

# Natural Hazards, Diverse Economy and Livelihoods in the Sierra de las Minas, Guatemala

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## **Abstract**

Residents of the small mountain community of Santa Rosalía in the Sierra de Las Minas, Guatemala, live with the threat of natural hazard events. Despite unpredictable seasonal rains and resulting challenges, residents continue living in remote and vulnerable circumstances. In our research, we use cartographic analysis, historical assessment and interview data to investigate the ways in which residents continue living in a place prone to natural hazards. We propose a theoretical framework based on diverse livelihoods, diverse economies and coupled human environmental systems to assess the diversity of activities and potential resilience building for people and place.

Keywords: *livelihoods, natural hazards, resilience, sustainable development*

## **Resumen**

Los residentes de la pequeña comunidad montañosa de Santa Rosalía en la Sierra de Las Minas, Guatemala, viven con la amenaza de riesgos naturales. A pesar de experimentar lluvias estacionales poco predecibles y los retos que estas conllevan, los residentes de Santa Rosalía continúan viviendo bajo circunstancias de aislamiento y vulnerabilidad. En nuestra investigación hacemos uso de análisis cartográficos, una evaluación histórica y datos de entrevistas para entender la manera en que personas sujetas a riesgos naturales continúan desarrollando sus vidas en sitios con estas características. En este trabajo integramos las teorías de diversidad de medios de vida, diversidad de economías, y sistemas humanos y naturales acoplados bajo un solo marco conceptual a través del cual evaluamos la diversidad de actividades y potencial de construcción de resiliencia para la gente y sitio.

Palabras clave: *medios de vida, amenazas naturales, Resistencia, desarrollo sustentable*

## Landslides and Rural Livelihoods

The onset and aftermath of natural hazards occurring in rural regions reveal variations in social relations, economic practices and perceptions of the environment held by individuals and groups in different places. From an outsider's perspective, the complex biophysical processes underlying natural hazards might suggest reason enough to avoid living in such regions, yet people continue to do so. Asking the questions why do people live in hazard prone rural areas and how do they develop and maintain their livelihoods in such environments can lead to improved understanding of individual decision-making processes and place-specific sustainable development.

In rural regions, livelihoods often connect people living in remote places to the wider world (McCusker and Carr 2006). They emerge from everyday activities when people create social networks, fulfill basic economic needs and define social roles within historical and present contexts. This may be why livelihoods in rural areas, given specific environmental conditions such as natural hazards, sometimes appear contradictory, unsustainable or complacent from a macro perspective but make sense within the local context. On the one hand, natural hazards disrupt ecosystem services, namely all the goods and flows contributed by ecosystems to human well-being, upon which people depend locally for their livelihoods. On the other, natural hazards disrupt ecosystem services that although produced locally in rural areas are consumed increasingly farther away according to societies' shifting regional and global demands. These extensive local-regional-global connections create what often seems a random collection of features in the rural landscape that at close scrutiny reveal ways in which people historically and currently accessed and distributed these services while dealing with the risk of natural hazards in their everyday lives.

Landslides are a point in case. In mountainous regions landslides are a common natural hazard and also a major "fact of life" (Muica and Zavoianu 1996). Landslides occur when heavy rains or seismic activity break threshold conditions in increasingly unstable slopes (Restrepo *et al.* 2009). A review of literature on landslides indicates that people have developed multiple strategies to cope with unstable slopes but also to recover and cope with the aftermath in different ways. These include but are not limited to structural strategies (re-design and repair infrastructure, stream diversion, reforestation) and nonstructural strategies (oral histories, monitoring and mapping, migration or abandonment, decreasing land intensive practices) (Oliver-Smith 1977; Johnson *et al.* 1982; Gurung 1989; Scott and Walter 1993; Ternoström 2002; Critchley and Marit Brommer 2003; Fenemor *et al.* 2004; Pandit and Balla, 2004; Rautela 2005; Doberstein 2006). In all instances of people coping with landslides, pre-existing conditions seem to play an important role in reducing vulnerability to landsliding including oral history and knowledge, land use patterns, management of lands and location of lands. Primarily, changes in land management whether through the avoidance of places, or changes in use or intensity of use enable people to cope with landslide events (Johnson *et al.* 1982; Scott and Walter 1993; Pandit and Balla 2004; Rautela 2005). Newer technologies to deal with landsliding include the construction of terraces, waterways, retention walls, check dams, and gully control whereas non-structural ones include alley cropping, mulching, cultivation of legume crops, and usage of green manure among others (Paudel and Thapa 2004). There are signs, however, that many of these strategies may not work in the long term (Paudel and Thapa 2004). In a case study of two Hi-

malayan watersheds, farmers were most likely to adopt new land management technologies if they had access to extension services and training but also experienced increased landslide density in their property. Such technologies may contribute to agriculture intensification in unstable slopes exacerbating, over time, soil losses and soil fertility (Shrestha *et al.* 2004). Other studies also suggest that the adoption of modern life styles, the arrival of newcomers, and the weakening of family and social networks may increase the vulnerability to landslide hazards (Crozier 1986; Gurung 1989; Johnson *et al.*1982; Rautela 2005).

Other studies have quantified the effects of large landsliding events in terms of economic, human and environmental losses, (Schuster and Highland 2001). In contrast, few studies have investigated why people willingly remain in places prone to such hazards, especially in rural or remote settings. Our goal in this paper is to examine and integrate applicable theoretical perspectives that relate to the ways in which rural residents cope with natural hazards, specifically landslides, in mountainous regions, present a short-term case study of landslides and flooding, land use, and livelihoods in the small mountain village of Santa Rosalía, Zacapa, Guatemala, and contribute an explanatory discussion of the subtle processes that lead people to live and remain in remote places prone to natural hazards. We propose to bridge human geographical and human environmental perspectives through the integration of social, economic, and environmental considerations into a single framework—a SEE approach—that may serve as a local yet broadly applicable approach to investigate why and how people develop their livelihoods in places prone to natural hazards (Figure 1) .

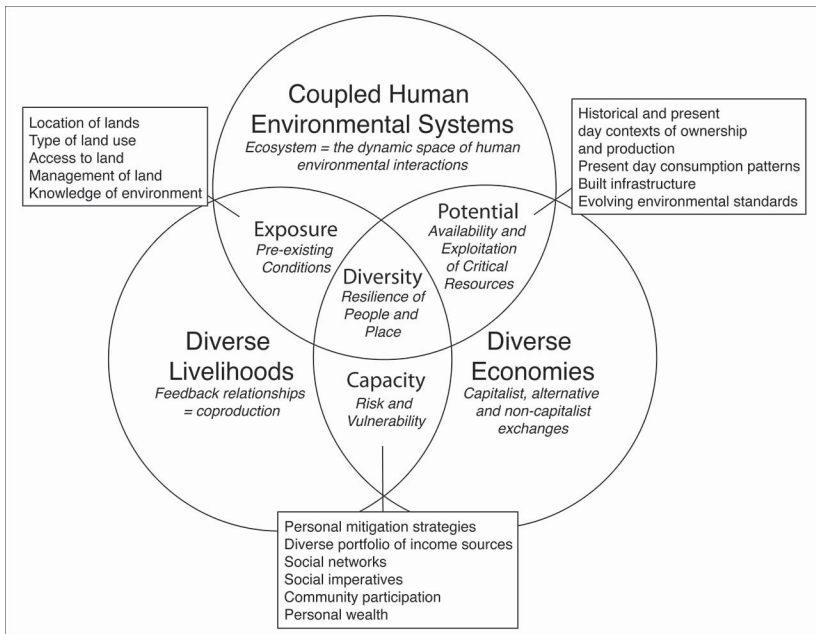


Figure 1. Conceptual diagram for a SEE Approach

## A Crossroads between Livelihoods, Economy and Environment

The SEE approach is a contextual model that emphasizes the inherent humanness of living in rural places. In Figure 1, the theoretical perspectives of diverse livelihoods, diverse economies, and coupled human-environmental systems comprise three spheres representing components of everyday living. In Figure 1, the sphere of diverse livelihoods encompasses the exchanges between people and places that occur in local contexts while incorporating outside information, processes and materials in their daily activities (Bebbington 2000; McCusker and Carr 2006). As people interact in local contexts, they may also establish external connections through networks, contact with non-locals, politics and trade, and may become integrated into regional or national contexts (Birch-Thomsen *et al.* 2001; Rigg 2006; Gravel 2007; Biles 2008). Most important in this sphere is that the local context and people are involved in a feedback relationship at many scales (Bebbington 2000; Needham 2009). In cases where power relationships exist, the feedback loop may not be equitable. In one example of natural hazards and livelihoods in Pakistani villages, two rural village experienced different outcomes from the recovery process due to inequitable social-political relations between the local and the national government (Mustafa 1998). One town received significantly more aid than the other due to greater political influence, exemplifying that social-political relationships can impact outcomes at various scales (McCusker and Carr 2006).

The sphere of diverse economy in Figure 1 refers to theoretical frameworks that examine the current neoliberal economic paradigm through a lens of diversity and suggest that there are many types of economic exchanges that go unnoticed by this paradigm. Diverse economy theory proposes that people simultaneously engage in multiple economic activities including capitalist, alternative and non-capitalist exchanges. These may include spiritual beliefs, sense of belonging, voluntary care taking, food and clothes-swapping, crop sharing, cooperative organizations, charity and other exchanges that help people make a living and create connections to places (Gibson-Graham 2006; 2008). Diverse economy as proposed by Gibson-Graham 2006 uses transactions (the exchange of goods, ideas and services), labor (the exchange of work-hours) and enterprises (the organizations, institutions, businesses and associations in which exchange occurs) to assess economic processes but there are many other possibilities for examining economic diversity (Rauch 2006; Hecht 2010). Most important is that by recognizing the fuller extent of economic exchange, a diverse economic perspective captures immeasurable data for understanding the ways in which people make a living beyond wages and salaries.

Lastly, the sphere of coupled human-environmental systems perceives a dynamic space of exchange between people, places and ecosystems (Berkes *et al.* 1998; Berkes 2007). This perspective moves away from the view that nature is a commodity and towards the perspective that humans are part of nature, relying on and impacting ecosystem services (Berkes *et al.* 1998). In applied research, a coupled human-environmental systems approach investigates the ways in which populations manage their surrounding environments to sustain their livelihoods, and survive external (natural hazards or government policy) and internal (loss of job or family member death) pressures (Berkes and Jolly 2001; Marschke and Berkes 2006; Peloquin and Berkes 2009; Hoole and Berkes 2010). Much of this research investigates rural populations that rely on agriculture and resource production for income and sustenance but may also partake in

migration, part-time work and informal jobs to cope or survive external stresses (Berkes and Jolly 2001).

Combining these theoretical perspectives in a SEE approach offers a rich multifaceted understanding of people and places. In Figure 1, three variables, *exposure*, *potential*, and *capacity*, delineate the intersections of the adjacent spheres. *Diversity*, constitutes the overlapping space of all three perspectives. It is a key variable underlying the resilience of social, economic and ecological systems (Elmqvist *et al.* 2003) and includes the range of activities upon which people may rely during a crisis or use to mitigate internal and external pressures (Mustafa 1998; Adger *et al.* 2005; Gibson-Graham 2006; Berkes 2007; Norberg *et al.* 2008; Hudson 2009). Whether or not greater diversity increases or decreases a person's or household's *exposure* to hazard, *potential* to recover and *capacity* to cope varies greatly from place to place.

A person's level of *exposure* could depend on the location of a person's landholdings (size and location such as on steep slopes susceptible to landslides or in a valley susceptible to flooding), the type of land use patterns (what crops are planted, slash and burn practices, fertilizer and pesticide use or grazing patterns), access to land and property rights (ability to relocate and obtain ownership or leasing rights), the management of land resources (how an individual invests in land or property improvements) and the individual's connection to and knowledge of the local environment (familiarity with weather patterns and ecosystem, having a mental map of environment features or experience in the environment). A person's *potential* to recover is subject to the availability of resources that results from historical and contemporary patterns of appropriation (distribution of land resources) and exploitation (types of production) of critical resources by others (Mustafa 1998). The *capacity* to cope assesses whether or not a person or household is vulnerable or experiences certain levels of risk and may depend on mitigation strategies (action taken in the aftermath), diverse portfolio of income sources (multiple income earning activities), social networks (family and friends), social imperatives (what it means to live in the place or to work the land), community participation (church, political social activities) and personal wealth (inherited wealth or wealth associated to income earning activities). Any assessment of these three variables as they relate to diversity and vulnerability, or the inability to mitigate internal and external pressures, requires further investigation into the subtleties of rural places to better understand their existence and what residents may perceive as negative or positive aspects of living in such places (O'Brien *et al.* 2007).

### **A Case Study of Santa Rosalía: Historical and Contemporary Ties to Global Processes**

Facing the threat of landslides and floods during the rainy season is part of everyday living for the 269 individuals living in 72 households in the remote mountain *aldea* or village of Santa Rosalía located in the municipality of Río Hondo, department of Zacapa, Guatemala (Figure 2) (Guatemala Census 2002; Aquino 2007). Santa Rosalía sits at 1,100 meters above sea level in a small fluvial valley below the confluence of the four tributaries that form the río Pasabien, one of several rivers draining the southern slopes of the Sierra de Las Minas (SLM) into the Río Grande de Motagua. The village has a mild climate

characterized by a distinct dry (December-April) and rainy (May-November) season. The existing climatic conditions in the vicinity sustain open-pine, open-mixed, and semi-open broad-leaved forests whereas higher elevations support closed-mixed and closed-broadleaf forests (TECSULT Foresterie Inc. 2000). Over the years, residents in the SLM have felled the forests for subsistence agriculture where milpas, annual crop fields of maize, intermingle with *guatales*, second-growth forests. Today these milpas and guatales continue to be used by residents of Santa Rosalía (Figure 3a). Santa Rosalía like many other communities in the SLM faces a variety of environmental challenges (Gibson *et al.* 2007). In Central America, a combination of, seismic activity, heavy rains, steep topography, and land-use change results in landsliding and flooding that provoke local and regional ecological change (Weyl 1980). There are many uncertainties regarding the frequency of rainfall and seismic events capable of triggering local and regional landsliding in the SLM. Whereas local extensive landsliding (of individual watersheds) may occur every year with the onset of the rainy season, regional landsliding (of many watersheds) may occur once every 13 to 80 years (Guerra-Noriega 2010, Ramos-Scharron *et al.* 2012). These processes greatly alter the physical landscape as illustrated by the aftermath of the earthquake of 1976, Hurricane Mitch in 1998 and the heavy rains of May and June of 2010 (Bucknam *et al.* 2001; Espinosa 1976).

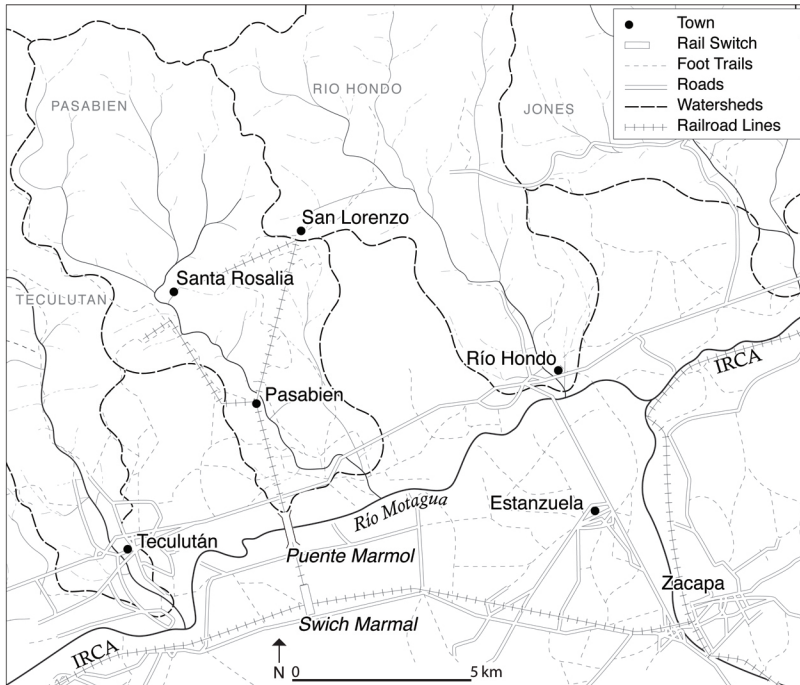


Figure 2a. The Sierra de Las Minas of eastern Guatemala and the Río Pasabien and Río Hondo watersheds, pre-1932

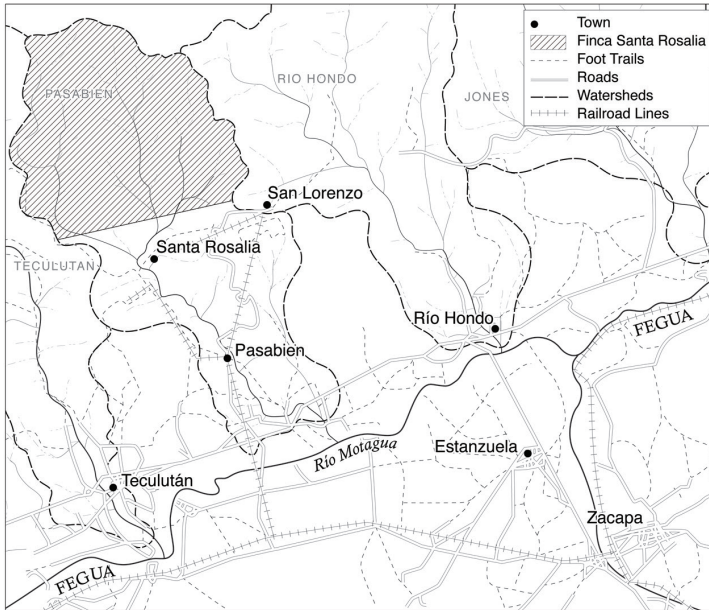


Figure 2b. The Sierra de Las Minas of eastern Guatemala and the Río Pasabien and Río Hondo watersheds, 1933-1989

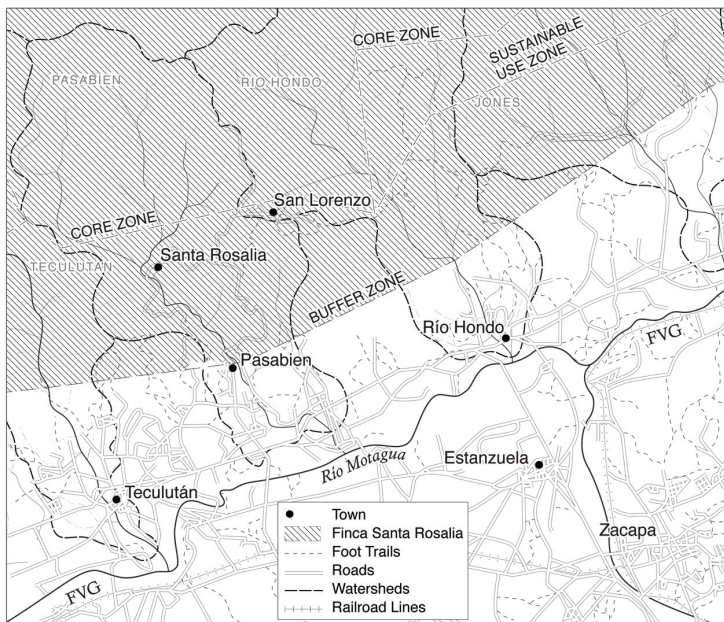


Figure 2c. The Sierra de Las Minas of eastern Guatemala and the Río Pasabien and Río Hondo watersheds, post-1990 periods



Figure 3a. Milpas and guatales on the mountain slopes surrounding Santa Rosalía



Figure 3b. Landslide along riverbank of El Inglés; note man in lower left for scale of landslide depth (both photos by Lindsey Sutton, June 2010)



The following comparative landscape analysis uses topographic maps and aerial imagery from 1963, 1973, 1976, 1998, 2000 and 2006, various publications, and people's accounts of past events to examine the extent to which the lived environment has changed over time and speaks directly to the variables of exposure, potential and capacity as presented in Figure 1. Land-use and infrastructure changes are cartographically summarized for three critical time periods in the 20<sup>th</sup> century in the Río Pasabien watershed and more broadly speaking the municipality of Río Hondo in order to assess these changes according to natural hazard events as well as describe the changes within political-economic contexts during these time period (Figures 2 and 4).

*Establishment of a foreign capitalist mining industry (Pre-1932)*

Residents in Santa Rosalía are *ladinos*, descendants of indigenous, Spanish, and European immigrants that arrived over 100 years ago to work in the marble mining industry. In the early 1900s they lived and worked at sites in Santa Rosalía and the nearby *caserío* (hamlet) of San Lorenzo where they developed subsistence activities including cultivation of milpas, extraction of turpentine and resins from trees, and quarrying of marble for wash stones (Patch 1919; Anonymous 1923). The history of larger-scale resource production near Santa Rosalía and San Lorenzo began just after the turn of the twentieth century when, in 1911, the U.S. owned Guatemala Mining & Development Co. received a concession to explore, claim and develop the mineral and land resources of Guatemala that they found of interest (Anonymous 1911). One of its subsidiaries, the Guatemala Marble & Mining Co., established in 1913 formal mining and water use rights and acquired land in Santa Rosalía, San Lorenzo, and San Marcos in the Río Pasabien and neighboring Río Hondo watersheds (Muñoz 1913; Patch 1919; Anonymous 1923; Sosa de Robles 2008). Reports from 1913 refer to 675 ha whereas those from 1923 to 3,600 ha. Within eight years the Guatemala Marble & Mining Co. developed a modern operation to quarry and process the extensive high-quality marble deposits for export to international markets (Figure 4a).

The company built a steel bridge, later named *Puente Marmol*, across the Motagua river and a ~ 26 km railway that consisted of two main lines (Figure 4b) (Patch 1919; Anonymous 1923; Sosa de Robles 2008). The first line built in the lowlands linked a site named Marmal, later referred to as Switch de Marmol because of the rail switch at the site, located in the vicinity of the International Railways of Central America (IRCA) to a site named Pasabien in the foothills of the SLM (Figure 2a-b). The second railway and two inclines connected the marble mine and mill in Santa Rosalía with Pasabien. IRCA completed in 1908 connected Puerto Barrios on the Atlantic coast with Guatemala City. Additional infrastructure projects developed by the Guatemala Marble & Mining Co. included the first-time construction of a 500 h.p. hydroelectric plant, a 10-gang electrically operated mill and derricks to move the marble blocks and a road between Pasabien and San Lorenzo.

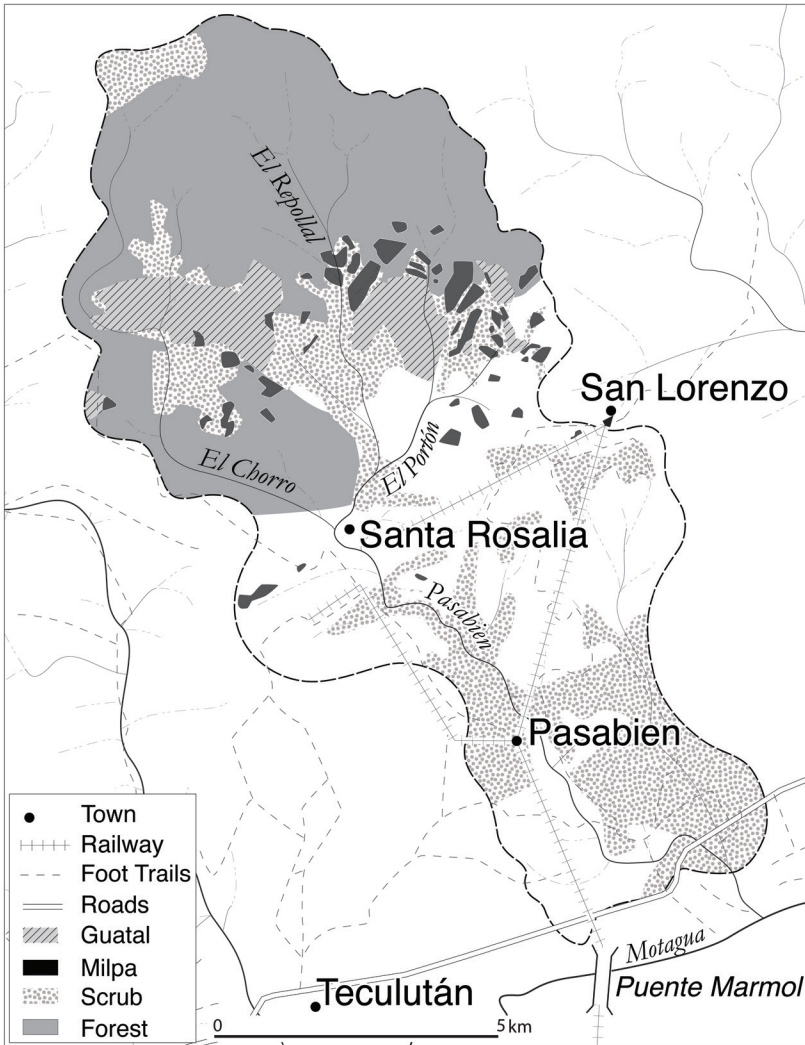


Figure 4a. Changes in infrastructure and land use in the Río Pasabien watershed, pre-1932

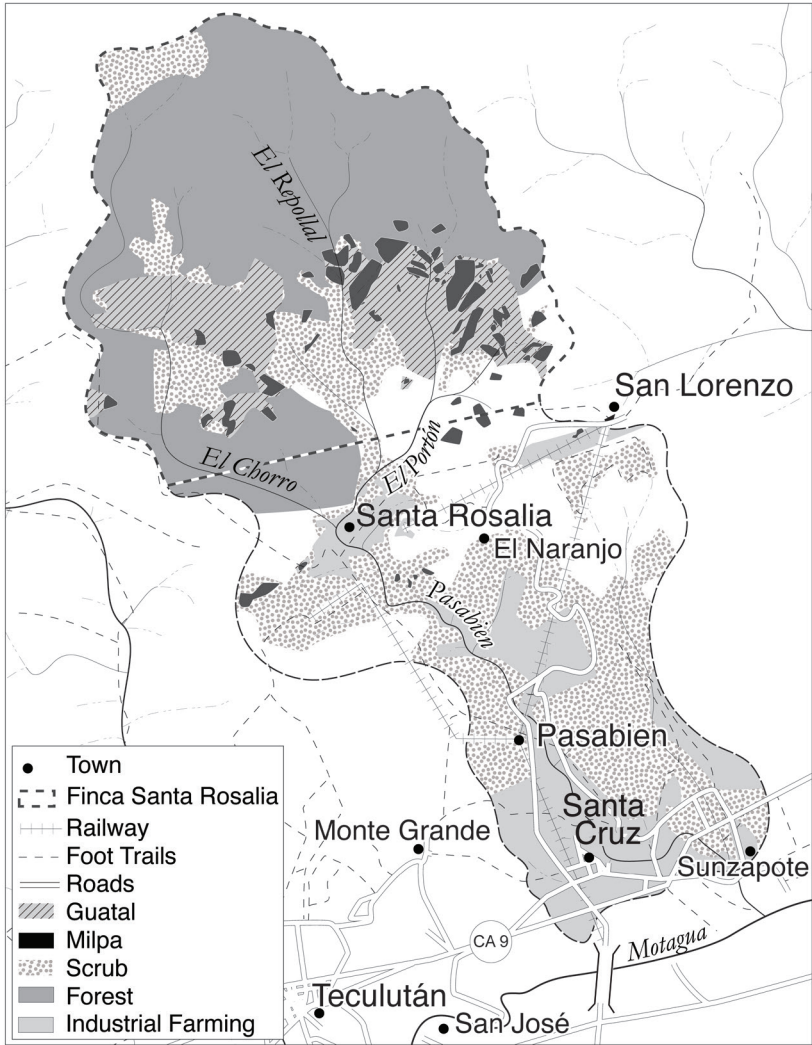


Figure 4b. Changes in infrastructure and land use in the Río Pasabien watershed, 1933-1989

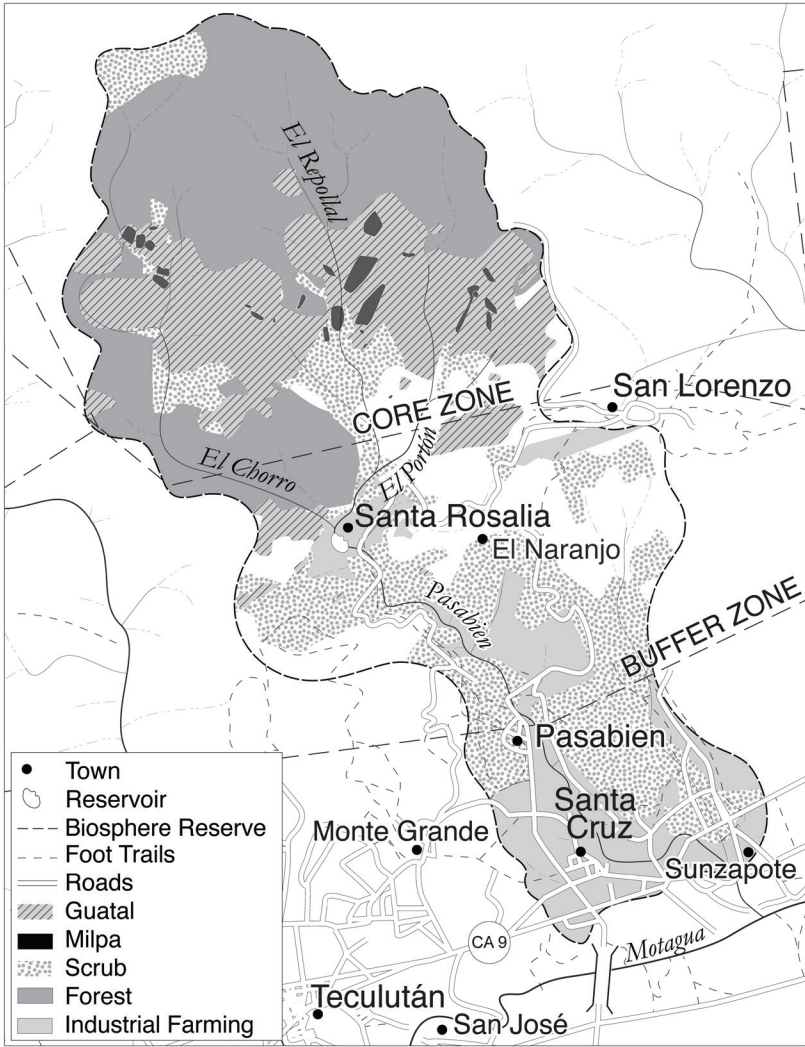


Figure 4c. Changes in infrastructure and land use in the Río Pasabien watershed, post-1990

By the end of the 1920s the Guatemala Mining and Development Co. ceased operations and the owner of the Guatemala Marble & Mining Co. left the country, and a severe accident on one of the inclines led to the permanent abandonment of the railway. At the same time the Guatemalan government declared part of the dirt road between the Swich de Marmol and San Lorenzo public by the request of residents from San Lorenzo and other villages in the area, and an extensive network of roads began to be built in Guatemala, including a dirt road connecting Puerto Barrios with Guatemala City and the transformation of Puente Marmol into an automobile bridge.

#### *Nationalization of mines and political shifts (1933 to 1989)*

Beginning in the 1930s the lands owned by the Guatemala Marble & Mining Co were seized and declared as *Finca Nacional*, public land, and the Guatemalan government enacted a new mining law, *Decreto Número 1828*, Decree Number 1828 (Méndez 1935; Sosa de Robles 2008). The *Finca Nacional* became known as *Finca Nacional Santa Rosalía*, Santa Rosalía Parcel, (Figure 4c) and in 1956 the extraction of natural resources was banned over an area of 4,061 ha (Castillo-Armas 1956). In contrast, local oral history says that the wealthy owner of the mining company, a man of German or Italian descent, left the lands to the villagers. During this time period the municipality of Teculután built a second hydroelectric plant in Santa Rosalía that began operating in 1944 (Sosa de Robles 2008). As a form of payment, Teculután supplied electricity to Santa Cruz and Monte Grande – two villages in the lowlands of Pasabien watershed within the municipality of Río Hondo. In 1952 Guatemarmol S. A. y Marmoles Finos de Guatemala S. A. (Marfisa) obtained mining rights to exploit the marble quarries. During this time period, road networks expanded and the road connecting Puerto Barrios to Guatemala City was built and paved becoming officially named CA-9 (Figure 2b). By 1968, the Guatemalan government acquired IRCA and renamed it *Ferrocarriles de Guatemala* (FEGUA), Guatemala Railroads. FEGUA operated 497 miles of railroad infrastructure that connected Guatemala City with ports on both coasts as well as neighboring countries until March 1996 when it ceased operations. In 1997 the Pennsylvania-based Railroad Development Corporation (RDC) along with Guatemalan investors formed *Ferrovías de Guatemala* (FVG), Guatemala Railways, and won a 50-year right to use the 497 miles of railroad (Figure 4c) (Sequeira 2010). Operations under FVG began in 1998 but halted in 2007 due to arbitrations held at the International Centre for Settlement of Investment Disputes (ICSID) over the legitimacy of the 50-year concession to RDC (RDC 2011).

#### *Privatization and natural resource development (Post-1990)*

The continued presence of people and ongoing resource use in the Pasabien and remaining watersheds in the SLM exacerbated existing environmental problems. In 1990, the Guatemalan government set aside 236,300 ha for protection in the SLM and created the Sierra de Las Minas Biosphere Reserve (RBSLM) (Figure 4c) (Congreso de Guatemala 1990). A year later the RBSLM became part of UNESCO's Man and Biosphere Program. The RBSLM is presently under the jurisdiction of the National Council for Protected Areas (CONAP), and managed by the Defenders of Nature Foundation (FDN). The FDN is an NGO established in the early 1990s to promote the conservation of

the RBSLM through community work and reforestation. The RBSLM includes a core (all extractive activities are banned), a sustainable zone (activities are limited to those that minimize environmental impacts), a buffer, and a restoration zone. At implementation, this regulation did not affect existing licenses and concessions in areas other than the closed mixed and broad-leaved forests. The Finca Nacional Santa Rosalía (Figure 2c) including Rosalía, San Lorenzo, and the marble quarries became part of the RBSLM, the latter three included within the buffer zone (Figure 4c).

In the mid-1990s, a partnership between HydroWest International and Inversiones Pasabien S. A. allowed the construction and operation of the Pasabien Hydroelectric Project (AP&T 2008). Finished in 2000 this project included a small concrete dam on the Pasabien near Santa Rosalía, a canal, a tunnel and pipeline, a power house located in the Pasabien village at 250 m asl and a road linking Santa Rosalía with CA-9 through Monte Grande (Figure 4c). Most of the road is private and access is controlled by Inversiones Pasabien S. A. Part of the canal, pipeline and road run through the old railway systems built in the early 1900s.<sup>1</sup> By the end of the twentieth century landscape patterns of resource extraction and water use were constrained to some extent by the creation of the RBSLM. Guatemarmol S. A. still operates a mine and processing plant at San Lorenzo and quarries of Santa Rosalía are being reopened.<sup>2</sup>

### **Santa Rosalía – Perspectives from the Field**

On 7 June 2010 we attended a workshop that brought together stakeholders with interests in the Pasabien watershed and from 9-27 June 2010 we lived in Santa Rosalía where we conducted fieldwork using qualitative research methodology. The workshop organized by the International Union for the Conservation of Nature-Guatemala (IUCN-G) and FDN was part of a larger effort to establish a committee for the protection and management of the Pasabien watershed. Other stakeholders attending this meeting included Inversiones Pasabien and Santa Rosalía's Community Council for Development (COCODE). The COCODE oversees local matters and holds community meetings. At this meeting we discussed our intended research with the president of Santa Rosalía's COCODE and asked for assistance in setting up two focus groups, one for women and the other for the general community. By holding a separate focus group with women, we hoped they would be more comfortable discussing their opinions.<sup>3</sup> We also conducted semi-structured interviews with twenty people, eleven women and nine men, ranging in ages from 25 to 60 years. We did not specify an age range for interviewees but instead selected individuals through chain sampling, identifying interviewees through the referral of community leaders and other interviewees in order to obtain a broader perspective of the ways in which past knowledge has carried forward into the present context (Table 1).<sup>4</sup> Using interviews to collect data is most commonly associated with contextual or case study investigations that examine the unique subtleties of places and the ways in which people mitigate internal and external pressures (O'Brien *et al.* 2007). The focus groups lasted approximately one hour each and provided a base from which we were able to gain a better understanding of local processes occurring within regional processes. The semi-structured interviews also lasted about an hour, but in some instances conversations with the individuals carried on after the interviews were finished. During the interviews, we

gathered more specific information about daily living in Santa Rosalía that we used to elaborate the SEE approach in detail.

Table 1. Questions for semi-structured interviews

<b>Conceptual Topic</b>	<b>Interview Question Guide</b>
<b>Sense of Place</b>	<p>What do people do to make a living?</p> <p>Is this different from the past?</p> <p>In what ways has life changed since electrical lines and transportation links connected the aldea to towns below?</p>
<b>Local Environmental Knowledge</b>	<p>What changes in the environment have occurred during residents' lifetime?</p> <p>Are residents aware of landslides in the areas?</p> <p>What do residents know about landslides?</p> <p>Have residents noticed significant changes after the Earthquake of 1976 and Hurricane Mitch in 1998?</p> <p>Have residents personally seen landslides or other changes in the environment?</p>
<b>Individual Preparedness</b>	<p>Do residents think they might be able to prevent landslides?</p> <p>What did residents do to prepare for Hurricane Mitch and how would they prepare for future storms?</p> <p>Do residents receive aid to help rebuild infrastructure after major storms?</p> <p>Do residents have a household plan in the case of a natural hazard event occurring?</p>

### *Living in Santa Rosalía*

Residents described living in Santa Rosalía as fresh, tranquil, healthy and pure but also hard, worse-off and critical. These comments from the interviews seem to juxtapose nostalgia for a serene sense of place and their present lived reality in a small mountain community susceptible to environmental and external pressures. Approximately 42 percent of interview respondents indicated that living conditions today were better than before when there was no road (approximately fourteen years ago) or electricity (approximately twenty-two years ago) using words such as good, tranquil, healthy, better than before, cool climate and pretty. The interviewee that stated life was healthy in Santa Rosalía indicated that there were fewer social problems in comparison to other towns where violence, murder and robbery were issues.<sup>5</sup> One respondent described living in the village as *extraviado*, lost, as opposed to living in the city where everything was immediate.<sup>6</sup> Others suggested that recent changes such as access

to cars, improved roads and a local school made life easier. Another indicated that she felt closer to God living in Santa Rosalía.<sup>7</sup> Interviewees that expressed negative opinions about living in Santa Rosalía focused on the challenges of living there today. Twenty one percent of the interviewees indicated that living in Santa Rosalía was difficult, or that the situation had become critical, and worse. These interviewees referred to worsening economic situations, such as a lack of jobs and low wages, as well as deteriorating environmental situations.

The connection to a regional and local environment comprises an important part of living in Santa Rosalía. Interviewees reminisced about exploring the mountains as kids, encountering the wildlife in the forest (howler monkeys) and working at their fields in the mountains. Residents also cherish their ability to go to the river, drink water from local sources, hike to the waterfalls and have kitchen gardens. Additionally, interviewees believed the air quality and climate are better in the mountains than in the towns below. One interviewee described a sense of place directly related to her level of familiarity with the surrounding area. She explained "I have been to and know the mountain. I love going there".<sup>8</sup>

Living in Santa Rosalía also encompasses family ties to the village. Few outsiders move to the community and usually newcomers, mainly women, arrive because they marry into a local family. Three interviewees emphasized the importance of family legacy and ancestral roots in the aldea. One interviewee stated "I have lived here all my life, the aldea is over 100 years old and also my family lives here" and another explained "I have only lived here. First I lived with my parents and then I moved 80 meters. I was abroad in the United States for three years. I came back because I had three young children. A mother alone can't raise children".<sup>9</sup> Several families in Santa Rosalía place great importance on religion and attend one of two evangelical churches, either the Church of Friends, or the Church of Prophecy. In addition to church services, the two churches host parades and festivities for residents. The presence of protestant churches in the Pasabien and surrounding watersheds has increased greatly since the early twentieth century (Figure 4a-c). The increase in the number of churches reflects the broader shift away from the Catholic Church and towards evangelical Christianity in rural Guatemala that began during the late nineteenth and early twentieth century and that continues to gain popularity in the contemporary post-civil era (Garrard-Burnett 1997; O'Neill 2010).

### *Making a living*

In the past, livelihoods incorporated mining, felling trees, clearing and cultivating fields in the mountains, raising crops in fields near the homes, herding livestock from the mountains and selling produce locally. Today, agricultural production, while still an ongoing activity in Santa Rosalía, may not be the main source of income for residents in the village. Families might own a few cattle and maintain inherited fields to keep up the family expectations of landownership, but due to working full time away from the house at the hydroelectric plant, the marble mine or elsewhere, families in Santa Rosalía do not have time to grow cash crops. Additionally, seed, fertilizer and pesticide prices have increased to the point that many local farmers are unable to purchase the quantities needed to plant and maintain their fields. In part, globalization processes have caused a decline in agricultural production that is experienced in Santa Rosalía and in other rural areas worldwide (Rauch 2009). As globalization opens up new



markets and increases competition, rural residents, instead of only relying on agricultural income, must diversify their activities and often migrate to other cities for short periods of time or work in other non-agricultural industries locally (Rauch 2009; Hecht 2010). Cartographic analysis of topographic maps and aerial photographs corroborate the agricultural decline, indicating fewer milpas in the mountains surrounding Santa Rosalía and revealing larger portions of second growth forest in the upper portions of the watershed since 2000 (Figure 4c). Based on these maps and images, we concluded that more small milpas existed in the forest between the 1930s and 1990s.

Working at the marble mine operated by Guatemarmol and the hydroelectric dam operated by Inversiones Pasabien provides the two main sources of income earning activities in the village. The men that work for Guatemarmol at San Lorenzo usually leave early on Monday morning and return home on Friday, either driving their car or motorcycle or catching a ride to work for the week. The few men that work for Inversiones Pasabien stand watch at the hydroelectric dam located at the reservoir just on the outskirts of the village, work on the road crew paving the main road or take part in reforestation efforts in the core zone of the RBSLM (Figure 4c). In the opinions of several interviewees, working for the mine and Inversiones Pasabien is better than working in agriculture but still pays very little. One man described his frustrations with the employment opportunities and agricultural production in Santa Rosalía, stating:

I worked 30 years in agriculture, but it no longer pays. It is hard to work in the mountains. A person is better off with a job...Working in agriculture is hard because of age...Later I worked at the marble factory, but I had a few accidents and lost my job. I worked 21 or 22 years with Guatemarmol. They paid me Q21.15 every 14 days. [Before] everything was cheaper. A sack of corn cost between eight and ten quetzales, today it costs 150...<sup>10</sup>

According to conversations with residents, the average income in the village ranged from US\$100 to US\$150 a month. This amount is enough to make ends meet but not enough to provide for unforeseen costs and additional household purchases. Commonly, young men work at the mine or for Inversiones Pasabien or leave Santa Rosalía hoping to find work in nearby towns, larger cities in Guatemala or the United States. Several families have relatives working in the United States they had not seen in over ten years. We spoke with one resident that was preparing for a third attempt to travel to the United States.<sup>11</sup> This resident hoped to work in the United States briefly, earning enough money to provide a better life in Guatemala for his family and build a house in the city of Teculután.

Women in Santa Rosalía today work domestically but a few of the older female interviewees told us that they used to work in the fields with their fathers and husbands. In addition to domestic work, women tend kitchen gardens, raise small-domesticated animals such as hens and may still occasionally help their husbands outside of the home. Two of the women interviewed help collect firewood while two others care for their families' cattle, milking cows and watching over the herd while it grazes in fields near the house. Several women also operate small stores (*tienditas*), out of their homes and sell medicine, ice cream and other small household items. They purchase supplies once a week, relying on the people in town that own cars and run carpool services to and from

the towns in the valley. These stores give the family an extra source of income and provide a social outlet for women. During the day while men work away from the home, women and children may go to one of the *tienditas* to buy a soft drink or toilet paper from the store and then end up staying to talk for a while. The variety of foods, medicines and household items usually sell for a minimally higher price than what they cost in the larger stores in Pasabien or Teculután. Some interviewees stated that the stores in the village charged higher prices than others and made it expensive to purchase basic necessities such as water. This frustrated residents because when heavy rains interrupted the water supply, they had little choice but to purchase higher priced water from these stores if they were unable to go Pasabien or Teculután.

### *Place infrastructure*

In many ways, the provision of electricity in the village twenty-plus years ago revolutionized the landscape but most interviewees regarded the construction of the one-lane road out of town as the more significant driver of change. Not only is the road the more recent infrastructural improvement in town but also it provides residents direct access to the larger towns below (Figure 4c). Additionally, while most residents have lived with electricity for over two decades, and now enjoy telephone connections, indoor lighting, cable TV and refrigerators, all interviewees indicated that because electricity was expensive, they still used wood-burning stoves for cooking. Men collect pine wood (*ocote*), and whittle it into small slivers that catch fire easily. Residents have always collected and used the wood for cooking and before electricity, used it along with store-bought candles and gas lamps to light homes.

Before the construction of the road by Inversiones Pasabien approximately fourteen years ago, residents either walked or rode pack mules to the towns below via trails (Figure 4a-b). In the past, people planned their excursions to towns below in the valley to stock up on materials to last them at least two weeks. Taking pack mules, they started out early in the morning around 4:00 a.m. and returned home by 8:00 p.m. The lack of a drivable road also complicated medical emergencies for residents. One interviewee stated “It was hard. With pack mules. Women used to give birth with the help of a midwife. And labor became complicated when going down the mountain in a hammock”.<sup>12</sup> Similarly, if children became sick, parents carried them down the mountain on foot to the nearest towns of Santa Cruz, Teculután or Pasabien. In a hurry, the trip to Santa Cruz took about three hours and from there, parents could take a car or bus to the hospital in the city of Zacapa about 30 minutes away on CA-9 (Figure 2a-c). Currently, Inversiones Pasabien is paving the road and residents hope that it will be safer for travel and more durable during rainstorms. The remaining obstacle is that sediment flows from upstream are deposited in the town reservoir and cause flooding that blocks access to the bridge leading to the village. When the bridge becomes inaccessible, residents can be isolated for days, but in an emergency walk across the river or use a pedestrian bridge downstream and arrange for a ride down the mountain.

At present, the town does not have a water filtration system or a pipe system that can withstand heavy rainstorms. Water from the Inglés river is transported to and distributed from a holding tank through small three-inch diameter hard plastic pipes that have been used for 25 years. A caretaker cleans the tank and residents contribute Q20 (US\$2.57) every three months to a small emer-

gency fund that they use to repair the water pipes. This amount is not enough to cover improvement costs that would guarantee uninterrupted water services to all the homes.

#### *A changing environment*

Interviewees consistently described changes in streambed integrity and water quality of the local rivers explaining that during each rainy season since Hurricane Mitch, waters rise higher than flood levels in prior years and wash down more sediment from upstream. The erosion upstream, especially in the Inglés make the local water supply turbid, leaving residents without a clean source of water for washing, cleaning, cooking and drinking. Several residents remember local water resources as always fresh and drinkable. One woman stated that as a child when she accompanied her mother to wash clothes in el Inglés, the water was always clean.<sup>13</sup> She pointed out that the riverbanks completely changed and today river waters wash away vegetation and leave nothing but rocks along the banks.

Most residents associated Hurricane Mitch with the decrease in the quality of local water resources but one interviewee believed logging activities in the past near the local rivers caused landscape changes.<sup>14</sup> Residents also linked significant environmental changes with severe droughts and heavy floods associated with past rainy seasons. Their perceptions of environmental changes emphasized declining quality of soil and land, decreasing agricultural production, increasing turbidity in rivers, interruptions in local potable water supply, greater frequency of heavy rainstorms and deterioration of forested mountain landscapes. Although interviewees linked the decline in soil quality directly with Hurricane Mitch, it is also likely that observed land-use practices throughout the twentieth century, such as slash and burn clearing of milpas in the mountains, significantly depleted soil nutrients prior to Hurricane Mitch (Figures 4a-b).

Interviewees described Hurricane Mitch and the 2010 rainstorms as the most intense rain events in their memory. During these events residents witnessed rising river waters and landslides that together resulted in damaged agricultural fields and forest, interruption of water services and disruption of transportation networks. Several interviewees stated that in June 2010, rainstorms were the longest and most intense since Mitch, causing the river to be the most turbid ever and the longest interruption in water supply. Prior to Hurricane Mitch, residents were not aware that landslides significantly impacted the area, but local knowledge of landslides is increasing. Residents stated they learned from FDN that logging and burning for agriculture coupled with heavy rains, made landslides more likely (Figure 3b). Despite the increased knowledge of landslides, interviewees expressed uncertainty when asked how they felt about living in an area where landslides occur. Several invoked religious beliefs in their responses to our questions, implying that their lives were in the hands of God. Some interviewees admitted they feared the consequences of a major landslide, especially if it cut off road access, and questioned what could be done to prevent future landslides. Specific concerns included that landslides and debris flow from the rivers could affect houses in the village, either burying homes, causing unprecedented rises in river waters or damming the river upstream and cutting off water supply.

*Responses to natural hazards*

The decline in the quality of water during every rainy season causes families to change household daily routines, costing families either money if they buy water or time if they have to travel farther to collect water. In other cases, families choose to use river water from El Inglés, but let the sediment settle. Based on our observations and interviews, women primarily collect water and travel to nearby streams or as far as the waterfalls, about one hour by foot. One resident expressed concern over the current water situation because her children became sick from drinking the water. She began boiling the water and adding a small amount of chlorine to sterilize it, a process she never had to do in the past and only recently learned would prevent bacteria growth.<sup>15</sup> Another interviewee also expressed concern about possible water contamination and stated “The water comes down dirty. We have gotten sick [from it]. No one knows how contaminated the water really is”.<sup>16</sup>

Overall, residents believe their actions make little difference in altering their current situation. Many described apathy after having been isolated for so long from the municipal government and expected no help from local officials. One resident commented “*cada cual jala por su lado*” (every man for himself), summing up the feeling of isolation and self-reliance when it comes to responding to extreme weather events.<sup>17</sup> In preparation for storms, residents purchase food, fuel and other supplies, reinforce roofs, collect firewood, wait out the storm at home and check for news updates on television or the radio. Many interviews stated they were just as prepared as they always had been living in Santa Rosalía. Every year they expect that storms will cause flooding and damage to crop fields and they prepare as much as they can. For example, one resident stated “when the corn field is almost ready for harvest, we bend the corn stalks upside down and they don’t spoil [in the rain], but we always do this, every year”.<sup>18</sup> Another interviewee told us that her family had built a second home away from the riverbanks because they feared their current house would be flooded if another hurricane like Mitch occurred. They have not moved into that house though because they like where they currently live.

The fear of a repeat of Hurricane Mitch is a persistent concern for residents in Santa Rosalía. Several residents were caught off guard by the damage caused by Hurricane Mitch but were aware of the storm from broadcast news reports. Most residents receive storm alerts via television, radio and telephone because the aldea does not have a formal warning system. One interviewee stated “We are more alert, but we don’t have anywhere else to go. We only have this house...In one’s mind, one wishes to leave [but] doesn’t know what to do”.<sup>19</sup> Without any other option, residents try to make the best of the situation, wearing rubber rain boots, attending crops, buying water and waiting out the floods that prevent them from leaving town. Up to the date of our research in 2010, heavy rains and landslides had never caused anyone to move out of the area.

On two separate occasions, community leaders from the village and hydroelectric company executives held meetings to discuss solutions for the residents but neither resulted in much success. The village’s efforts through the COCODE to organize a series of community meetings at the schoolhouse resulted in sporadic participation. The workshop hosted by the hydroelectric company aimed to teach residents new livelihood strategies, such as using cow manure as a fuel. The problem was that most residents did not own cattle and do

not have the money to buy or care for the livestock needed to produce enough manure for gas. Despite minimal formalized planning efforts and limited funds, residents pointed out that after Hurricane Mitch, individuals came together to help each other out and to rebuild the bridge. In their opinions, this would be the case again because “those of us that are always here help each other, neighbors, family”.<sup>20</sup>

### **Conclusions – a SEE perspective**

Residents’ personal narratives of place, home and surrounding environment reveal a strong sense of history, belonging and kinship ties in Santa Rosalía. Multiple livelihood activities generate this collective connection to place based in nostalgia, affinity for the environment and endurance of hardship. Residents’ comments suggest that while they share feelings of isolation and neglect, they also share a deep appreciation for their surroundings and for being removed from the busy life in larger cities. For over a century, the supply of wood, water, minerals and land enabled residents to work and live off the land in the village but residents lament that local fields no longer produce the same amount of crops as in the past. Today, individuals must find alternatives to agriculture in order to make a living.

This is especially the case since residents in Santa Rosalía depend greatly on local resources that continue to be in demand by multinational mining and hydroelectric operations. While Inversiones Pasabien and FDN have engaged with the community, our observations and interviews suggest that individuals are just beginning to demonstrate a more comprehensive understanding of the ways in which human processes impact the environment in the watershed. Additionally, local perceptions relate more to recent events as opposed to taking into consideration external long-term processes and the impacts of individual behavior such as illegal slash and burn agriculture in the RBSLM. This is evident in that several residents link Hurricane Mitch with environmental change, when in fact, logging, mining, agriculture and livestock activities have altered the landscape throughout the twentieth century.

From the interview data, it seems that despite the external pressures, residents in Santa Rosalía maintain a highly localized narrative of place in the village and the watershed. This may be due to the fact that the lived reality in Santa Rosalía is physically isolated from larger cities in the valley and reflects both a mentality of survival against and affiliation with the local environment. These social, cultural and environmental connections (family ties, feeling of safety, affinity for the mountains, sense of belonging) to the village combined with the work opportunities in non-agricultural industries nearby, somehow provide the necessary diversity that helps residents continue living in the village, even in the face of impending floods and landslides that negatively impact daily life. While it may seem impractical from a macro-level perspective that individuals stay because of their remoteness and the seasonal flooding and landslides, in the local context, these livelihood, economic and environmental activities that help residents remain in the village could be the focus of resilience building and sustainable development efforts. Similar to coping and responding strategies used in many mountain communities worldwide to mitigate the impacts of landslides, some of the practices used by residents in Santa Rosalía contribute to resilience building (knowledge and use of local resources, willingness to search for other

employment opportunities) while others limit these possibilities (illegal use of the RBSLM lands, intensification of milpas, lack of reliable water service).

The long-term presence of mining operations, hydroelectric projects, migration flows and industrial development downstream in Pasabien and Teculután illustrate that Santa Rosalía has been a crossroads for international, state, regional and local processes since the beginning of the twentieth century. Although several interviewees indicated that the village was completely isolated economically, politically and geographically from the municipality, we believe that the established links to commercial centers that began in the early twentieth century via the railroads and industries (i.e., the Guatemala Marble & Mining Co.) and continue today (Guatemarmol S.A. and Inversiones Pasabien) play a large role in the local economy. Additionally, migration flows mentioned by a few of the interviewees in response to our questions about working and living in Santa Rosalía lead us to believe that established links exist to other cities nearby as well to the United States. Further investigation of migration flows in subsequent research may provide new insights into the details of these flows, specifically to what extent remittances support the local economy of Santa Rosalía. Based on our investigation, we believe that if these non-agricultural economic links to industry, investments and migration were non-existent (and had been non-existent in the early twentieth century), it would be extremely challenging for individuals to continue living and maintaining livelihoods in such a remote area and before long the pressure to meet basic livelihood needs might lead many residents to abandon the area.

The presence of these links early in the twentieth century helped sustain the village over its 100 years of history and the current hydroelectric project in the watershed provides precisely what the marble mining industry provided in the first half of the twentieth century – non-agricultural employment and the opportunity to maintain life in a remote region in the SLM. New rurality theory suggests that in the current neoliberal paradigm of globalization, income from non-agricultural sectors in many rural areas worldwide provides the opportunities for people to continue living in such places (OECD 2006; Rauch 2009; Hecht 2010). Perhaps though, due to the presence of global-international investment and industry early on in the watershed, the residents of Santa Rosalía have always operated between agricultural and non-agricultural activities in order to remain in a place to which they feel connected and what they are experiencing today with the presence of the hydroelectric project is a kind of second new rurality transformation.

One of the main concerns locally is that the village remains minimally funded by the municipal government and sits on the political fringes of the municipality of Río Hondo. The visible differences between the infrastructure built by Inversiones Pasabien, such as the road, the bridge and the dam, and the municipal infrastructure such as outdated water pipes, are a reminder of this political isolation. This may explain why residents have poorly attended stakeholder meetings, such as the one we attended in June 2010 organized by IUCN-G and FDN. Another possibility for low community participation is that disconnects between FDN's conservation efforts, Inversiones Pasabien's economic objectives and the COCODE's constrained political scope result in residents' limited knowledge of local circumstances and alternatives. Additionally, most residents indicated that work and family life leave little time for attending meetings and actively participating in efforts led by outside organizations. But, in spite of the

feeling that it is every man for himself, the diverse activities we observed in our investigation seem to help families build resilience and mitigate some of the hardships created by deteriorating land resources, flooding and landslides as well as political-economic isolation. Most importantly, efforts to support the many activities of everyday living that have potential to build resilience in the village will help residents reduce their level of exposure, increase their potential to recover and strengthen their capacity to cope with natural hazard events (Figure 1).

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### **Notes**

<sup>1</sup> Personal email correspondence from Heber González, May 12, 2011.

<sup>2</sup> Personal email correspondence from Heber González, May 12, 2011.

<sup>3</sup> In 2010, the Gender Inequality Index (GII) for Guatemala was 0.547. In comparison, Sweden had the highest gender equality with a GII of 0.050 and Yemen had the least amount of gender equality with a GII of 0.756. The GII measures equality between men and women based on the three dimensions of reproductive health, empowerment and the labor market. We believed that with such low gender equality indicated by the statistics, that women may feel more empowered to express their opinions among other women instead of in a mixed-gender group.

<sup>4</sup> Five of the women and three of the men that participated in the focus groups were also re-interviewed as part of the sample for anonymous semi-structured interviews.

<sup>5</sup> Interview Nineteen, 24 June 2010

<sup>6</sup> Interview Fifteen, 24 June 2010

<sup>7</sup> Interview Two, 17 June 2010

<sup>8</sup> Interview Three, 17 June 2010

<sup>9</sup> Interview Ten, 19 June 2010; Interview Six, 18 June 2010

<sup>10</sup> Interview Six, 18 June 2010

<sup>11</sup> Interview Six, 18 June 2010

<sup>12</sup> Interview Four, 17 June 2010

<sup>13</sup> Interview Seventeen, 24 June 2010

<sup>14</sup> Interview Six, 18 June 2010

<sup>15</sup> Interview Two, 17 June 2010

<sup>16</sup> Interview Six, 18 June 2010

<sup>17</sup> Interview Five, 17 June 2010

<sup>18</sup> Interview Eight, 18 June 2010

<sup>19</sup> Interview Ten, 19 June 2010

<sup>20</sup> Interview Five, 17 June 2010

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