1. Advanced training should be offered to Guatemalan personnel to lead and maintain continuous monitoring and hazard awareness from the local perspective.
2. Trained Guatemalan personnel must receive effective support from Guatemala. Support includes, but should not be limited to: jeeps, gasoline, and a per diem and salary for trained surveillance personnel. If this support is not consistent, international collaboration will be extremely limited.
3. Guatemalan agencies (INSIVUMEH, local universities, and so on) should collaborate. This collaboration should be strengthened and encouraged.
4. The CEPREDENAC organization, a Guatemalan governmental agency, should fund a volcano surveillance program for the region that should be used to help support volcano surveillance at Santa María. The program should include instrumentation and training.

What we found was encouraging. Three active volcanoes in Guatemala--Santa María, Fuego, and Pacaya--each receive regular observations to develop complete data sets of complex volcanic information. INSIVUMEH installed volcanic monitoring equipment around each of these volcanoes. Some data are sent in real time to the INSIVUMEH headquarters in Guatemala City and other data are collected by observers who have been trained by INSIVUMEH personnel for this purpose. In addition, INSIVUMEH receives daily radio contact from these volcano observers.

A Trek through Finca El Faro

Figure 5 Santiaguito with a small vertical eruption column and Santa María looming above. View from the SE. November 1998. Photo courtesy of William Rose.

We met one of these specially trained observers at the Santa María Volcano Observatory on a walk we took through a large finca called El Faro, which offered us a close view of the many daily eruptions from Santiaguito (see Figure 5). Santiaguito is a small volcano that has grown out of the southwest flank of Santa María. It has been active since 1922.

In addition to meeting with the observer, we were here to learn more about the recent changes to Santiaguito's behavior. These changes suggest to volcanologists like Rose that the Santiaguito area is

quickly *ceasing* to be a safe place to live. The volcano is shedding materials in a nearby valley above finca El Faro, a behavior that, in addition to other volcanic and environmental observations, suggests the probability of future mudflows. Finca El Faro, like several properties close to Santiaguito, is in the path of imminent destruction.

The observer lives in the area and had worked in the military before being invited to join INSIVUMEH. He keeps a notebook of all of his careful observations of volcanic activity, noting sounds, smells, changes to the shape of the volcano, and so on. His other role is volcanic hazard communication. Since he lives in this area, he knows many of the people: the owner of the finca and his family and relatives as well as many of the people who work at the finca picking the coffee beans that are so important to Guatemala's economy. But more importantly, these people know him. The personal networks people build in Guatemala, as in many Latin American countries, are as complex as they are essential to survival and credibility. The observer told us about the volcanic behavior of Santiaguito speaking not only from his trained memory, but also sharing anecdotes from the people of this finca who knew, understood, and respected his role there.

The people of El Faro also know the land here as they know their own families; changes, shared and compared in the course of casual conversations, are noticed. The observer, after all, is there essentially to help protect their families, their possessions, their livestock, and their land. He had won their trust, and in turn, helps educate these people on what to look for in this changing volcano that might indicate danger. He is, in many ways, a technical communicator.

One of the formidable challenges that this observer and other like him continue to face in communicating volcanic hazards is that the current population thinks of the Santiaguito area as a safe and relatively profitable place to live. Despite its 77 years of constant volcanic activity, Santiaguito has been a *safe* place to live. The volcanic materials from the 1902 eruption have long been converted to rich volcanic soil that makes employment and economic opportunities like finca El Faro possible. Some people have lived here for many years and others migrate into the area when there is work, such as picking coffee beans. To the local population, both fixed and migratory, the Santiaguito area means work. They do not really understand the potential volcanic hazards here. They have not lived long enough to see all the normal behavior of a volcano--"sleep lots, then wake up," Rose adds--that occurs in deep time, geologic time, which might span decades or even centuries.

The observer also learns from INSIVUMEH personnel the possible evacuation strategies in the event of an eruption or other natural disaster, like the flooding and mud flows that resulted from Hurricane Mitch. And, as we were about to learn firsthand, recent behavioral changes to Santiaguito strongly suggest that the area is rapidly becoming unsafe. The observer's knowledge of the land, the people, and Guatemala's natural-hazard mitigation strategies will only increase his value to the country and to the people of El Faro and the surrounding area.

To get to a lookout area, we had to cross the Rio Nima I on a wide swing bridge that had all the scars of severe flooding and erosion. I was told that we would normally drive over this bridge and up and through the finca to our final destination, a lookout about five miles away at an altitude of 2000 meters/6561 feet. However, the flooding from Hurricane Mitch had wiped out the previous swing bridge and the newly erected bridge was not deemed safe enough to support the weight of our truck. Our five-mile drive became a five-mile trek. As I walked across the bridge, I could see, thirty feet down, the massive boulders that Santiaguito had spit out and that were carried to this point by a combination of gravity and water from all the heavy rains running down the sides of this and several other steep

mountains. And to remind me of Hurricane Mitch, a tall tree swept around a bend upstream and managed to avoid being lodged between thousands of rocks of all sizes as it slipped underneath my feet and bounced downstream only seconds later.

On the other side of the bridge, men and their sons loaded large pieces of wood into bound piles, which they carried across the bridge load by load by load on their backs to dump into the bed of a pickup truck. The wood, most likely, was for firewood, which provided light, heat, building material, and cooking fuel to the many homes here, few if any of which had electricity. Firewood is precious, and one of the few benefits (if it is possible to call them benefits) of a hurricane was that there was a lot of potential firewood floating in the river and hiding in the jungle.

The day was hot and humid and the air was thinning as we climbed up the trail. Women dressed in traditional Mayan garb and their children, old men and their wives, picked bright red berries from the coffee plants. We occasionally saw groups of men rebuilding part of the trail, most of which is packed volcanic rock from the 1902 eruption of Santa María but other parts of which are cobblestone-like to prevent further erosion from heavy rains. The trail also serves as a road up the mountain, and is probably used to truck the fifty pound bags filled with picked, ripe coffee beans. At one point, the trail narrowed. Around me steep hills were covered with coffee plants and thick jungle-like forestation. A waterfall draped in the distance. Behind me, I could see forever it seemed. Fields of sugar cane, coffee plantations, and other signs of a healthy agricultural region quilted the landscape. If it was less hazy, I was told that I might be able to see the ocean.

Because it was hot, humid, and the air was thin, I had to walk slowly. I was not used to this environment. Matías left the others and joined me as I lumbered along. We spoke in French, since I could not speak Spanish and he was more comfortable with French than with English. Suddenly, he told me to stop and to listen. I heard a deep, resonant rumble. "Qu'est-ce que c'est?" I asked. It was the voice of Santiaguito, Matías explained. Looking around again and a little more than spooked, I realized that there was no place to run, no escape, and I was too tired anyway. Matías laughed at me, explaining that Santiaguito talked a lot and that there was no danger now.

A bit further up the trail, Matías stopped to point out four stone crosses. They were there in memory of four people who had died from an eruption of Santiaguito, which had happened in 1991 (see Figure 6). The eruption caused a pyroclastic flow, the most deadly of all volcanic hazards. Bobbie Myers, Steven R. Brantley, Peter Stauffer, and James W. Hendley II, authors of the US Geological Survey's Fact Sheet entitled "What Are Volcanic Hazards," write this about pyroclastic flows:

> High-speed avalanches of hot ash, rock fragments, and gas can move down the sides of a volcano during explosive eruptions or when the steep side of a growing lava dome collapses and breaks apart. These pyroclastic flows can be as hot as 1,500°F and move at speeds of 100 to 150 miles per hour. Such flows tend to follow valleys and are capable of knocking down and burning everything in their paths. Lower-density pyroclastic flows, called pyroclastic surges, can easily overflow ridges hundreds of feet high.
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> The climactic eruption of Mount St. Helens on May 18, 1980, generated a series of explosions that formed a huge pyroclastic surge. This so-called "lateral blast" destroyed an area of 230 square miles. Trees 6 feet in diameter were mowed down like blades of grass as far as 15 miles from the volcano.[1]

Figure 6 A pyroclastic flow derived from the collapse of Santiaguito. View from the S at El Palmar. November 1989. Photo courtesy of Michael Conway.

The others in our group, Sandoval, a geology graduate student from MTU, and the observer were now far ahead of us. Rose was in sight, but much further along. It started to rain, softly for the first fifty yards or so, and then turned quickly into a heavy downpour. This part of Guatemala gets 7 meters/275 inches of rain a year. We were so high up the mountain that you could almost touch the bottoms of these rain clouds, which would have been more enjoyable had it not been for the thunder and lightening. Rose and I decided to turn back, and Matías went ahead to tell the others of our plans. As we began our descent, we had to tread carefully on the fallen leaves and branches, which often covered trenches caused from rains like this one. The cobblestone-like covering was slippery with decaying vegetation.

We were soaked by the time we reached the half-way point. The slosh in our hiking boots each time we took a step was almost louder than the rain hitting the big, waxy leaves of the trees above our heads. What began as light runoff was now gushing down the trail, crisscrossing and following the slope of the land. Some runoff was three and four inches deep. By the time we reached the swing bridge an hour or so later, we noticed that Rio Nima I had swelled considerably, carrying with it yet more volcanic debris and more vegetation downstream. The same men and their sons we had seen carrying firewood over the bridge were now comfortably lounging under a tarp waiting for the rain to subside so that they could finish moving their firewood. They invited us out of the rain to await our colleagues, who arrived about 45 minutes later looking silly under the huge and edible tropical leaves they had cut to use as umbrellas.

A Visit to El Palmar

We decided to visit the town of El Palmar next, since it was close by and would offer us a view of Rio Nima I further downstream. Two older men climbed into the back of the INSIVUMEH pickup truck to get a ride home, a common practice throughout all of Central America, since many people who live in rural areas cannot afford to buy a truck or a car. The road was very rough and flooded in several spots. The truck was in 4-wheel drive the entire way.

As we approached the outskirts of the town, we drove past a sign with the government seal on it, which read that the government had condemned the area and that people should not be living there. Yet, there were some buildings with laundry hanging from rope stretched between trees, an occasional dog, and some doorways where a few people gathered, talking and staring cautiously at the government seal on Matías's truck.

We drove a bit farther into the town and parked the truck. Wet, cold, and miserable, I wasn't sure whether I was up for another walk. But I got out of the truck curious to know why the government sign had been posted. We walked toward the Rio Nima I and entered a disturbing space. Walls of buildings stuck out of the ground with no roofs or windows or any sign of habitation. Their floors were filled with a fine pumice up to the window ledges, which must have been two or three feet up from the floor. A deep chasm was all that I could see of the Rio Nima I. As I approached the edge of the chasm, amidst warnings in Spanish from the two older men, I cautiously peered over and could see nothing. I could only hear the sound of a very strong river current about fifty feet below. I looked to my right and saw half of a church with a cross still atop on one side of the chasm and the other half on my side. It was very still and the rain had finally stopped (see Figure 7).

Figure 7 The streets of El Palmar. November 1998. Photo courtesy of William Rose.

At one point I met up with Rose and asked what had happened here. About twenty years ago, the Rio Nima I began to flood the town (see Figure 8). Volcanic debris that collects on the rim and sides of long-time active Santiaguito is carried down by all the rain this area receives each year.

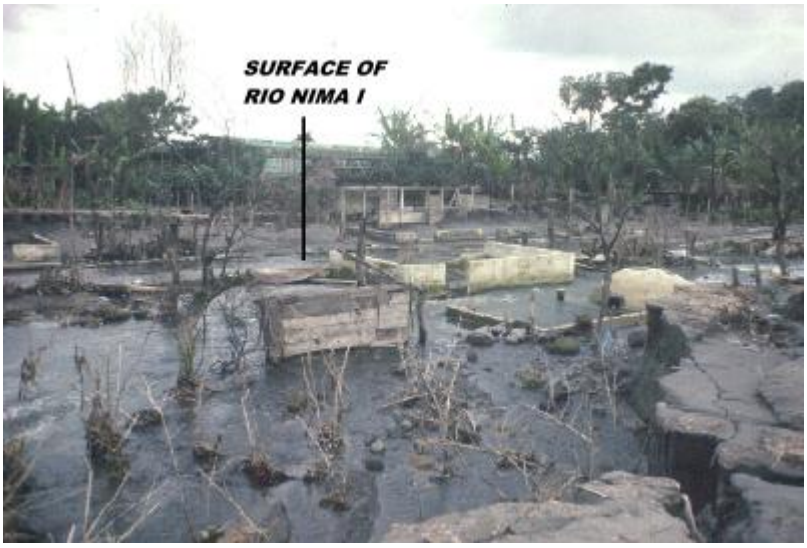

Figure 8 The town of El Palmar in 1983. In 1983, as shown in this photograph, you could see the surface of the Rio Nima I in the distance. In 1998, the surface of Rio Nima I was fifty feet below the elevation you see here. Photo courtesy of William Rose.

Over time, the volcanic debris fills the riverbed, forcing the water to overflow the banks and follow the path that gravity imposes. In addition, Rio Nima I is at a much higher elevation than a neighboring river, Rio Samalá. When the Rio Nima I floods, its waters go downhill and meet those of Rio Samalá (see Figure 9).

Figure 9 Aerial view of El Palmar seen from the SE. November 1998. Photo courtesy of William Rose.

The result--over twenty years of many heavy rains, continued volcanic activity, loose pumice, and no monetary or equipment resources to empty the riverbeds of the debris--caused the sight before me (see Figure 10). El Palmar is now just a memory for those, like Rose, who had been there when it was filled with life.

Figure 10 Santa María with the debris-choked Rio Samalá in the foreground. View from San Sebastian. November 1998. Photo courtesy of William Rose.

El Palmar offers us some lessons about natural hazard communication. Despite experiencing twenty years of continued environmental problems, the people of El Palmar tended to stay. Unlike finca El Faro, a place of seasonal economic activity that tended to attract migrant workers, El Palmar, a town, had a mostly sedentary population and all the goods and services to support and maintain it. Rose explains the irony, "People hate to leave a place they have lived for generations, and they will stay even if there is a lot of risk and inconvenience. During the twenty years things got worse generally, but it was

just the past rainy season (May-September 1998) which really was the final *coup de grace*." Before May 1998, there were always parts of the town that still seemed normal, and some stores were open.

Rose also explained another complication in the El Palmar situation. El Palmar is on the edge of a vast area along the Rio Nima II, which has remained undeveloped because of high volcanic risk. However, such places are a magnet to people who own either no land or very little. These people can herd goats, collect wood, and participate in the many seasonal and chance labor opportunities that the area affords. These are economic activities that they cannot do anywhere else.

We returned to the truck. Complaining about our discomfort with being wet seemed too trite after visiting El Palmar. We drove for a few more miles and said adios to our two traveling companions.

To return to our hotel in Quezaltenango, we had to drive through some large Mayan towns, such as the town of Almolonga. People have electricity and many have running water; these are luxuries not available to many people in the country. People also own vehicles. The thick traffic through the narrow stone streets often came to a standstill for five, ten, and twenty minutes while trucks and cars stopped to give passersby a lift or to just squeeze through the tiny street. The smell of carbon monoxide was almost overbearing. There are no emissions standards in Guatemala, and diesel fuel runs many a bus and truck. Women wore intensely colorful and beautifully embroidered skirts and tops and often had woven baskets that were filled with corn, beans, and other foods balanced on their heads. The only distinguishing feature of the men was that most wore cowboy hats and looked pretty plain next to their wives and daughters. Store fronts provided glimpses of women making and heating tortillas and men leaned against the outside walls of buildings, talking and watching all the activity, searching for something familiar.

Quezaltenango is a large city of 246,000 people, but its stunning colonial architecture is laid out like a maze. We drove down narrow streets that intersected with others, surrounded by buildings on all sides that were set close to the road. Pedestrians and bicyclists sometimes hid in doorways to avoid getting hit by a vehicle driving on the sidewalk as it made way for a vehicle coming from the opposite direction. Back at our hotel, we showered and changed into dry clothes. Sandoval explained our wet condition to the hotel proprietor, who let us leave our wet clothes and hiking boots overnight in the kitchen next to the warmth of the large grill.

Meeting the Governor

We headed into the city of Retalhuleu the next morning, where we met with the Governor of this department, which is similar to a state in the US. The Governor wore a buttoned, collared shirt that was open from the neck to the middle of his chest and had the sleeves rolled up. His shoes were worn, but his fingernails were immaculate, a sign of status among men in this part of the world that I had noticed throughout Guatemala and El Salvador. Clean and manicured hands separate those who work the land from those who do not. The Governor's office was understated, plain, dark, and dirty, and had floor-to-ceiling windows that were at street level. While we were sitting in his office, a funeral procession passed by less than ten feet away from the open windows with music blaring from one of the cars, making conversation difficult. On the walls hung photographs of various Guatemalan leaders, including the president of Guatemala. The Governor wore a beeper and carried a cellular phone, which are symbols of his status in urban Guatemala. There was no computer.

After Rose and Matías explained our purpose and interests, the Governor talked to us about Hurricane Mitch and various government actions toward natural hazard mitigation. The government had relocated the people of El Palmar, given the threat to human life and property due to natural disasters as well as the funding and resources it took to address these situations. To encourage people to leave, the government cut off all services to the area, including electricity. However, the people were starting to move back to El Palmar despite the glaring evidence of continued and growing danger and the stark living conditions. The people figured that in the event of another natural disaster, the government would relocate them again, allowing the people of El Palmar to accumulate yet more land--for free--from the government. And yet, as Rose had explained, people have other excellent reasons for wanting to be in the hazard zones. From the rich volcanic soil, the consequent economic opportunities, and the complex, tight network of relationships, El Palmar was home, both economically and emotionally.

As I considered what I had seen so far in my visit to Guatemala, from the huge and profitable fincas to the gated, barb-wire fenced, and machine-gun patrolled mansions in Guatemala City, I realized that *land* was at the heart of the conception of wealth and power in Guatemala. An October 1994 article in *Harvard Magazine*, 'Confronting a "Culture of Lies",' offers this glimpse into the glaring economic divide in Guatemala: "Today, 2 percent of the population still owns 67 percent of the land, a figure that grows more skewed over time. . . . The poverty line is so sweepingly drawn, according to a 1990 UNICEF report, that it encompasses 86 percent of the population, while coffee, bananas, and opportunities to exploit cheap labor boost the other 14 percent well into prosperity" (p. 50).

Santa María, Santiaguito, and other active volcanoes in Guatemala make this economic system possible. Like all active volcanoes, Santa María and Santiaguito are good for the earth and even good for people, despite their deadly activities and influence on other natural hazards, like the flooding of El Palmar. Volcanic eruptions bring minerals and nutrients up from the inside of the earth in the form of ash and lava and related volcanic products. These volcanic products eventually break down and form a rich soil that is excellent for crops. In Guatemala, agriculture is the occupation of 58 percent of the labor force. Santa María and Santiaguito are no exception. The south side of Santa María, for example, is home to many plantations that produce coffee, cardamom, rubber, and sugar cane for example. These plantations offer work to many thousands of indigenous people and produce export crops that bring income to the country. And where there is work, there is a dense population. There are over 300,000 people in the vicinity of Santa María. There are also several significant resource investments, which include a major geothermal power facility and a hydropower facility.

Rose offered a preliminary geological explanation of what we saw at finca El Faro and at El Palmar, adding that we would like to see more to better understand the behavior of the Santiaguito and its effects on the flooding in the area. Matías explained how the chief of INSIVUMEH was to arrange for us to tour the area via helicopter. He asked the Governor to see if he could assist in making these arrangements. Given the Governor's political status and connection with the military and the government, Matías, who also worked for the government, took advantage of the complex people network. The Governor immediately called the local army training base where young men and women learn to fly airplanes and helicopters. When he powered off his cellular phone, he explained that the weather continued to be good and that we could tour the area by helicopter that afternoon or the following morning. Matías was to call the army training base an hour or so later to verify our plans. After a cordial and formal goodbye, we left the Governor's office excited about the tour but apprehensive about the weather and any last minute change-of-heart that the army commanders might have about being our hosts.

We spent the hour eating a traditional Guatemalan breakfast of scrambled eggs, beans, fried plantains, and tortillas in a local restaurant. After breakfast, Matías left us to make the phone call and we strolled around the town taking pictures and watching the many vendors in the central park. Open air markets abound in Central America, especially in the large cities. Matías returned, explaining that tomorrow morning we would need to be at the military training base at 8:00, and, depending on weather, we would be airborne. We decided to spend the day doing more touring of the flooded areas.

Bridge-Building at Finca Filadelfia

We headed to Finca Filadelfia, another large coffee plantation. Finca Filadelfia, like El Palmar, had experienced significant flooding recently, and like El Palmar, this had been going on for many years as a result of Santiaguito's activities. We drove to the gated entrance of the finca and were met by an armed guard whose gaze moved from the government seal on Matías's truck to our faces several times while Matías requested permission to enter. Having said very little during Matías's introduction, the guard motioned with his head that we could proceed. We moved on and parked the truck near a large barn-like building. In the distance was the Rio Tambor with a small front-end loader in the middle of it straining to move a massive boulder. About a dozen men surrounded the scene. Some were in the river moving large rocks by hand. Others stood on the banks watching the man running the front-end loader. The Rio Tambor, we learned, had flooded and taken out a small bridge the night before from the same rainstorm that we were in at finca El Faro. These men were moving rocks in the riverbed to divert the current and hopefully reduce the amount of erosion and flooding.

About a hundred yards upstream, another group of men were building another bridge (see Figure 11). Matías explained that we wanted to tour the finca to study the causes and effects of flooding. The men still had another three or four feet of panels to attach so that we could cross. They quickly tacked down some rough boards and we thanked them as we walked to the other side.

Figure 11 Rapidly constructed temporary foot bridge over the Rio Tambor, Finca Filadelfia. November 1998. Photo courtesy of William Rose.

We walked for about a mile along the edge of the Rio Tambor and through a thick forest of coffee plants with ripe red berries. We reached a large opening in the landscape and saw a familiar site: a broad vista of the aftermath of many years of flooding. The Rio Tambor was tame now, but we could see that it had spread across a lot of terrain, desiccating many acres of this plantation that could not be reclaimed without significant investment and effort. We could see Santa María in the distance upstream.

We rounded a bend in the river. Before us men, old and young and usually working alone, swung sledgehammers against the rocky debris that Rio Tambor left behind. They were crushing the stone to make gravel, which they could sell or barter for whatever their families needed. This was but one of the many chance economic opportunities that living the Santa María area offered. Their gravel piles were three or four feet high on average, indicating a productive and exhausting day of raw manual labor. We could only guess that these men returned to this site day after day to work the rock.

Back across the Rio Tambor and into our truck, we headed further upstream, to a small village of maybe twenty families, most of whom seemed related. We approached a one-room dwelling made of adobe that had window openings but no windows. The dwelling's backyard had a small covered patio. Between the support posts for the roof of the patio swung a hammock on which a man rested reading an old, battered book. Rose, Matías, and Sandoval spoke with him and his wife, inquiring about the behavior of the river during and after Hurricane Mitch. Around us and barely touching the boundary of the patio was the Rio Tambor. The flood waters had not withdrawn here as yet, although the water was shallow and trees and small islands poked up through it. A dog timidly trotted across the strong current to a nearby island. Two boys played in the mud nearby, naked and loving every minute of getting dirty. Clearly no one here was planning to relocate. This was *home*.

The Helicopter Ride

We were up and in the truck by 6:00 am the next morning to head to the military training base outside of Retalhuleu, which would take us about an hour and a half to reach. We stopped quickly at an abandoned church along the highway to gaze at Santiaguito. Steam rose in big puffs from its mouth and was usually followed by steaming rockfalls along its sides. There were no other clouds in the sky, and the wind was calm. Weather would not be a deterrent for our tour.

The entrance to the army training camp was gated and had three or four uniformed and armed recruits in a small security shed. Two recruits approached the truck. It took Matías quite a while to explain the purpose of our visit. This guard asked many questions and took notes, while the other guard walked around the truck. The guard with the clipboard eventually returned to the security shed and radioed our arrival information to the main building in the distance. A few moments later, he returned to the truck and gave us specific instructions on where to drive and park the truck. The other guard jumped into the bed of the truck as the gate opened.

The guard escorted us to the main building where we were met by other personnel who explained the procedure that we would follow that morning. The MTU graduate student and I requested to use the rest rooms, and were directed to a building behind the main building. Inside were two women dressed in green camouflage khakis and shirts with heavy black boots that laced to their shins. They were taking turns at the one mirror, fixing their already perfectly coifed hair and adding more makeup to perfectly painted faces. The scene reminded me of Goldie Hawn in the film *Private Benjamin*.

Shortly after we returned to the main building, we were escorted to the airstrip about 500 yards away by another young recruit who spoke perfect American English. Our helicopter was there being checked by the co-pilot and the communications person. The helicopter was American made (see Figure 12). While we waited for the pilot to arrive, we spoke with yet more recruits. All of them spoke excellent American English, were very polite and curious about our purpose. Their flight training forbade them to fly within a certain distance of any volcano because of the danger of a sudden release of dense ash clouds that have downed more than one aircraft. When the pilot arrived, I noticed that he was much older than the others

and was treated with formal military respect. Rose and Matías reviewed our purpose and suggested a route to follow, as both of them had taken aerial tours through this area in the past.

Figure 12 Guatemalan Army helicopter used in aerial survey of volcanic hazards. Our escort (left), co-pilot (center), and pilot (right) de-planing after our tour. November 1998. Photo courtesy of William Rose.

We climbed into the helicopter and sat on seats made of tattered cloth panels that were stretched across metal-tube framing. The communications person was the last to climb in. He secured the helicopter's two long sliding doors so that they would stay open during our tour. Rose and Matías had requested this so that we could take photographs. I quickly moved to a middle seat since there were few seats with harnesses to strap you in.

Moments later we heard the deep, pulsating rhythm and whine of the blades above. With the doors open, the sound was deafening. We waved to the recruits on the ground and began to ascend in a manner achievable only in a helicopter. With the wind rushing in on both sides of me, I kept my eyes glued on the control panel of the helicopter. I finally spotted a gauge on the instrument panel that indicated how level we were. We listed about thirty or forty degrees as we quickly veered toward Santa María and Santiaguito.

The land was mostly flat and rose abruptly closer to the volcanoes in the distance. Every hue of green lived here. The pilot flew low to the ground, giving us ample opportunity to see the flooding that was all around this area. He followed the rivers. I could see men breaking rock in flood zones where the water had receded along several rivers and their tributaries. Small villages were often hard to spot, since they were scattered thinly and hid beneath the jungle canopy. More common were isolated single-family, one-room dwellings made of corrugated metal, adobe, and various combinations of scrap materials, both man-made and organic. Fields of sugar cane were every where.

Occasionally, I saw people watching us fly overhead. They never waved. Sometimes it seemed as if some of them ran for shelter when they recognized the distinctive sound of this army helicopter. When I saw this, I became intensely aware that this US-made helicopter might have been one of the helicopters that flew over this area during Guatemala's 36-year civil war, which formally ended in late 1996. During this war, the military ran the government and killed an estimated 140,000 people, mostly from the indigenous population, in a quest to quell any guerilla threat, real or imagined. The terror and human rights violations were so severe and horrific that a 1990 National Public Radio report described this period as "a wave of violence unparalleled in this hemisphere in modern times," as well as a "Mayan holocaust." Abductions, violent and politically motivated murders, rapes, and complete destruction of over 440 villages are details fresh in the memories of many people in Guatemala. I also recalled a story

Rose told us over dinner one night. Several years before, he was in a small Guatemalan village and watched the military arrive and abduct several boys for "voluntary military service." "It was horrible," Rose said. The aftermath of mothers and children crying indicated a profound knowledge that these boys would probably never return and that they would be forced to turn against their families and neighbors, possibly even witness or participate in their deaths.

With these thoughts ripe in my mind, I stared at this breathtaking and exhilarating landscape of hundreds of fincas that covered the plains as well as the volcanoes in the distance. The gauges on the instrument panel indicated that we were level, but climbing as we slowly approached Santa Maríaand Santiaguito.

We flew over El Palmar and finca Filadelfia. From our elevation, it was easy to see how the flooding related to the daily eruptions of Santiaguito. About five rivers emanate from this area. Large gray-brown areas of rocky materials filled the riverbeds closest to the volcanoes, while flooding still existed further downstream. This pattern of volcanic hazards is common: mudflows tend to occur upstream (finca El Faro and El Palmar) while flooding tends to occur further downstream (finca Filadelfia). See Figure 13.

FIGURE 13 Aerial view of the Rio Nima I (left) and Rio Nima II valleys, looking S. El Palmar is located at the left edge of the photo. November 1998. Photo courtesy of William Rose.

When we reached Santiaguito, we were at an altitude of over 10,000 feet. The pilot proceeded cautiously. Suddenly, Santiaguito threw out a large puff of vapor and steaming rocks teemed down its sides towards the rivers below (see Figure 14). Even our stoic pilot showed signs of awe and humility. We rounded Santiaguito and Santa María along their eastern flanks and met a strong air current that shook the helicopter in all directions. But within seconds, the instrument panel indicated that we were level once again. We all looked at the pilot with relief.

FIGURE 14 Aerial view, looking W, of the Santiaguito eruption we witnessed on the helicopter tour. November 1998. Photo courtesy of William Rose.

The helicopter headed back and retraced our path at our high altitude and at an accelerated speed. We could see the Pacific Coast in the distance. Haze was building as were clouds that showed promise of a typical, tropical afternoon storm. We set down on the helipad and walked to Matías's truck. The pilot and co-pilot joined us and after our many thanks for a fulfilling and safe journey, we headed out to get some breakfast.

The helicopter tour really put things in perspective for me. Whenever Santiaguito or Santa María erupt in a major way (like the 1902 eruption), which Rose and other volcanologists believe will happen in our lifetimes, the impact on Guatemala will be profound. Many investments have been made in this region since and *because of* the 1902 eruption of Santa María. Seeing the geography of this area from the air, and remembering the realities of transportation here, I could not imagine the complexities of evacuation.

Getting Otoniel Matías Official Credentials

The remainder of our trip included more stops to see flooding damage both upstream and down of the various rivers in the area. Matías knew many of the people in these areas and he took these opportunities to gather more data on the behavior and effects of flooding and volcanic activity. He also took the opportunity to learn as much as possible from Rose, a prominent volcanology expert and the immediate-past chair of MTU's Geology and Geological Sciences department, asking several questions about geology, instrumentation for studying volcanoes, seminars and research on the topic that might increase his knowledge, and so on. Matías's continued education was paramount to volcanic hazard communication in Guatemala, and Rose shared his knowledge and professional connections liberally.

This interchange was also a follow-up to the Santa María Volcanic Hazard Workshop that Rose and Sandoval had orchestrated in 1993. The purpose of the workshop was twofold: 1) To recognize Santa María formally and proactively as a *Decade Volcano,* and 2) To provide an arena in which to discuss various interdisciplinary aspects of *volcanic hazard mitigation,* both generally about risk communication and specifically about risk communication and the Santa María volcano. At this workshop, which was held in Quetzaltenango, Rose introduced Matías to some of the most prominent volcanic researchers in the world. Through these connections, Matías had received scholarships and grants to attend courses and seminars about volcanoes in Switzerland, Hawaii, and other parts of the world. In addition to the complex office politics there, INSIVUMEH has a very limited budget for educational opportunities, even though it is in a country with many active and dangerous volcanoes.

While email and the World Wide Web (see the section Supplemental Web Sites for examples) could offer Matías a wealth of affordable educational opportunities and resources, his access to these is strictly controlled and therefore very limited. In many Latin American countries, knowledge is power, and placing strict limits and controls on access to knowledge, however self-defeating this might seem to US American sensibilities, is common practice and to a large extent expected by both managers and their staff. Matías himself does not have a telephone in his home. He owns an old computer that has no modem.

Rose had been frustrated throughout our trip as he searched for ways to give back to Guatemala, for it had given him thirty years of rich volcanic data that awarded him grants, prestige, tenure, and an impressive academic publications list. He had tried direct, official channels as well as indirect ones, such

as the Santa María Volcanic Hazard Workshop, which he and Sandoval organized. The grant that funded our research trip to Guatemala was another attempt, this one focused specifically on volcanic hazard communication.

After several days, he concluded that investing in Matías was our best hope. He and Matías discussed the possibility of having Matías attend MTU to receive a master's degree in Volcanology. However, Matías does not have the educational credentials that MTU requires for entrance into its graduate program. The irony here, as Rose sees it, is that Matías is in many ways highly educated, even though no formal institution, either MTU or his government employer, INSIVUMEH, offically recognizes his knowledge. As Rose would later explain to me, "Oto's eleven years in the midst of many volcanic crises and his dealings with the people affected are more valuable to volcanic hazards research than many years of academic experience. But, it doesn't help him get respect from within his own agency, because in urban Guatemala, perhaps even more than in the US, formal degrees really count." A graduate degree would push Matías into a circle of prestige that would bring him as many accolades as it would agony from inevitable office politics.

Another roadblock to this idea is monetary support. Rose, Matías, and Sandoval, who teaches Spanish at MTU, discussed the possibilities of having Matías teach Spanish courses to fund his education. Salaries at INSIVUMEH and throughout Guatemala are small and the cost of living, even in remote Houghton, Michigan, is far beyond the realm of possibilities for Matías. Although Rose has not given up on this idea, enrolling Matías in MTU's graduate school will require all of his influence as a past department chair to make it possible.

Joining the conversation, the MTU graduate student offered to upgrade Matías's computer, which would cost significantly less than purchasing a new one. Several weeks after our return to the US, Rose sent out an email announcement explaining that buying Matías a new computer--a laptop with a high-speed modem that he could take with him on field trips--was the most sensible solution. Several of us, including many researchers who had attended the Santa María Volcanic Hazard Workshop in 1983 and who had kept in contact with Matías over the years, contributed money to the cause. The laptop was delivered to Matías in February 1999 by a geology graduate student from MTU who was there to do volcanology-related field research. The delivery marks a hopefully long and knowledge-filled educational journey for Matías and its resulting volcanic hazard assistance and communication for Guatemala.

Leapfrog Technology on the PanAmerican Highway

When we left Quezaltenango, we decided to drive along the PanAmerican highway through the highlands and back to Guatemala City. The highlands is a beautiful agricultural region of steep rolling hills covered with farmland and surrounded by volcanoes. It is also a killing field, as this is where most of the military efforts against guerrilla insurgency took place during the civil war. And to add to its history, it is also where several devastating earthquakes crumbled whole cities to the ground, killing and displacing thousands of people.

Driving through villages, we saw many women in traditional Mayan garb carrying dried beans and other foodstuffs in baskets on their heads, corn cobs drying in the sun on roofs of corrugated metal, and men building and repairing roads and buildings. Clusters of white calla lilies lined narrow brooks. Chickens and cows and pigs meandered in the fields and around small dwellings. Life here focused on basic, day-to-day survival.

I noticed that wild dogs lay alone and in seemingly regular intervals in the breakdown lane especially on sharp inclines. Matías explained that they were there waiting for the many truckers who drive this road to throw out the remains of their breakfasts, lunches, and dinners.

At one point, we climbed a steep hill and reached a plateau of sorts. Before us was a shocking reminder of the world we were to return to in a few days: there before us, on the side of the road, lay four enormous spools of fiber optic cable. Leapfrog technology, such as the laying of fiber optic cable for digital and voice communication, is a major part of the US national export strategy for places like Guatemala, which are officially called BEMs, or, Big Emerging Markets. The big spools looked so entirely out-of-place and unnatural here.

CONRED: The Hurricane Busters

We returned somewhat reluctantly to the carbon monoxide, traffic-filled, and noisy streets of cosmopolitan Guatemala City. One of our final visits was to an important government agency called Coordinadora Nacional Para La Reduccion de Desastres (CONRED). Rose, Matías, and I met with the executive director of this agency, who was still coping with the aftermath of Hurricane Mitch and all the other hurricanes and tropical storms of 1998. Posters of various disaster-reduction strategies covered the walls. A large whiteboard showed the markings of an intense recent meeting. Maps of volcanoes and rivers had pins marking problematic parts of the country. A large, round conference table surrounded by the most comfortable seats I had seen in Guatemala was the center of this brightly lit and activity-focused command center. It offered a sharp contrast to the office of the Governor in Retalhuleu. Through the windows of this office, located in the center of a heavily guarded military airbase and compound, I could see the silhouette of Pacaya, another active volcano, against a colorful sunset.

The executive director of CONRED described the steps they were taking in response to the flooding, mudflows, and mass displacement of people. He was interrupted constantly by telephone calls, fielded by his assistant, always responding to the unknown caller with a sense of urgency and immense authority. Rose explained our purpose and described what we had seen of the flooding and volcanic activity during our week in Guatemala, while the assistant took many notes on a small notepad. The director was not surprised with Rose's observations and conclusions. He, like the director of INSIVUMEH and several others we had met in positions of authority, said that this was the best possible time for natural hazard communication efforts. He, for example, was in the midst of proposing an aggressive program that would recruit and train hundreds of young people throughout the country to work at a grassroots level and educate Guatemalans about natural hazards. He understood too well that *natural hazards cannot be prevented, only mitigated*. Rose produced several examples of volcanic hazard communications materials from his knapsack. One was a booklet produced in Guatemala that was geared for children. It was filled with colorful cartoons of Volcanito (see Figure 15), a cute and happy volcano figure that taught children about the benefits and dangers of volcanoes, as well as how to notice and respond to impending danger. The booklet also contained maps of evacuation routes and shelters throughout the country.

Figure 15 The Civil Defense (CONE) in Guatemala uses the Volcanito figure to educate children about volcanic risk. Photo courtesy of The Volcanic Hazards Mitigation Group at the University of Geneva, Switzerland.

Rose also showed the executive director copies of booklets that we had collected in El Salvador that showed potential as a good genre of communicating the risk of volcanic hazards. The booklets were geared not for children, but for their teachers. In them, information provided both technical background, many graphics and illustrations, and exercises and projects that the teachers could use liberally in their classes. The booklets also contained references and telephone numbers so that the teachers could learn more and enlist the assistance of experts on that particular topic in El Salvador.

One booklet, for example, was about the dangers of water contamination. Water contamination is a continual problem throughout Central America. "Waste management," as we had seen in both rural and outlying urban areas of El Salvador and Guatemala, usually consists of inhabitants dumping heaps of trash on and over a precipice above a river. The river feeds the water supply further downstream and provides a source for irrigation all along its banks. Natural disasters, like the flooding from Hurricane Mitch, only compound the problem of water contamination.

At the end of our meeting, the executive director reached into a box and produced T-shirts for Rose, Matias, and myself. On the front of the T-shirt is the word Voluntario (Spanish for volunteer), and a cartoon of a duck dressed in field clothes pounding the crumbling word "MITCH" with a mallet labeled CONRED. And above the cartoonist's line rendition of the forceful sweep of the mallet are the words "HURRICANE BUSTERS." A fitting end to this trip.

Conclusion: Develop a Community of Multiplicadores at All Levels

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Our data gathering complete, we spent the three-hour flight from Guatemala City to Houston (the only common leg of our journeys home) discussing what we had seen and learned, and most importantly,

what could we do next to communicate the risks of volcanic hazards to the people of Guatemala and to the world. Given the way that people communicate in Guatemala (mostly oral communication through complex people networks drawn along stark class lines), we agreed that volcanic risk communication and consequent risk mitigation requires a grass-roots approach to be successful. We were, after all, just *gringos* in this "Land of Contrasts." We had little influence on anything or anyone, least of all on the indigenous peoples of this country who had a long historic list of reasons for distrusting strangers.

I recalled a lunchtime conversation with Sandoval and Rose many months before, during which Sandoval introduced me to a powerful word and concept in Spanish--***multiplicadores***, which means "people who spread the word in specific fields of knowledge." These are people who have status or influence within the community. As we considered our communication strengths in this situation, we realized that our existing resources and connections consist of an impressive network of volcanologists, university faculty and students across many disciplines and in many countries, specialists within government agencies and private industry, technical communicators, and so on. All of these people are, in many ways, *multiplicadores*. Our communications strategy, then, began to focus on how to cultivate our existing network into a network of multiplicadores, people who "spread the word about specific fields of knowledge" about volcanic risk.

Multiplicadores in the Scientific and International Communities

Rose's and Sandoval's efforts in organizing Santa María Volcanic Hazard Workshop had succeeded in bringing international experts from all over the world to Quetzaltenango to tour the area, share ideas, and mostly to interact with local representatives from various organizations in Guatemala. The Workshop was the first step in addressing the Decade Volcano program in Guatemala. The phrase *Decade Volcano* represents the response that members of the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) had to a 1990 United Nations effort. The United Nations effort was called the *International Decade for Natural Disaster Reduction* (IDNDR). Here is an excerpt from a 1995 IDNDR report entitled *Disasters: Threat to Social Development,* published by the United Nations Department of Public Information:

Two steps forward, one step back: progress in social development will be eroded if countries do not take natural disasters into account in their development planning. This was one of the key messages emerging from the recent UN-sponsored World Conference on Natural Disaster Reduction, in Yokohama, Japan, from 23 to 27 May 1994.

Situation

- Damage inflicted by disasters kill one million people each decade and leave millions more homeless.
- Economic damages from natural disasters has tripled in the last thirty years. In the 1960s, disasters cost the world an estimated $40 billion; in the 1970s, the cost was $70 billion; by the 1980s, it had risen to $120 billion.
- Before 1987, there was only one disaster the cost of which exceeded $1 billion in insured losses. Since 1987, however, thirteen additional such disasters have occurred (see Table 1).

Table 1. Billion-dollar losses from natural disasters 1983-1994

Event/Place/Year	Economic losses in US$bn
Hurricane Alicia (USA, 1983)	1.65
Winter storm Herta (Europe, 1990)	1.90
Forest fire (USA, 1991)	2.00

Winter storm Wiebke (Europe, 1990)	2.25
Hurricane Iniki (Hawaii, 1992)	3.00
Winter storm Vivian (Europe, 1990)	3.25
Winter gale (Western Europe, 1987)	3.70
Blizzard (USA, 1993)	5.00
Typhoon Mireille (Japan, 1991)	6.00
Winter storm Daria (Europe, 1990)	6.80
Hurricane Hugo (Caribbean, USA, 1989)	9.00
Floods (USA, 1993)	12.00
Earthquake (USA, 1994)	30.00
Hurricane Andrew (USA, 1991)	30.00

Source: From Disaster Management to Sustainable Development: How the Public Sector, Private Sector and Voluntary Organizations Can Work Together, WHO, 1994.

- In January 1995, Japan was hit by the latest in a series of 13 major earthquakes since 1923 which have measured between 6.8 and 8.1 on the Richter scale. The city of Kobe suffered a death toll in the thousands and initial estimates of damages and long-term repairs ranged up to $50 billion, according to *The New York Times*.
- Excluded from the above figures are the social and health costs of disasters in terms of lost homes, jobs and hopes--the basics of human life.

There is a clear link between the 1994 United Nations sponsored World Conference on Natural Disaster Reduction cited above and the World Summit for Social Development to be convened from 6 to 12 March 1995 in Copenhagen, Denmark. The link is to be found in the negative contribution that disasters make to society's worst ills: migration, poverty, disease and environmental degradation.

People everywhere are vulnerable to natural disasters. While industrialized countries suffer greater economic damage in absolute terms, poor countries are impacted more severely in relative terms: GNP lost due to natural disasters is estimated to be 20 times greater in developing countries than in developed countries. Also, deaths from natural disasters are more frequent in poor countries. Japan, for example, averages 63 deaths per year from natural disasters. Peru, with similar natural hazards and only one sixth the population of Japan, averages 2,900 deaths per year.

The International Decade for Natural Disaster Reduction (IDNDR), 1990-2000, is essentially a UN-led campaign to reduce the impact of natural disasters. As the 1994 World Conference on Natural Disaster Reduction (a mid-term review of national and international progress toward reducing the impact of disasters) demonstrated, the issues are complex, and the prognosis mixed.[2]

But even with this strong link between the scientific and international community, the message of risks of volcanic hazards still is not reaching the people who live and work in the areas surrounding Santa Mariá. Our search, then, focused on how to construct an ongoing, interactive link between us, the *gringos*, and the people of Guatemala whose lives were so intricately woven with volcanoes.

Multiplicadores in Local Government Agencies

In assessing the potential audiences, we were pleased to find that our connections with official channels tied to volcanic hazard communication were strong and that Rose's years of research and work in Guatemala had rewarded him with much respect in these circles. The official channels, like INSIVUMEH and CONRED, wanted only volcanic data, continued access to volcanic research in their country, and, of course, any equipment and international expertise that could help them lobby for continued government and international funding. But these channels are not enough. They are seeped in the unstable politics of Guatemala, rendering them unpredictable and unreliable.

Multiplicadores in the K-12 Community

We considered another audience--children, who are the audience most likely to be affected by volcanic hazards. The current volcanic data confirms this. It is likely, as Rose explained, that Santiaguito and/or Santa Maríawill erupt during the lifetimes of today's children. Children bring home stories to their parents, siblings, and extended families, who in turn share these stories with the community.

Rose had told us several months before of his most gratifying and successful risk-communication effort by showing a photograph of himself communicating with Don Patricio Parouche Herrera (see Figure 16), who was an eyewitness to a 1929 eruption of Santa Mariá, which completely destroyed his village and killed hundreds of people including his neighbors and family. Moments before the photo was taken, Rose had shown Don Patricio an album of photographs taken in the aftermath of the 1929 eruption. In one of the photographs lies the image of the partially burned corpse of Don Patricio's neighbor. Surrounding Don Patricio and Rose were several children and some other villagers who listened intently as Don Patricio transformed memories into tales as he moved from photograph to photograph. At the end of this session, Don Patricio, remembering the terrible devastation--at once physical, cultural, and spiritual--agreed to help Rose raise awareness within this community of the dangers of Santa Mariá.

Figure 16 Rose (far right) and others listening to Don Patricio Parouche Herrera (center) tell the story of the 1929 eruption of Santa Mariá. Photo courtesy of Jonathan Fink.

Multiplicadores in the Educational Community

An influential group to communicate the risks associated with volcanic hazards to children are teachers. Teachers are also multiplicadores. Teachers help children construct knowledge of the world, how to use this knowledge, and how to take responsibility for it. This theme factors heavily in the recent writings of Fernando A. Muñóz-Carmona, a Colombian who has spent most of his professional career as a geologist, seismologist, and administrator in two volcano observatories and at the Colombian Geological Survey. Muñóz-Carmona left his career to pursue a doctorate in communication at Arizona State

University, because he, like Rose and a growing number of other scientists, feel that their mission and professional responsibility is much broader than that of collecting and publishing scientific data and reaping the rewards associated with this practice. It is worth noting that he also attended the Santa María Volcanic Hazards Workshop in 1993. Muñóz writes these words on volcanic risk communication:

> For both experts and the community, it is important to understand how the construction of knowledge is exercised and how the resources derived from it are allocated. It is necessary to shift to a situation where the people involved recognize their power and mobilize those resources present in knowledge, beliefs, culture, and perceptions in everyday activities.. . . The application of the scientific method not only has to continue but has to be encouraged, but, recognizing a participative situation not only in the process of decision-making but in the very process of building knowledge. We not only as professionals, but also as members of the community, have to be ready to report to the community any circumstances that can significantly influence the process of risk. However, it is the community itself (which include the experts) that must take charge of understanding and assuming the responsibilities derived from the experience of risk. Under these circumstances, it is clear that it is the awareness on behalf of the community that they are living in a process (a process of risk) that will create the conditions that will allow for adequate management of volcanic risks and hazards.[3]

One of the efforts that Rose and Sandoval have made as university faculty is to educate their students about the broader, social context of volcanology. Rose teaches a course on volcanic hazard communication. Sandoval teaches a course on intercultural communication. Both often guest lecture in each other's courses. This interdisciplinary approach exposes students to a different kind of professional responsibility--a participative, knowledge-building interaction between the experts, the community, and the government about the process of risk as Muñóz describes. Rose often invites his students to travel with him to do volcanology research. The geology graduate student who joined us in Guatemala was doing research for her thesis on remote sensing of volcanoes like Santa María. She had never been out of the US and learned as much about the geologic and volcanic situation near Santa Maríaas she did about the culture and social conditions of those who live near the volcano and those who live in the cities and enforce the laws of the country. This kind of experience will travel with her throughout her career, informing her perspective as a professional geologist and perhaps transforming her into a multiplicador.

Multiplicadores in the Community of Developed Countries

Muñóz's message is taken to yet another level in the US government's Natural Disaster Reduction Report, which states quite clearly that natural hazards, like volcanic eruptions, rarely affect just the local population--they affect other nations, like the US, in complex ways. Consider these words from the US government's *Natural Disaster Reduction Report*:

> Natural disaster reduction is not a domestic matter alone but rather an international challenge for the United States. The Mount Pinatubo eruption occurred half a world away, yet it caused immediate U.S. losses of over $1 billion and triggered a change in U.S. strategic military presence in the western Pacific that will have implications for decades. For many nations of the world, a single natural disaster can significantly reduce that year's gross national product; in a number of regions, these events recur so frequently that they strain the social fabric, not just the economic growth. The resulting unrest contributes significantly to global geopolitical instability. As a world leader, the United States cannot afford to focus its efforts on disaster reduction on a domestic scale only; it must continue to take a global approach.[4]

National interest in volcanic hazard communication from countries like the US offers Guatemala a channel for funding and other aid. With this aid, it becomes more possible for INSIVUMEH and CONRED, for example, to hire and train more staff, purchase modern volcanic monitoring equipment, and develop programs that both offer Guatemalans work and an opportunity to educate themselves and other Guatemalans about the risks of volcanic hazards. And as we saw in the cases of Otoniel Matias and the volcano observer at finca El Faro, these "official" multiplicadores operated in "participative" ways with the communities.

The Web as a Community-Building Resource

With these audiences--the scientific community, the international community, developed nations, local governmental agencies, children, teachers, and students--in mind, we sought a communication vehicle through which we could connect these multiplicadores. The World Wide Web seems like the most economic and wide-reaching communication vehicle, albeit a somewhat problematic one. Most teachers outside of the universities do not have access to the Internet, let alone have access to a computer or possess computer skills. However, we feel that by creating a Web site about volcanic hazards in Guatemala that contains materials for teachers about volcanic hazards and the importance of communicating them to children, perhaps we can entice and enlist yet more multiplicadores--university professors, students, and others in Guatemala who have Internet and Web access (like Matias with his new laptop)--to communicate the risks of volcanoes.

Our idea is to create an information repository about volcanic risk in Guatemala. Our hope is that our multiplicadores will download the information and distribute it to teachers and other multiplicadores, like Don Patricio, in Guatemala, who in turn will adapt the material to the language, cultural expectations, and learning styles of their students.

This process of adaptation is formally called *localization* in the business community. Localization is most effective as a local, participative process, one where local and not foreign talent does the adaptation. Not being familiar with the intimate day-to-day communication practices in the small villages of Guatemala, we are not qualified to do this adaptation. In addition, the people of these small villages view us as strangers, as outsiders. Our credentials, while they mean something in the elitist circles of government, business, and higher education, mean nothing in the agrarian world of Guatemala. We are not members of their complex people networks, which take years if not lifetimes to develop, and therefore not credible or trustworthy sources of information. However, people like Don Patricio and the observer at Santa Mariá, as well as teachers in the small schools in this area, are trusted members of these small, intimate communities. In Guatemala, their words would be valued--in a profoundly cultural way--more than ours.

Some of the material that we will make available on our Web site includes:

- Posters that might show areas of the greatest volcanic risk
- Games that might include precautions to take and evacuation strategies in the event of a volcanic eruption
- Activities, such as building a model of a volcano and recognizing their different behaviors
- Background information on volcanoes and their benefits and dangers
- Community information about who to contact locally for more information

Rose has also mentioned that he would like to get his students involved in this Web site. The students can create many of the materials as well as maintain the Web site over time. Sandoval, as a teacher of Spanish, is another important resource for this effort. He has taught this beautiful and flexible language to many of Rose's students, who then are more likely to travel to places like Guatemala and participate in this complex culture at a more intimate level. As for my contribution, I offer you this story with the hope that you will recognize the potential for your broader role as technical communicators--that of a multiplicador--as well as the professional responsibility it carries in this world of immense cultural diversity.

In the best of all possible worlds, we wish for this Web site to become a community-building resource in the spirit of Muñóz's reflections. Perhaps one day we will be able to upload to our Web site locally

produced content from Guatemala, which may become a resource for a teacher in another country, where volcanoes offer prosperity and take it away.

Background Analysis

This section introduces you to three cultural dimensions that will help you better understand this case study. Note that these cultural dimensions are not exhaustive in their contribution to a thorough analysis of this case. They do, however, highlight key cultural differences in the communication processes of Guatemalans and US Americans.

Orality/Literacy

The literacy rate in Guatemala is an interesting demographic. The most recent profile of Guatemala in the Central Intelligence Agency's *World Factbook* offers these statistics:
Definition: age 15 and over can read and write
Total population: 55.6%
Male: 62.5%
Female: 48.6% (1995 est.)
In contrast, an Internet provider in Guatemala, quetzalnet.com, offers these statistics for comparison:
Literacy Rate: 50%
Illiterate Population Over Age 15: 45%
Illiterate Female Population Over Age 15: 52.9%
Ages of Compulsory Education: 7 to 14
Compounding these differences is the number of languages in Guatemala. The 1996 Summer Institute of Linguistics, in its "Ethnologue of Guatemala," offers these linguistic statistics (see http://www.sil.org/ethnologue/countries/Guat.html for a complete listing):
The number of languages listed for Guatemala is 53. Of those, 51 are living languages and 2 are extinct.
Oral communication predominates in Guatemala, particularly in the smaller villages where illiteracy rates are high. Oral communication consists mostly of personal dialogue that often consists of redundancies and other oral-like characteristics that sometimes seem annoying to US American ears. Oral communication is quite distinct from written communication. Written communication, as Walter Ong writes, "restructures consciousness," "heightens consciousness." Writing allows us to examine the world in an "abstractly sequential, classificatory, [and] explanatory" way (Ong, *Orality and Literacy*, New York: Routledge, 1982, p. 8). Writing is not a daily part of agrarian life in Guatemala. Therefore, the communication patterns and the thought processes are very different from those in the US. The style, language use, and persuasive strategies in information written in the US would not automatically make sense to a villager in Guatemala (assuming that she could read). Even within Guatemala, there are enormous differences in language use and the orality/literacy dimension between the wealthly and poor.

Consider, too, that perhaps visual communication will be more effective in Guatemala, especially considering the pronounced language issues. In so doing, factor in the cultural differences. Images that represent a message in one country might represent a completely different message in another. Images intended for an indigenous, agrarian population are different from those intended for an educated, often urban, and professional population.

Power Distance/Authority Conception

Power distance and authority conception are cultural dimensions well examined in the works of Geert Hofstede and David Victor. Hofstede defines power distance as (*Cultures and Organizations: Software of the Mind*, New York: McGraw-Hill, 1991, p. 28):

> The extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally. 'Institutions' are the basic elements of society like the family, school, and the community; 'organizations' are the places where people work. . . . Power distance is thus explained from the value systems of the less powerful members.

In his research of employees at IBM, Hofstede found that Guatemalan power distance was second only to Malaysia, rating a high 95 points on a scale of 100. Victor describes authority conception, a similar concept, in this way (*International Business Communication*, New York: HarperCollins, 1992, p. 169):

> Authority itself is primarily symbolic in nature. In other words, authority does not exist in isolation but reflects instead the conception of organization power and leadership common to an organization's members. . . . Since authority conception derives from the collective values of those who vest it, authority itself reflects the cultural values of the organization or society in which the authority is recognized.

To learn to recognize the extent and nature of authority conception in a target country, Victor suggests that we look at the children's literature of the target country. "Considerable understanding of how power is perceived and leaders are treated can be derived from the social guidelines laid out in teaching young people how to behave toward those in power and whether or not they have the right to question authority" (p. 182).

High Context/Low Context

Edward T. Hall defines high and low context communication in his seminal book *Beyond Culture* (New York: Anchor Books, 1976, p. 91):

> A high-context (HC) communication or message is one in which most of the information is either in the physical context or internalized in the person, while very little is in the coded, explicit, transmitted part of the message. A low context (LC) communication is just the opposite; i.e., the mass of information is vested in the explicit code. Twins who have grown up together can and do communicate more economically (HC) than two lawyers in a courtroom during a trial (LC).

Hall gives this concept of high and low contexting a slightly different twist in a later book he wrote with Mildred Reed Hall, *Understanding Cultural Differences: Germans, French, and Americans* (Yarmouth, ME: Intercultural Press, 1990, p. 180):

> High-context people are well informed and maintain extensive information networks to insure their being abreast of the latest developments; they require a minimum of background information; and they are accustomed to many interruptions and cannot always adhere to a schedule. Low-context people are not well informed outside their own special area of expertise. They are compartmentalized and require lots of background information before they can make a decision.

Perhaps needless to say, Guatemalans fall on the high-context end of the contexting continuum, while US Americans fall on the low context end. This difference is significant in the cross-cultural and technical communication processes. It begs the questions: how much information do we supply, and, what information do we supply?

Discussion Questions

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1. How might technical communicators help volcanologists communicate the risks of natural hazards?
2. Identify the traditional and non-traditional communication methods presented in this case study. Consider effectiveness criteria for each method. Next, identify the primary and secondary

audiences that these methods are intended to reach (as suggested in this case study). Rank these methods by their effectiveness. Finally, investigate additional methods that are not presented in the case but that you think might be effective. Discuss your findings.

3. Can we apply the same principles of technical communication in third world countries? If so, why? If not, how might we adapt technical communication principles to the needs of audiences in the third world? What skills do technical communicators need to communicate effectively to a third world audience?
4. Consider the role of women in Guatemala. Might they be potential multiplicadores of risk mitigation and communication. If so, why and how?
5. Identify the ethical issues in this case study and discuss how they might affect the communication of risk to different audiences in Guatemala.
6. Watch the 1998 film Dante's Peak and discuss the risk communication methods used and avoided in the story. Which ones were successful and which ones were not successful? How effective might these methods be in a third-world country like Guatemala?

Assignments

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1. Design a Web page for the volcanic hazard communication Web site for Guatemalan multiplicadores. See Supplemental Web Sites to choose a volcanic hazard that will form the content of your Web page. Consider creating a system of icons that reflect the cultural context of the indigenous people of Guatemala and that relate to volcanic hazards. For example, we thought that an icon showing the destruction (flattening) to sugar cane fields against the silhouette of a smoking volcano might offer a powerful and local image.
2. Write a letter of introduction to a volcanologist, offering your services as a multiplicador. Explain the value of your services and relate these to the expertise of the volcanologist. Place your explanation in the broader social context. Add your resume, making sure that you have modified it to support your claims in the letter of introduction.

Supplemental Web Sites

For thorough coverage of Santa Mariá, Santiaguito, and the Santa MaríaVolcanic Hazards Workshop, see http://www.geo.mtu.edu/volcanoes/santamaria/.

For demographic and journalistic coverage of Guatemala, see the *Washington Post's* World Reference for Guatemala, which includes links to the CIA World Factbook, among others: http://www.washingtonpost.com/wp-srv/inatl/longterm/worldref/country/guatemal.htm.

For a US tourism guide to Guatemala, go to http://city.net/countries/guatemala/?page=overview.

For a local look at Guatemala, go to these Web sites: http://infoguat.guatemala.org/Profile.htm and

http://www.quetzalnet.com/quetzalNET/Tourism.html.

To learn more about volcanoes and their hazards, see this Web page at the US Geological Survey (USGS): http://volcanoes.usgs.gov/. See also the excellent Volcano World Web site at http://volcano.und.nodak.edu/vw.html.

To learn about multiplicadores--volcanologists interested in volcanic hazard communication--in other countries, go to the Volcanic Mitigation Team's Web site at: http://www.unige.ch/hazards/volcano/welcome.html.

To learn how to build a model of a volcano, go to http://volcano.und.nodak.edu/vwdocs/volc_models/models.html.

To learn about the threat that natural disasters impose on social development: gopher://gopher.un.org/00/conf/wssd/pc-3/bkg/950227122401.txt.

To learn more about the Natural Mitigation Strategy in the US, go to the Federal Emergency Management Agency (FEMA) at: http://www.fema.gov/home/mit/ntmstrat.htm. See also a related Web site at the USGS: http://www.usgs.gov/sndr/report/index.html.

To learn more about the effect that Hurricane Mitch had on Guatemala and other countries in Central America, go to the USAID Web site at: http://hurricane.info.usaid.gov/ofda.html.

Suggested Reading

Burgos-Debray, Elisabeth, Ed., *I, Rigoberta Menchú*, Ann Wright tr., New York: Verso, 1998.
This is an account of the life and experiences of Rigoberta Mehchú, an indigenous Guatemalan woman who learned Spanish to help the indigenous peoples of Guatemala.

Doheny-Farina, Stephen . *The Wired Neighborhood*. New Haven: Yale University Press, 1996.
This book offers a thoughtful look at virtual communities and real communities, and more importantly, how they can influence each other in both positive and negative ways.

Freire, Paulo. *Pedagogy of the Oppressed*. Myra Bergman Ramos, tr. Continuum: New York, 1989.
Freire develops a theory of education for illiterate peasants in the third world. This may serve as a theoretical starting point for volcanic risk communication in the third world.

Goldman, Francisco. *The Long Night of White Chickens*. New York: Grove Press, 1992.
This novel is a love story that draws intense intercultural comparisons between a US American and a Guatemalan. The story recreates the political and social realities between the two nations.

Grabill, Jeffrey T. and W. Michele Simmons. "Toward a Critical Rhetoric of Risk Communication: Producing Citizens and the Role of Technical Communicators." *Technical Communication Quarterly* 7:4 (1998), pp. 415-441.

Mader, George G. and Martha L. Blair with Robert A. Olson. *Living with a Volcanic Threat: Response to Volcanic Hazards: Long Valley, California*. William Spangle and Associates, Inc.: Portola Valley, CA, 1987.

Written by urban planners, this is a detailed case study about the volcanic mitigation and communication that took place in the early 1980s in Long Valley, California. In this case study, mitigation efforts describe a volcanic hazard that never occurred. The study explores the consequences leading up to and following the mitigation efforts.

Montejo, Victor. *Testimony: Death of a Guatemalan Village*. Victor Perea, tr. Curbstone Press: Willimantic CT, 1987.

The true and horrific tale of a Guatemalan village, Tzalalá, that is terrorized by the military on September 9, 1992, as recounted by the village school teacher, Victor Montejo.

Slack, Jennifer Daryl, David Miller, and Jeffrey Doak. "The Technical Communicator as Author: Meaning, Power, and Authority." *Journal of Business and Technical Communication* 7 (1993):12-36.

Explores how technical communicators can construct knowledge in socially active ways.

Endnotes

1. Bobbie Myers, Steven R. Brantley, Peter Stauffer, and James W. Hendley II, "What Are Volcano Hazards?" *U.S. Geological Survey Fact Sheet 002-97*, reprinted online at http://geopubs.wr.usgs.gov/FactSheets/VolcanicHazards/VolcanoHazards.html.

2. For the full text, go to gopher://gopher.un.org/00/conf/wssd/pc-3/bkg/950227122401.txt

3. Fernando A. Muñóz-Carmona, "Notes about Managing Volcanic Risk and Hazards," which was presented at the Pan Pacific Hazards 1996 Trade Show, in Vancouver, Canada, 29 July-02 August 1996, p. 6.

4. Natural Disaster Reduction: A Plan for the Nation, 1995. See http://www.usgs.gov/sndr/report/international.html.