Literature Reviews on Mitigating Flood Disasters in the Belize River Valley

A Compendium

VIU Belize 2009 Project Team
Vancouver Island University
Editors: Larry Wolfe and Victoria Macfarlane
2009b
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THE VANCOUVER ISLAND UNIVERSITY TEAM

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Preface

This report comprises reviews of scholarly, government, and nongovernment publications as background for policy analyses related to mitigating disasters in the Belize River Valley. While based on interviews, literature reviews, and fieldwork, the reports, analyses, and recommendations of this project are solely the work of the students.

These reports do not reflect the policy of the National Emergency Management Organization (NEMO), the Government of Belize, or Vancouver Island University (VIU). Nevertheless, it is hoped that there will be useful analyses and recommendations in this work that will help to save lives and property of Belizeans when the next disaster occurs.

This report is an output of the VIU Belize 2009 Project Team – a group of two faculty members and 13 upper division students from Vancouver Island University in British Columbia, Canada. The project originated in discussions with NEMO in 2007, when the faculty leaders discussed the project with senior NEMO and government officials. In late 2008, the team began to prepare for the project by learning about interviewing techniques and other aspects of fieldwork. Also late in 2008, Tropical Depression 16 was devastating parts of the Belize River Valley – an area of traditional villages located along the Belize River in central Belize. The fieldwork for this project was conducted in May 2009. Reports were prepared by the students and edited by the faculty leaders in subsequent months.
Acknowledgements

Vancouver Island University and the VIU Belize 2009 Field Team would like to thank the National Emergency Management Organization for its generosity and hospitality in hosting our 2009 field project. In particular, we appreciate the welcoming we received from Lt. Col. George Lovell (ret.), CEO for National Emergency Management; Ms. Noreen Fairweather, the National Emergency Coordinator, and Lt. Col. Shelton De Four (ret.), Deputy National Emergency Coordinator, for welcoming our team to the participate in studies to mitigate flood risks for the residents of the Belize River Valley. We also appreciate the insights and time from Lt. Col. Roberto Ramirez (ret.), Mr. George Coleman, and other members of the NEMO team for their always generous advice and assistance, for taking the time to attend our presentations, and for always greeting us with their wonderful Belizean hospitality.

In addition, we wish to give special thanks to Mr. Steve O’Brien, Humanitarian Officer of NEMO, for his many hours of assistance in the field and office to carry out this project, for arranging many introductions, interviews, and meetings, and especially for his many very useful insights into the 2008 disaster, descriptions of agency responses, and understanding of the life of people of the Belize River Valley. We also wish to give special thanks to Mr. Calbert Budd, District Coordinator for NEMO, who was a constant companion, guide, and ready source of information for the valley where he has lived his life.

We also wish to thank Dr. Roy Young for being a great source of information on all things about Belize, a guide for Belize City, for hosting our team at Natures Resort at an affordable rate, and for being a wonderful friend of the team. We also thank Ionie Wade, Justin Young, Gloria Young, and other members of the Bermudian Landing community for their kind hospitality for our days spent at Natures Resort – our home away from home for much of the month. Thanks also to Mrs. Jessie Young, Mr. Robert Panting, and other workers at the Community Baboon Sanctuary for use of the facilities, for information on the community, and for a great tour with the monkeys. We also appreciate the wonderful hour that the late Mr. Fallet Young spent with the team leaders in April 2009, giving his insights into the community. His passing is a loss to all of us. Also, special thanks to Clare Moody of Belmopan, who volunteered to host a couple students at her own home. Thanks also to George Richard Sosa at the Belmopan Hotel for all of his kind assistance. We also appreciate the assistance of Mr. Conrad Arzu of Belmopan’s Trendsetter Autos for providing his van to us at a very affordable rate. We found delightful services from Mr. Doug Thompson of the Black Orchid Resort, Jessie and Jeff Banner at De Real Macaw, and John and Jeanie Barkman at Jungle Jeanie’s Cabanas. All along the way, Belizeans were generous in making all of us feel very special to be here in the Jewel of Belize. We also especially appreciate the kind assistance and support from Ms. Audrey Hansen from International Education at Vancouver Island University, to the dean, the chairs, and our colleagues at VIU for their support in getting this project launched.

We were assisted by many agencies in Belize. The Belize Coast Guard arranged boat transportation on the Belize River so we could reach May Pen, which is cut off by a damaged bridge and stretched along both sides of the river. This boat operation was vital, yet also a very memorable experience, providing insights into the nature of the river that was so damaging in its floodwater days. We were also able to talk to many senior government staff, including several ministry chief executives, senior staff, and operational personnel. We also received important information from the Ministry of Natural Resources and Environment, Ministry of Agriculture, Ministry of Health, Ministry of Housing and Urban Development, Human Development and Social Transformation, the National Association of Village Councils, the University of Belize, the Belize Red Cross, and other agencies. Also, in Canada, we interviewed several emergency management persons who provided us with insights that helped us get ready for this field endeavour.

Finally, we owe a very deep debt of gratitude to the leadership and residents of the Belize River Valley. Every resident we approached welcomed us for an interview – an interview that probed into their personal lives and took a long time. Yet no one complained or rushed our team. On the contrary, we were kindly received and given insights and information that could only come from those who had suffered much from the devastating floodwaters of 2008. In particular, we would like to thank Chairman Clinton Rhaburn of Flowers Bank, Chairlady Olivia Moody of May Pen, Chairlady Olive Banner of Lemonal, and Chairman Pook and Councilors Marilyn Lopez and Tircia Pook of Rancho Dolores. You were and are our friends and mentors as we learned from your communities. We will be forever grateful.
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Introduction

The 2009 VIU Belize Field Project addressed the issue of flood disasters in the Belize River Valley of Belize. The team comprised thirteen students and two faculty leaders from Vancouver Island University in British Columbia, Canada. The project team is led by Dr. Larry Wolfe and Dr. Victoria Macfarlane from the Departments of Geography and Psychology respectively. The team included students from geography, psychology, global studies, criminology, education, and other departments. Four members already had bachelor’s degrees and some completed their degrees based on credits from this field project.

The Belize River Valley

In October and November 2008, Tropical Depression 16 caused serious flooding throughout Belize. Communities in the Belize River Valley (BRV) were particularly hard hit. The Belize River has a low-lying floodplain that frequently floods in the rainy season. The hydrology of the basin is extremely complex. The upper watershed includes both the Maya Mountains as well as settled lowlands and rolling hills of the Cayo District of Belize and a large area of Guatemala. Dams on the Macal River, a tributary to the Belize River, provide hydroelectric power to Belize and some stream regulation. The timing and extent of flood flows along the Belize River depend on where the rains fall and the time required for the river to drain the valley. If rains concentrate in the upper watershed, some delay occurs before floodwaters reach the BLV. The basin is also a somewhat open system. The valley lies on a limestone Karst base, and floodwaters can be fed by underground flows. Further, when waters begin to overflow the banks, they can traverse into other watersheds, such as the Spanish Creek watershed. From here, the waters flow into a complex of lagoons and marshes that include the Crooked Tree Wildlife Sanctuary. From here, the waters can flow into New River Lagoon and New River, and cause flooding in the far north of the country. The water also returns to the Belize River through Black Creek downstream of the village of May Pen. Complicating the picture, the lower reaches of the Belize River and related basins have a very low gradient. The river discharge into the sea is slowed by this minimal gradient as well as limited discharge capacity of the river mouth. Scientists predict that, with climate change, precipitation in the valley will increase and sea level rise will retard the discharge of water to the sea. This will increase the frequency and duration of floods in the future.

The VIU team focused on four of the ten villages in the lower Belize River Valley: Flowers Bank, Rancho Dolores, Lemonal, and May Pen. These villages were devastated by TD 16. Floodwaters inundated many houses and farms, and these waters remained for weeks. Bridges and roads were flooded, requiring a major relief and supply operation that lasted for weeks. At the height of the flood, the Belize Coast Guard navigated through the confused array of channels and debris-filled waters to maintain operations. NEMO and its partners were assembling supplies and medical services. The Belize Red Cross and staff of the Ministry of Health provided medical assistance for flood-related and non-flood-related illnesses. Many residents lost their crops and scores of livestock were killed. After the deluge, NEMO worked with villages to restore homes, rebuild many destroyed structures, and refurnish some houses. One Coast Guard boat was lost, but later recovered. At the end of the crisis, the most important indicators of the success of these operations are that, miraculously, no one died. The potential was clearly there for serious loss of life.

Historically, the Belize River Valley was first settled in early 1700s, when the English established a log cutting industry, using African slaves for labour. The industry first exported logwood for dyes and later mahogany. This industry led to the early formation of thriving villages of Creole people along the river. These villages have endured over the centuries. They have a distinct culture and, in addition to English, they speak Kriol – a separate language spoken by many Belizeans. The villages have strong village identities and cultural and family linkages with other villages in the valley. After the decline of logging, the village economies were based on subsistence farming. In more recent times, many farmers have produced market crops. Recent efforts to promote agriculture include development of tilapia (fish) ponds, raising livestock, and production of cohune oil. The valley also has a growing ecotourism industry based on
extensive forest cover and charismatic wildlife such as howler monkeys, crocodiles, and many other varieties of wildlife and birds.

The VIU Project

The Belize 2009 Field Project was designed as an opportunity for upper-level Canadian university students to obtain academic credit while doing a real world project in another country. They obtained valuable practical experience using the knowledge and skills they gained in university, as well as while adding a “project” to their work resumes. At the same time, they were able to contribute to a project that might actually lead to saving lives of people oppressed by disaster. The team leaders were academics as well as experienced private consultants with a long association with Belize. Students were expected to treat the project as a work experience as volunteer subconsultants. The students were thus expected to work to an ‘A’ level of quality, with close coaching of the team leaders. In the end, the goal was to save lives for academic credit.

The VIU Team worked in cooperation with the National Emergency Management Organization (NEMO) of Belize. NEMO is an umbrella organization of government and non-government agencies that address disasters and emergencies in Belize. NEMO works through 14 support committees of government and non-government agencies that organize disaster management. NEMO staff provided extraordinary assistance to the team. They identified the four Belize River Valley villages as key clients for the project. They introduced first the team leaders and then the teams to the village leaders. They contacts for arranged interviews with numerous senior government staff members. They worked with the Belize Coast Guard to provide boat transportation to May Pen for interviews. Every time the team needed assistance, they needed only to ask NEMO staff.

The team also worked with village leaders and village members. The hospitality and generosity of villagers was remarkable. The village leaders were generous in welcoming the team and introducing the team to the village. The villagers welcomed team members for often lengthy interviews, often providing refreshments and sharing engaging stories of their life and their flood experiences. A key indicator of the generosity of these communities was that no one refused an interview. The response was 100 percent among those present in the community.

The student team received academic credit for three courses for the project. All students took Geography 466 – Geography of Belize. In this course, students learned about the geography, environments and cultures of Belize. In addition to learning from the villagers, the team visited Belize City and Belmopan. They travelled by boat up the New River to the Lamanai archaeological site. They visited Caye Caulker and snorkeled about the coral reefs. They travelled the Hummingbird Highway to Hopkins, where they were entertained by Garifuna drummers.

The students also had a choice of taking either Geography 467 – Field Methods I or Psychology 460 – Program Evaluation. This course involved developing interview protocols and interviewing village residents, and agency officials in Belize and Canada. Students also made numerous field observations and prepared draft material for the teams project report (VIU 2009a). As part of this course, students selected their individual topic for field research and also began their review of literature on their topic.

Finally, the students took Geography 468 – Field Methods II. For this course, students completed review of the scholarly literature on a topic related to disaster management and floods. They then used this information and field information to develop a policy analysis recommending options for mitigating flood damage in the Belize River Valley.

The preparation for the project began late in 2008 and early 2009. Students met at VIU to learn about Belize, disaster management, interview techniques, literature reviews, policy analysis, travel in Belize, and other project-related topics. Students got an early introduction to disaster management courtesy of the
weather – meetings were disrupted by a series of three snowstorms in Canada. As part of the preparation, the team raised several hundred dollars to subsidize the costs of the trip.

Students left for Belize in late May. Most students chose to travel via Cancun and Playa del Carmen to have a holiday in Mexico on the way to Belize. The team got its second introduction to disaster management as news spread of a growing pandemic of H1N1 influenza, which was reported in the Yucatan region. Although the epidemic turned out to be less serious than expected, scores of people were dying in Mexico. Had any student contracted this flu, the project would have been suspended to avoid infecting anyone in the villages. In the end, the students left Mexico early and went to Caye Caulker to finish their pre-project vacation.

Once in Belize, the students were based in Bermudian Landing. This site was central to the valley. May is the hot and dry season. The accommodations were comfortable, but water for washing and sanitation was sometimes limited. The team also learned about the biodiversity of insects in Belize and how to treat the bites. They enjoyed Creole cuisine, including the staple rice and beans with stew chicken, as well as country foods such as turtle and fish. They learned about the processing of cashews. Most of the time, the team could hear the roar of howler monkeys somewhere in the neighbourhood, and occasionally very close by.

The team was organized into two teams – a geography team and a program evaluation team. Each team developed a list of topics for the interviews. The geography team assessed flood hazards and vulnerability of farms and homes to flood. This involved both field observations and interview questions. This portion of the interviews gathered information that was essential for providing emergency relief, so this was not confidential. The second component of the interview was confidential, and involved questions for the evaluation of disaster management approaches. The team divided into four field groups, each comprised of geography and program evaluation teams. The team recorded written notes on survey forms, which were processed to prepare the various reports of the team.

At the end of the project, the team had a celebration at the Belmopan Hotel, attended by the team, staff from NEMO, and others. To remind the team of why the project was important, an early morning earthquake shook Belize. This was a 7.2 earthquake originating from near the coast of Honduras. While Belmopan experienced negligible damage, the quake did significant damage at some coastal villages in southern Belize, including Monkey River, Placencia, and Hopkins. In the Belize River Valley, the quake heavily damaged the main bridge serving Rancho Dolores.

After return to Canada, the students prepared their project report inputs, literature review, and policy analysis. This required a few drafts of each report. The reports were compiled into compendia and edited by the team leaders.

The reports were prepared with advice of the villages of the Belize River Valley and staffs of the Government of Belize. However, the reports are solely the work of the team, and offered for consideration of the Government and other stakeholders. The responsibility for all content rests solely with the team and does not indicate any policy of the Government of Belize.
Emergency Communications and Disaster Management  
(by Gene Gapsis)

Gene Gapsis has worked with special needs children for 20 years with the Qualicum School District on Vancouver Island in British Columbia, and is good at supporting learning in all types of people. She is currently pursuing a psychology degree at Vancouver Island University part time. Gene is working for certification as a HAM or amateur radio operator, and is involved with the Provincial Emergency Program of BC. She has lived for the past three decades on Vancouver Island where she raised four children. She was a member of the program evaluation group of the VIU Belize 2009 team.

The management of a disaster must be a coordinated, continuous, analytical process that addresses preparedness, response, mitigation, and prevention of risks (Poncelet, 1997). This paper addresses communications issues during the management of disasters. It considers both the technology of communication and the human aspects.

The goal of communication in emergencies and disasters to sustain physical, social, political, and economic well-being through an efficient, two-way exchange of information and appropriate response to needs as they arise. Cooperation among informal, community-based networks and more formal agencies and organizations is necessary for achieving effectiveness during both emergency and non-emergency times (Kiefer et al., 2008; Mileti, 1995).

The level of preparedness of a population and the strategies employed to maintain their lifestyle and livelihood reflect a complex interface between individuals, communities, agencies, and the environment (Salter, 1997). The early focus of disaster management on the destruction of physical capital, according to Dynes (2002), has been expanded to include a much greater emphasis on the social impacts and vulnerability of individuals, communities, and societies. Certain individuals and groups are more vulnerable to disasters than others, and have unique communications needs. As noted by Kiefer, et al., (2008, p. vii), “When disaster strikes, it inevitably tends to impact most severely the portions of the population that are least able to prepare for, respond to, or recover from its effects.”

Disaster management is increasingly focusing on social capital, which is the quality of community togetherness that makes people able and willing to work together to achieve community benefits. In disasters, communities with high social capital are able to organize and support each other in response and recovery from disasters. Social capital contributes to better outcomes because it is embedded in the norms and networks that facilitate collective action (Dynes, 2002).

“Information and the exchange of information are at the core of social capital, as is...the trust that emanates from successful exchanges” (Kiefer, Mancini, Morrow, Gladwin, & Stewart, 2008, p.12).

1.0 Communications and Stages of Emergency Management

1.1 Stages of Emergency Management

Studies on emergency communications and disaster management stress the importance of effective communications at all phases of an emergency. Reynolds and Seeger (2005) identify the phases in an integrative model they call Crisis and Emergency Risk Communication (CERC), as the pre-crisis, initial event, maintenance, and resolution stages. Quinn (2008) summarizes specific strategies during three stages of crisis: pre-event, event, and post-event. The four emergency management stages classified by Shover (2007) are mitigation, preparedness, response, and recovery. In the discussion below, communication needs at different stages of emergency management will be presented. First, issues related to communication between agencies and communities will be examined. Next, issues related to communication between emergency management and other agencies will be considered.
1.2 Principles and Strategies for Effective Emergency Communication

Effective disaster management requires effective communication at every stage in emergency management. Because of the dynamic nature of disasters, efficient two-way exchange of information is fundamental to ensuring a coordinated, real-time response to known and unforeseen circumstances in an evolving situation (Reynolds and Seeger, 2005; Page, 2008). Effective communication enhances an agency’s ability to provide effective warnings to vulnerable people, deploy resources as needs evolve, and give support to local citizens. Kapuchu (2005) states that, “In emergency response operations, leaders of responding agencies must provide effective operations across governmental units and other non-crisis organizations’ complex boundaries and problems” (p. 218).

Essential elements of effective emergency communication include:

- Clear, accurate, and credible, information from a trusted source
- Timely, complete information that is updated regularly, with explanations
- Clear and simple language in a consistent tone
- Specific description of threat and concrete examples of its potential impact
- Specific recommendations for mitigation of risk to ensure personal safety
- Sufficient information to avoid confusion, uncertainty, and anxiety
- Multiple methods of dissemination (radio, television, alarms, cell phone notification) in order to reach all parties

Given the extreme vulnerability of a region such as the Belize River Valley (BRV) to climatic variability, as well as its limited resources, multiple challenges are present at every stage of preparation and response. Strategies to make more effective communication possible include:

- Education suited to the population around potential risks
- Involvement of local communities in decision-making
- Two-way participatory feedback to facilitate useful planning, tailored to the community
- Sharing of information between responders at all levels in order to develop integrated local, regional and national planning
- Ongoing collaboration to revise plans and increase effectiveness
- Preparation of useful documents, procedures, protocols in forms that are easily understood and utilized
- Commitment to continuous improvement in the technological means to communicate
- Developing access to funding
- Ongoing information exchange to maximize planning effectiveness and avoid duplication of effort

Before disasters occur, there needs to be public education that helps members of local communities understand the risks they face. Their involvement in the decision-making process will promote a clear understanding of how they are vulnerable. This approach benefits from their historical and local knowledge (Kiefer, J., Mancini, J.A., Morrow, B.H., Gladwin, H., Stewart, T.A., 2008).

Implementation of local, regional, and national planning has to be integrated and based on principles, which reduce conflict (or duplication of effort) to a minimum (Saravanan, McDonald, & Mollinga, 2009). Also, ongoing information exchange over the post-disaster recovery period requires maximized connectivity and the free flow of undistorted, up-to-date information in order to most effectively meet multiple and overlapping demands (Hatala & Lutta, 2009).
2.0 Preparation and Mitigation Stages

During the preparation and mitigation stages, clear plans and protocols need to be established to respond to possible emergencies. Communications challenges and issues during this stage include:

- Different levels of understanding of risks and options in disaster situations
- Different vulnerabilities to the effects of disasters
- Different levels of personal capacity and resources to cope with disasters

Strategies to address these challenges include:

- Participatory processes to involve communities in planning for disasters
- Education of community members regarding risks and options
- Technologies that assist disaster management agencies in planning (e.g., identifying vulnerable populations) and education and information dissemination

2.1 Communications Issues and Challenges

Different Experiences and Perspectives

Not all individuals perceive emergencies in the same way. Because crises occur in a social, cultural, and historical context (Quinn, 2008), risk can be viewed as a socially-constructed attitude (Salter, 1997). In other words, the extent to which residents will perceive that they are at risk from a flood or other storm will depend on their past experiences, social norms and perceptions of their families, friends and communities. Risk perceptions are also affected by incoming information from other sources. It is important, therefore, to recognize how people in a given locality perceive risk when designing communication strategies. Reliance upon a single source of information, or singular frame of reference, can lead to inappropriate action at any level (Weick, 1985). In an emergency, the actual victims act as first responders, prior to the arrival of formal help. The better prepared they are for emergencies, the safer they will be until outside help arrives.

Participation of all stakeholders in emergency planning, before emergencies occur, is critical. In the planning phases, trusted partners can help develop an effective communications plan (Quinn, 2008), focusing on meaningful dialogue around risk and management interventions. It is an inherently political process calling for an open, democratic atmosphere. The research project, Providing Access to Resilience- Enhancing Technologies for Disadvantaged Communities and Vulnerable Populations (PARET), confirms that relationships of mutual respect and collaboration must be in place before any tool or system will be effective (Kiefer, et al., 2008). This research also discusses “leverage points in community networks” where collective activities can increase the potential for change, bringing people closer to desired outcomes (p. 16). A community’s resiliency is built into its connectivity (Kiefer, et al., 2008) and the extent of effort for change influences the likelihood of success. Recognition of the need for change is the first step in this process.

Challenges in Communities

Communications in the Belize River Valley are difficult because not all residents can be easily or effectively reached in the various stages of an emergency. Thus, resolving communications challenges will require creative solutions and participation and contributions from all stakeholders. According to Quinn (2008), community-based participatory research can identify community concerns, the government’s response, and communications issues. In the pre-emergency stage, community members can work together with government officials to address such issues as how to get warnings and thus avoid isolation by flood waters; developing knowledge of the risks from disease and dangerous animals; gaining access to potable water and food, sanitation, shelter, or medical care; and other issues. All of these issues require collective competence that can only be established through communication over time (Kiefer et. al., 2008).
Need for Knowledge and Information before a Disaster Occurs
Prior to an emergency, a public consultation process can identify the unique characteristics of a community and pinpoint those areas most vulnerable to environmental events. Understanding the economic livelihoods of the community will help prioritize strategies to support the differing financial needs of the residents. When villagers learn about the potential for harm for failing to heed warnings, they are more likely to prepare for the emergency or evacuate in a safe, timely, and efficient way. Villagers need to know about the different types of storms, the standardized system of warning used by NEMO, the location of shelters, and opportunities to volunteer and participate in the community’s response to flooding and storms. When volunteers are identified and trained in advance, teams of villagers will be ready to act when needed. These preparations will build a stronger community and a greater sense of security in the face of impending hardships.

While communications equipment is important, it is the networks of people at the local level that form the foundation of good communication. These networks evolve through people coming together informally and building friendships and trust. These networks must be inclusive of all members of the community. Otherwise, some households may be isolated from community participation and supports and will not be reached easily in the early stages of an emergency. Positive informal networks can influence one another’s behaviour, e.g. to seek shelter, evacuate, to heed other warnings, or to come to the aid of the vulnerable. “The success of community resilience lies in the collective partnership of people, social networks, and available tools” (Kiefer, et al., 2008, p. 5).

The Importance of Mutual Trust and Understanding
Research has shown trust is particularly important under challenging circumstances where people feel they have little personal control over their exposure to potential hazards (Frewer, 2004). Many factors play an important role in the effectiveness of technology. Effective communication networks established prior to a crisis can help overcome distrust within the community as well as any toward government or other outside agencies. When communities and disaster agencies understand how neighborhoods, towns, and regions relate to each other, they can determine how easy or difficult it will be for individuals and families, communities, and the district to come together in an emergency, rely on each other, and communicate essential information to one another when needed (Kiefer, et al., 2008). The most dynamic networks are built on trust and mutual exchange.

Hydrologic Early Warning Systems
Hydrologic early warning systems can be a low-cost alternative for decreasing the interval between alert and event (Douglas, E., 2003). The establishment of rainfall and water level measuring devices in a watershed can provide information to community based response teams, allowing critical decision-making and mobilization time. While there is widespread acknowledgement of the need, national initiatives for such planning and implementation within river basins are relatively recent and evolving gradually (Chene, J-M. 2009). The Japanese International Cooperation Agency (JICA) is working with the Government of Belize to gather data to create a hydrologic model of the BRV in order to predict flood levels downstream. Transmitters installed in the river will link to the two cellular communications companies in Belize to provide continuous logging of water levels, although cellular coverage is not good in some areas.

“Flood and storm forecasting and warning, and dissemination of this information play a pivotal role for saving lives, property, and crops” (Mirza, M.M.Q., Patwardhan, A., Attz, M., Marchand, M., Ghirmire, M., Hanson, R., 2004, p. 346), but these systems are limited by the density of instrumentation possible and coordination of data by trained personnel, both of which depend on financial resources. The emergence of cost effective space-based technologies may also eventually prove to be a viable alternative (Hossain, F., 2006).

Skills Development in Planning Phase
Openness to new ideas, a willingness to learn, adaptability, and communications capabilities
help a community to manage its own risk (Comfort, 2001). Evidence of measurable success will include increased education, awareness, and well-designed community plans with a clear mandate that enables people to access information and participate in decision-making (Kundzewicz et al., 2002). The benefit of this cooperation is strong working relationships during periods of stability, during which trust is fostered through sharing of information, resources, values, ideas, and a willingness to collaborate.

2.2 Strategies for Communications in the Planning and Mitigation Phase

Establishment of Community Emergency Committees

Community-based response teams can help build trusted partnerships both within the community and with outside agencies. The identification and training of natural leaders can make community education easier because local residents may feel more comfortable learning from someone whom they know and trust (Lasker, 2004). Local communities will have a greater sense of ownership, responsibility, and empowerment when they participate in examining of their own vulnerability and their ability to manage risks (Salter, 1997). Residents can be given the opportunity to learn as well as contribute to the community’s disaster preparedness programs through meetings, interviews, focus groups, community forums, and other methods.

Channels of communication will be more easily activated in an emergency when the community is engaged prior to an event. Spokespersons can be identified who will be responsible for ongoing development of community awareness at the local level. Pre-established relationships within the community generate greater capacity for mitigating risks, more independence while awaiting relief from outside the community, and thus greater resiliency in the event of disasters (Quinn, 2008).

There are many options for on-going community education such as a church-sponsored events, door-to-door contact, cultural events, radio interviews about local concerns with committee members, or handouts. These and other strategies can draw isolated members of the community into an issue of community-wide importance. Creating partnerships and being visible to the media can improve access to outside resources in an emergency (Quinn, 2008).

Education through the Media

Radio communication (AM/FM/Weather) is widely available in the communities of the BRV, although battery-operated radios are not common. Television, along with radio, forms the most common information source even though dependent on electricity, which is not always available or reliable, especially in emergencies. Reaching a broad audience, television messages are powerful audio-visual teaching tools.

Mobile Telephone Contact Lists

Mobile phones can be an easy way for individuals to relay information to friends and family. As communities gain access to cell phone networks, mobile phones will play an increasing role in community connectivity. With the limited number of phones in the villages, a contact sheet of all important telephone and cellular numbers, including those of community members, will expand the reach of emergency personnel and improve emergency responses.

Community Databases

In the first hours of an emergency, communities and first responders would be greatly assisted by a comprehensive list of village emergency committee members, village chair and council, village nurse, community members with special needs or medical concerns, outlying residents far from the village core or those adjacent to flood plains. Some of this information is currently in village emergency plans, but these are often not computerized in local villages. Computerization of this information in a widely accessible database would enhance communications capacity in responding to disasters.

Community Technology Centers (CTCs)

Centers that offer education in computer technology can foster positive change and increase emergency connectivity by making information technologies more accessible to the community. By providing technology access and education, rural communities can take advantage of early warning systems and increase their communications potential.
Geographic Information Systems (GIS)
GIS technology can provide maps capable of multiple layers of information including the geographic concentrations of human vulnerability (Kiefer, et al., 2008). GIS can provide precise information about location of residents and critical facilities, reducing the time it takes safety personnel to perform rescue efforts or provide supplies or medical aid. If precise locations are mapped using GPS technology, responders can easily find locations at night or during a flood, when landmarks are inundated and not visible.

311 systems
A 311 system is a dial up telephone system that can be used to link citizens with resources available through government offices. By dialing 311, an individual can receive information about shelter locations, evacuation routes, and emergency social services. However, people are required to register in advance for such a system. The aged or more vulnerable individuals may need help registering in such a database and using the system (Kiefer, et al., 2008). In addition, not everyone in potential disaster zones has access to a telephone or cell phone. Nonetheless, this is an important tool for disseminating warnings.

3.0 Strategies for Response and Recovery Stages
Risk management is ‘the systematic application of management policies, procedures, and practices to the tasks of identifying, analyzing, assessing, treating, and monitoring risk’ (Salter, 1997, p. 25). Crisis management does not follow automatically from risk management and disaster planning. Research has shown that successful disaster management results primarily from the activities of emergency organizations (Quarantelli, 1988). The most productive activities require an effective communications process, the exercise of authority, and the coordinated exchange of vital information among stakeholders about the nature, magnitude, significance, or control of risk (Reynolds & Seeger, 2005). During the response phase of disaster management, personnel are deployed, protocols are implemented, and communications between the affected community and outside agencies may or may not exist. Communications challenges during this phase include:

- Difficulties with access to, understanding, and interpretation of messages (such as warnings)
- Urgency and the need for timely communication of threats and options
- Storm-related breakdowns in communication channels
- Dynamic and constantly changing circumstances requiring flexibility
- The public need for confirmation of warnings and other information

Strategies to address these challenges include:

- The use of multiple channels of communication
- Warning systems easily understood by all levels, e.g. pictorial
- Opportunities for two-way communication (to facilitate understanding and clarification)
- Technologies that ensure that information is received

3.1 Communications Challenges and Issues

Need for a Timely Response
With the onset of a crisis, the immediate threat and a compressed time frame require direct and timely response (Reynolds & Seeger, 2005). As noted above, the actual victims act as first responders, prior to the arrival of formal help. Organized, practiced procedures will lower stress and increase the efficiency of the response, especially if a systematic structure is in place. Responders will be able to respond more effectively and with less stress to emergency task demands within a pre-determined system. Multiple communications between groups will be easier to trace in a vertically structured organization, but on-the-ground decisions will often be the product of sound initiative on the part of well-trained people.
Some Residents are at Greater Risk
Some residents more communication options such as land lines, cell phones, computers, and Internet, radios, and television, whereas others have access to few or none of these. Additionally, some residents have a greater social network of friends and family who can keep them informed. On the other hand, socially isolated individuals and families are less likely to be rescued, to seek medical help, to take preventative action such as to evacuate, or to receive assistance from others in the form of shelter (Dynes, 2002).

Channels of Communication may be Compromised
In some disasters, channels of public communication are compromised, requiring alternative means of sending information. Communications systems may be vulnerable to structural damage, and overload.

The problem with communication - that’s the number one issue in any disaster event, communication always fails (Agency interview, 2009).

Anything to increase the connectivity of the community will contribute to disaster mitigation. The immediate communication needs in an emergency are to reduce uncertainty, allowing residents to create a basic understanding of what happened so that they may act appropriately.

If communication among members of a community is limited, some residents may be cut off from the rest of the population and relief supplies. This may lead to unnecessary and tragic consequences. In some villages, communication with isolated residents may be by boat. Practically, this means the risk of another life in a dory traversing a raging river.

Receipt and Interpretation of Warning Messages
According to Mileti (1988), public reaction to emergency warnings is more involved than a simple stimulus/response reaction. As a social psychological process, warnings must be designed to produce the desired responsive actions. This means overcoming habituation, selective listening, and listener bias. Well-designed warnings impart an understanding of the hazard, cause the listener to attach personal meaning to it and to believe in its accuracy and severity (Mileti, 1988). Effective warnings are best received from a credible, reliable, and trusted source. If given with a solid sense of certainty and supported by probabilities and facts, this tone will help dispel confusion and anxiety.

Need for Two Way Communication
One of the most basic problems in information transfers between organizations and the public, according to Quarantelli (1988), is “what is meaningful information to organizational personnel is not necessarily useful to endangered persons” (p. 77). Training and pre-planning can identify what details will be of greater relevance locally, but the flow of information during a crisis is more variable and “…there may be an ongoing shift in decision-making points” (p. 378).

Two-way communication during times of disaster is critical. Access to warnings, isolation by flood waters, risks from disease and dangerous animals, lack of potable water and food, sanitation, shelter, or access to medical care – all require two-way communication. Without a means of communication to connect affected individuals, they must rely on personal resources and efforts, which may be minimal if warnings have not been received early enough. “Risk communication,” according to Reynolds and Seeger (2005), “is closely associated with threat sensing and assessment” (p. 45), and a two-way exchange can reduce generalized anxiety and prevent actions that might increase harm.

Other factors include: levels of confidence in government leaders (Lasker, 2004), the ability of affected residents to take action, the level of resources available to citizens and their suitability, the number of times people have been subject to “false alarms,” as well as the number of times they have “successfully” survived by choosing not to evacuate in previous disasters (Kiefer, et al., 2008).

The characteristics of those receiving warnings such as their setting, social ties, demographic differences, values, and psychological predispositions must be considered when designing warnings (Mileti, 1995). These messages must be matched to the audience’s culture, language, and experience and provide
specific descriptions of the hazard as well as specific harm-reducing strategies (Alcantara-Ayala, 2004; Alcantara-Ayala, Lopez-Mendoza, Melgarejo-Palafox, Borja-Baeza, & Acevp-Zarate, 2004; Shover, 2007; Reynolds & Seeger, 2005).

Those receiving warnings also try to get confirmation and additional information from sources other than the one from which they received the initial warning (Lindell, Prater, & Peacock, 2005).

4.2 Strategies to Improve Communications in the Response and Recovery Phases

Design Effective Warning Messages

As discussed above, people will not necessarily hear warning messages as they are intended. Warning messages must be designed to communicate in accurate, credible, timely, and reassuring ways in order to induce behaviour change that can alleviate the threat (Reynolds & Seeger, 2005). The challenge is to communicate in accurate, credible, timely, and reassuring ways in order to induce behaviour change that can alleviate the threat (Reynolds & Seeger, 2005).

Provide Multiple Warning Systems

Because access to telecommunications is very limited in the BRV, communications capacity may be limited in the early days after the disaster response effort has begun. In rural areas, other means of relaying warnings must be found. In the absence of radio broadcasts, sirens, alarms, whistles, air horns, even historically utilized blasts on a conch shell can all serve to alert dispersed communities of impending risk as long as residents understand in advance what the signal means (Mileti, 1995).

Because communications networks can be damaged in a disaster event, multiple redundant means of communications should be utilized (Samarajiva, 2005), but there is also the potential for delay or loss of information when mobile phone circuits, SMS, and phone trees overload the system. Multiple options may become available, such as cell broadcasts to subsets of customers, satellite-based radio systems, and remotely activated alarms on phones or even church bells (Samarajiva, 2005).

Repeat Messages Frequently

Regular repetition of authoritative information will further reduce rumours and increase public confidence. There is an ongoing need for two-way exchange of important information, concerns, and reactions to the events and previous communications in order to make further decisions (Mileti, 1995).

Information and Telecommunications Technology

Telecommunications systems often become overloaded during a disaster. Cellular technology is also vulnerable to the loss of cell towers, but it is becoming one of the most familiar means of reaching people during a disaster. Especially for individuals in the community, text messages or Short Message Service (SMS) will use less network capacity and can be queued in times of heavy traffic. In order to reach the most economically disadvantaged members of a community, government officials could work with cell carriers to arrange cost-free additional minutes and text messaging pre- and post-disaster (Kiefer, et al., 2008).

Priority Access Dialing

Telecommunications companies and disaster managers should agree on a list of essential numbers that should be reconnect first in the event of an outage. This will facilitate priority repairs and access to aid the response effort.

Emergency Call Alert Systems

As more persons carry cell phones, emergency response agencies can develop emergency call alert systems. When a community-wide emergency is happening or expected, authorities can use an automated calling system to deliver warnings and alerts to all telephones in the system. This requires that residents register their phone where they live and where they work. This allows warnings to reach everyone with a phone and everyone they give the warning to. The technology for emergency call alert systems is available “off the shelf.” This technology would require cooperation of telephone and cellular companies.

Disaster managers may also be able to use Reverse 911 targeted message systems global positioning system (GPS) equipped cell phones
to reach vulnerable populations within a community. This system could disseminate warnings or other recorded messages and places emergency location capability in the hands of everyday users (Kiefer, et al., 2008).

**Automated Call Centers**
To centralize the flow of information and relieve pressures on staff, a call center could be established at the district level to coordinate incoming information. By establishing one number that people could call to report conditions that are threatening, an automated 24-hour call center could direct the information to the appropriate agency or EOC. Short message service (SMS) and email could also be relayed to the call center and redirected, lessening the time between information being gathered and warnings being relayed (Samarajiva, 2005).

**Dedicated Emergency Broadcast Network**
A nationwide emergency communications network could be established to handle all official emergency notification and information. With battery backup, such a radio station could transmit without interruption. It is also in the national interest to provide credible safety assurances to tourists through a national warning system (Samarajiva, 2005).

**An Incident Communications System (ICS)**
A consistent communications protocol utilizes common terminology across all disciplines, according to Shover (2007), and integrates internal and external communications. Additionally, a hosted service could create a central point for information access and exchange of updates regarding affected areas that would also build public confidence by fulfilling their right and need to know in order to make informed choices (Reynolds & Seeger, 2005). The pressure on emergency management personnel would also be lessened. The emergency management agency could also assign staff to the news office of major news medics, providing a human face to the disaster response team.

**UHF and VHF**
Ultra-high frequency (UHF) and very-high frequency (VHF) radios have a range that is a function of the transmitter power, the type and location of antennae, the actual frequency used, and the length of the cable connecting the radio to the antenna (Dubendorf, 2003). These radio transmissions are affected by obstructions such as hills, buildings, or dense forest. The range, known as “unobstructed line of sight” varies with conditions. The higher the frequency, the lower is the penetrability.

**HF**
Medium to long range communication is possible with high frequency (HF) radios. Remote radio base stations could be used for more widely dispersed residents of communities without infrastructure or telecommunications capabilities. HF is less sensitive to terrain but can be affected by atmospheric conditions. Community low-power broadcast stations can be used for effective targeted dissemination of emergency communications.

**General Mobile Radio Service (GMRS) and Land Mobile**
Similar mobile radio frequencies are relatively low-cost and have an extremely short range but could provide two-way radio communication in relief efforts.

**Citizen Band (CB) and Family Radio Service (FRS)**
These groups can provide close proximity mobile service within communities as a low cost, low power, unlicensed option providing close proximity, line of sight radio frequencies on mobile or handheld units.

**Alerts and Warnings through Community Contacts**
Warnings may also be sent through intermediaries such as churches (Samarajiva, 2005), with pre-existing community contacts which also act, in some cases, as emergency shelters.

*Information packages* for residents without power or communications devices can also be distributed with damage assessment teams entering communities (Davis, et al., 2007). The most comprehensive communication network in an emergency combines formal and informal networks. Especially at the community level, the informal network represents a significant independent source of information not
as easily accessed by government and non-government agencies (Hatala & Lutta, 2009).

Reliance on technology as ideal communications tools may overlook some of the more fundamental problems which limit their effectiveness. In isolated and subsistence communities, communications technology may not always be available, affordable, or accessible to all populations. Also, cultural and educational characteristics may limit desire to embrace technology. It will take time for technological emergency systems to be implemented and accepted (Kiefer, et al., 2008).

4.0 Evaluation of Communication Effectiveness

Post-crisis communication is characterized by a focus on evaluation of the tactical response and how well it met objectives (Jaques, 2009). Through an assessment of how, why, and when demands were resolved, communities and agencies acquire new learning, better understanding of risks and risk avoidance (Reynolds & Seeger, 2005), and utilize the recovery phase for proactive planning for future events. Pre- and post-crisis stages can be viewed as part of a continuous loop, rather than as separate stages in a linear model (Jaques, 2009). It is most often during the post-crisis period that effectiveness of established procedures is questioned, especially by the media and the public.

4.1 Community Communications

Challenges

Probably the greatest post-disaster challenge is to maintain focus on risk reduction and capacity building in non-disaster times. Acquisition of cost-effective communications technology, recruitment of volunteers, and development of communications networks are all pressing commitments that must vie for money and attention with other social issues. Pressures to return to normal responsibilities can stall or prevent real change.

Improving Community Communications

Ongoing communication among all stakeholders about risk and its acceptability is important for resolving issues of vulnerability and social responsibility (Salter, 1997). Kiefer et al. (2008) argue that

...Information technology is the critical subsystem within an interdependent network of social, political, and technological systems that can increase community resilience. It plays a key role at the various leverage points where formal and informal community networks interact (p. 21).

Disaster agencies can use the post-crisis period to discuss emergency procedures and carry out additional training of stakeholders. It is a time to develop materials that reflect lessons learned, enhance communications channels, and develop new partnerships or improve old ones. Further development of working relationships with existing community-based organizations such as churches and sports groups as well as increasing media exposure, door-to-door outreach, and in-school programs will build stronger, more resilient communities interested in being part of the emergency response network. Through ongoing sharing of current, accurate information regarding the status of the community and the actions of participating relief organizations, agencies can work together to achieve the overall goals of protecting the community and restoring its functionality (Comfort, 1999).

Community members will make positive changes if they feel responsibility for the well-being of others, which is the essence of building community capacity and social capital. Capacity is increased the more community members experience working together in ways that improve community life. The PARET study sets out important guidelines for selection of technology (Kiefer, 2008, p. 17):

- Technologies selected should be those that are most readily deployable to vulnerable populations.
- Technologies selected should use an all-hazards approach
- Technologies selected should have some degree of utility throughout all four phases of a disaster (planning, preparedness, response, and recovery)
• Technologies selected should be able to involve the three tiers of emergency response: local, district, and national.

The authors continue:

Information becomes a powerful element in the process of community members connecting, especially if its companion reciprocity becomes the norm. Critical to these community processes are the technologies that facilitate the speed, clarity, and comprehensiveness of the back-and-forth flow of this information (Kiefer, 2008, p. 17).

4.2 Interagency Communication

Challenges

Good management of community disasters is encouraged by planning that is not too agency-specific and which takes into consideration relevant social factors (Quarantelli, 1988). Public, private, and nonprofit organizations can cooperate in developing communication and mobilization capabilities that enhance connectivity and avoid isolation of response agencies from one another. The political will to establish these capabilities recognizes the devastating costs, locally, regionally, and nationally, of being unprepared (Kapuchu, 2009).

Overloaded or failed telecommunications systems may result in loss or delay of information in disasters. This can result in responders doing jobs other than their assigned tasks, loss of supervisory staff, or duplication of work by several staff. The most efficient channels of communication are those based on established relationships and inter-departmental or inter-agency familiarity. Such relationships are difficult to establish and maintain in the midst of an emergency (Quarantelli, 1988). “Hierarchies,” according to Kapuchu (2009), “generally perform badly in emergencies because if... top nodes fail, they isolate large networks from each other” (p. 208).

While a clear chain of command is more efficient in the response phase, in many situations decentralized decision-making may become more appropriate especially in response to new or unexpected tasks (Quarantelli, 1988). Generally, information flows from the primary sources at the national level, through intermediate departmental links to the receivers in threatened communities (village chairperson, council, or emergency response committee).

The four basic functions which must be fulfilled during a crisis are emergency assessment, hazard mitigation, population protection, and incident management (Lindell, Prater, & Peacock, 2005). Multiple agencies are collecting, collating, and communicating data, and information sharing between and among members of these organizations needs to be encouraged (Hatala & Lutta, 2009).

Improving Interagency Communication

Sharing Information

The social environment of organizations creates the context in which information is handled and decisions are made. Effective management creates healthy working alliances. Hierarchical structures often seek to control of specific types of information. However, agencies are better prepared for emergencies when there is a commitment at every level to share information with other levels.

When multiple organizations are involved, any sensitivity to protect agency “turf” limits the flow and access to information (Salter, 1997, p. 63). This leads to failures to “connect the dots” as happened in the Katrina debacle. Responders should be committed to reducing social and economic impacts rather than the preservation of their image or influence (Hatala & Lutta, 2009). This will speed the recovery process and leave a positive and hopeful attitude in the community and society.

Local, regional, and national emergency response networks are essential to the coordination of emergency responders. Without communication, individuals and groups are not able to gain an overall sense of what has happened and what must be done next (Scanlon, 1994). Ideally, there is a high degree of coordination among clusters of groups working in the same or similar conditions, facing similar problems and tasks. Without interagency communication, this coordination may not extend beyond one group (Quarantelli, 1978).
Often partner agencies fail to include disaster recovery planning and post-crisis management strategies in overall goals (Jaques, 2009), so they return to their normal responsibilities after a disaster. Adequate staff, time for consultation with other departments and agencies, and funding will need to be identified to maintain readiness of partner agencies. Jurisdictional boundaries are frequently crossed during emergencies and any unresolved or vague overlaps of authority and responsibility that became apparent at the height of the response efforts will need to be clarified (Quarantelli, 1988). He also points out a consensus must be reached on the meaning of coordination in order to reduce resistance and move forward.

Encouraging Initiative

Loosening the command structure, especially in hierarchal organizations, according to Dantos and Seville (2006), alleviates potential overload during emergencies, reduces rigidity and information sharing barriers, increases efficiency, and makes the organization more adaptable to sudden changes in the environment (Barua, Ravindran, & Whinston, 2007). These benefits must be balanced with very clear lines of authority that maximize efficient access to resources and minimize duplication (Shover, 2007). Especially in emergencies, there are considerably greater efficiencies in response times if pre-determined communication protocols are developed in advance through consensus. Yet even when established protocols and plans are in place, relief personnel and agencies should be prepared and trained to create “just-in-time” policies (Davis, et al., 2007, p. 25). Not everyone will listen to television or radio and hear the official warnings, so social capital becomes an important element in effective action (Dynes, 2002).

Exercises and Drills

Exercises and drills are essential for identifying gaps in preparedness plans and strengthening agency and community relationships.

Those public health systems that invest in a variety of capacity-building activities and test functional capabilities in real-time, emergency conditions will be better able to achieve the preparedness goals to mitigate mortality, morbidity, and the social consequences of the disaster (Davis, MacDonald, Cline, & Baker, 2007, p. 25).

Emergency conditions will undoubtedly be complex, and people involved may be geographically dispersed and resources scarce (Artman, 1999), such as in the Belize River Valley.

Avoid Duplication of Effort

Duplication of effort is inefficient and can delay or fragment emergency response efforts. Assessment of the needs of persons in distress is often carried out by multiple agencies and sometimes different departments of the same organization. Duplication of needs assessments by different agencies can result in uneven distribution of relief, causing bitterness and hardship for some community members. Agencies need a system for sharing information in order to achieve timely, effective, and equitable response activities (Salter, 1997).

Interoperability among Systems of Organizations

Interoperability refers to the ability to communicate using common language and systems to promote flexibility and coordination. Communications during an emergency pose multiple challenges inherent in the continually changing conditions and the involvement of multiple levels of organization in numerous agencies.

Multiple public, private and non-profit groups such as churches, international aid agencies, and private volunteer groups may converge upon the disaster zone creating logistical challenges for disaster management personnel. Together they monitor and report information and relay warnings, extending the scope of primary information networks (Lindell, Prater, & Peacock, 2005). In some instances, information is more trusted when it originates from within one’s social network, such as the extended family or church (Eisenman, D.P., 2007). “A well-coordinated inter-organizational network will serve the betterment of individuals, organizations, and society in emergencies” (Kapucu, 2006, p. 211).
While full interoperability is hard to achieve. Large investments in communications hardware and systems will not always resolve the apparent lack of compatibility between police, fire, ambulance, emergency command centers, community-based response teams, medical services, utilities providers, marine users and emergency shelters (Kapucu, 2006; Mycoff, 2007; & Samarajiva, 2005). Factors promoting interagency communication include a willingness to share, adequate training, trust, education, human relations, concern for public value, a common interest, experience, communications skills, previous communications, common priorities, flexibility, technology, and leadership (Kapucu, 2006). Greater cooperation and cooperation in an emergency depends on work before an emergency to establish communications contacts and relationships. Connectivity can only be achieved when every level is attuned to providing communication to other levels (Johnson, 2000).

**Combined Events Frequency**

A combined events channel may be a way to link and share real time information and provide the most coordinated response. Because it is not possible for all support agencies to communicate on a single frequency, the fact that emergency responders each operate on their own frequency and bandwidth, and the barriers and delays this creates, would support establishment of a call channel similar to that utilized by the Coast Guard internationally. This involves using a dedicated channel for emergency messages and initial contact, with longer conversations moving to other channels. Creation of a combined events channel would increase communication between agencies but would require adequate training for personnel.

**Amateur Radio Operators**

HAM radio operators communicate on all frequencies and bandwidths. Because of this, they can provide a possible source of connectivity “when all else fails.” These private operators form a world-wide network and can be called upon to maintain lines of communication especially during the first 96 hours of a disaster, until regular communications are restored. Cost can be a barrier to establishment of HAM operator stations.

**Emergency Operations Command (EOC)**

*A central command structure* is needed to coordinate the division of responsibility of different agencies that know their individual role in an emergency (Scanlon, 1994). The deployment of personnel for surveillance and assessment, support to shelters, and provision of relief and supplies are all best coordinated through an EOC which can provide a high level of coordination. It should be staffed 24/7, preferably in three shifts. It should have access to an updated database of all contact numbers for emergency personnel and agency contacts (Davis, et al., 2007). If a collaborative approach is followed in the pre-emergency phase, solid relationships will be built and confidence and trust will form. This will simplify deployment of effective disaster response teams. Through a modular, responsibility-based structure, resources are managed and duplication is avoided (Shover, 2007). Consolidated action plans, which document the function, goals, and objectives of partnering agencies, provide a single point of contact (Davis, et al., 2007) for continually updating and coordinating planning. While the EOC will provide coordination among clusters of organizations working together, it may not extend to groups beyond that cluster (Quarantelli, 1978). The proximity of CEOs responsible for specific response sectors encourages the sharing of information and discussion of options.

The EOC can become a stressful environment as crisis conditions unfold and lines of responsibility overlap.

To avoid overloading of communications lines, a dedicated communications base can support a hot line to answer questions and stop rumours, and maintain the integrity of emergency response communications.

**Viable emergency plans** build quick and effective responses to emergency situations when time for deliberation is at a premium. The dynamics of emergency response require continuous feedback, at the heart of which is reliable exchange of information which may run counter to hierarchal organizational structure during routine times (Kapucu, 2006).
Summary
A sustained commitment to multiple modes of communication can achieve effective coordination of effort across all layers of emergency response. Local communities and agencies responding to disasters must jointly engage in developing community emergency response plans. These plans should respond to the unique characteristics of the community and its residents. Sharing of information and effort between government, non-government agencies, and faith-based communities is essential to successful mitigation of hardship for affected individuals. A broad, non-political, humanitarian focus to collective efforts in such circumstances will maximize access to relief and obtain the most benefit from the human resources available. Communication needs do change over the stages of disaster response. In order to build resilient communities, relationships based on trust and fairness must be developed and maintained in non-emergency times as the best defense against natural or man-made disasters.

References


Mitigating Physical and Psychological Health Effects
(by Jacqui Jones)

Jacqui Jones is a psychology student at Vancouver Island University. She is considering a career in medicine. She was a member of the program evaluation group of the Belize 2009 Field Team.

Hurricanes and floods have played key and devastating roles in Belizean history and have been a key factor in the establishment of the National Emergency Management Organization (NEMO). The medical and psychological effects of these natural disasters can lead to major health crises within the country. The nature of hurricanes and floods is that of destruction. With destruction comes a sense of loss, grief, trauma and fear. In addition, the public health consequences associated with tropical storms and flooding include storm-related mortality, injury, infectious disease, psychosocial effects, displacement and homelessness, damage to the health-care infrastructure, disruption of public health services, transformation of ecosystems, social dislocation, loss of jobs and livelihood, and economic crisis (Shultz, J., Russell, R., & Espinel, Z., 2005).

Psychological Effects and Flooding

How are post traumatic stress disorder and hurricanes/floods related?

“Exposure to traumatic events that threaten or cause extreme physical harm” can lead to the psychological affliction known as Post Traumatic Stress Disorder (APA DSM-IV, 1994). Norris (2001) states that in 130 samples comprised of 50,000 individuals who experienced 80 different disasters, 62% of which were natural disasters, that 65% of the samples suffered from PTSD. With staggering numbers such as these it is important that health officials recognize the potential for PTSD in disaster situations.

According to Rhoads, Pearman & Rick (2007), one out of every three people who experience a natural disaster will also experience symptoms of PTSD. Their research into PTSD found that individual’s ability to cope with stress and their level of vulnerability has a direct relation to the severity level of PTSD that one may suffer.

Rhoads, Mitchell & Rick (2006) talk about the reasons vulnerable populations are more likely to suffer from PTSD. There is evidence that poor populations are more susceptible because they are less able to leave or abandon their property. People in developing nations are more likely to suffer because their socioeconomic status is lower which makes them more vulnerable.

Death is another reason for trauma.

It should be recognized that substantial mortality is a common attribute of disasters that occur in the developing world, where housing quality and warning systems are often inadequate by U.S. standards (Norris, Perilla, & Murphy, 2001).

Findings also show that women, young people, and people with low socioeconomic status were at comparatively high risk of anxiety-mood disorders... Socio-demographic variables (predictors) that estimate anxiety-mood disorders: Age less than 60, female, education less than college graduation, low family income, ‘other’ pre hurricane employment status (largely unemployed and disabled), and being unmarried (Galea, 2007).

Another interesting comparison is the variability between the different ethnic populations.

Ethnic differences in PTSD prevalence were noted following Hurricane Andrew, with the highest rates being found in Spanish-prefering Latinos (38 percent), intermediate levels in African Americans (23 percent), and the lowest rates in Caucasians (15 percent) (Shultz, J., Russell, R., & Espinel, Z., 2005).

These results were linked to those who suffered from loss of homes and property and were strongly related to depression and distress in individual’s sufferings.

What are the effects of trauma on individuals?

Whether trauma affects a whole family or a single member, the entire family endures the
traumatic aftermath, and the primary parenting functions of protecting, loving, and teaching become disturbed. Trauma stops the developmental clock (Allen & Bloom, 1994), producing relational growth impasses in the traumatized family, just as it does in the individual. Trauma disrupts attachment bonds and severs important internal and external family connections. Dangling without the support of its own members and blockaded from emotional nourishment from the outside, the family becomes unable to adequately provide the safety, affect modulation, and education that its members require.

Community leaders and teachers notice how eerily quiet the children are and may be thankful given the adults' own level of distress, that these children seem to be "taking it" so well. However, the unnatural inhibition of children's normal spontaneous activity is usually an indicator of a great deal of underlying turmoil. In other cases, children's distress is more evident, showing clinging, crying, and behavioral regression. In addition, the distress of parents, teachers, and other adults usually spreads quickly to children and increases their fear and disorientation. The stresses on families include persistent post disaster problems of lost income, employment, and housing. These stresses result in increased feelings of powerlessness and loss of control, which often lead to increased rates of child and spouse abuse.

**Programs and Treatment Methods for Post Traumatic Stress Disorder**

Miller talks about the importance of interventions with parents and families should be directed at assisting the child to regain a sense of safety, validating the child's emotional reactions rather than discouraging or minimizing them, strengthening the sense of security and control in the family environment, anticipating and providing additional support during times of heightened distress (such as anniversaries of the event), and minimizing secondary stresses. “This is why the provision of information, education, and basic services, although not usually thought of as "therapy" itself, is often an indispensable part of improving the mental health of families after a disaster” (Miller, 1999).


This adaptation for children and adolescents involves a post crisis group debriefing that incorporates an introductory phase, in which the goals and purposes of the group are spelled out; a fact phase, in which the children each describe what happened to them in the disaster; a feeling phase, in which the children may express the emotions and reactions they have had to the crisis; a teaching phase, in which the group leader educates the children as to the nature of stress symptoms and the course of recovery; and a closure phase, in which the children are encouraged to develop some plan of action to facilitate improved coping in the future (Miller, 1999).

Johnson (1989) emphasizes that the group's sense of security and normal routine needs to be re-established at the conclusion of the debriefing. Even class debriefings, designed to help students adjust in a familiar setting and structure, can be upsetting. To the extent possible, a sense of continuity should be provided by a return to some semblance of a normal schedule of activities. After the debriefing process has fulfilled its therapeutic purpose, the leader lets the students know that the time has come to resume a normal routine.

Another CISD model of intervention for use in the schools is presented by Ritter (1994). This approach encourages schools to act proactively to establish a working relationship with CISD teams in the local community, instead of waiting for a disaster to occur and then trying to play catch-up by throwing something together. Ritter also recommends the careful credentialing of CISD mental-health team members to assure that they have the proper experience for this type of clinical work. Schools have utilized CISD team resources effectively in connection with natural and manmade disasters. Protocols for the effective use of CISD-type resources require flexibility, cooperation, and coordination of local and regional debriefing resources. They also may require additional expenditures to coordinate different groups and individuals and bring them all up to speed on such topics as trauma, death.
and dying, grief, the CISD process, and other therapeutic and psychosocial interventions.

Miller (1999) describes a family-based crisis-intervention model designed for use within one week following a disaster. Initial sessions are designed to elicit open expression of feelings and the development of rapport with the therapist. Cognitive restructuring is used when appropriate to correct distortions and irrational thinking on the part of the family members. Next, issues requiring immediate attention are identified. Communication skills are taught and social-support systems are mobilized within and outside the family. The family is then encouraged to take concrete, positive problem-solving action to create a sense of movement and progress toward goals.

Vernberg and Vogel (1993) describe a disaster-intervention protocol that divides intervention strategies into four phases.

The pre-disaster phase primarily involves incorporating mental-health services into local or regional disaster plans. Interventions in the immediate impact phase of the disaster include ensuring support for help providers at affected sites, gathering and disseminating accurate information, and making initial contact with children who have been affected by the traumatic disaster event (Vernberg & Vogel, 1993).

According to Miller (1999) short-term adaptation phase interventions include classroom strategies that allow emotional expression and cognitive processing of the traumatic events through group discussions, drawing, play therapy, and other appropriate outlets. Interventions during this phase also include family approaches such as providing information and education, absenteeism outreach, and brief family therapy. It also includes individual modalities, such as one-on-one debriefing, individual psychotherapy, and pharmacological approaches, if appropriate. Finally, long-term adjustment phase interventions include more extensive individual and family psychotherapy, as well as the use of communal rituals and memorials.

The emotional shocks of natural disasters, like hurricanes, can have long-term mental health consequences for survivors. Post-hurricane disaster research can provide insight into what best helps survivors cope with PTSD in traumatic situations and what methods can best support their ability to recover from the trauma.

**Treatment Methods for PTSD**

<table>
<thead>
<tr>
<th>United States Methods for Treating PTSD</th>
<th>Belize Methods for Treating PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friedman primary care posttraumatic stress disorder screen</td>
<td>Acute Psychiatric Unit at the Belmopan Hospital</td>
</tr>
<tr>
<td>Posttraumatic Stress Diagnostic Scale</td>
<td>Individual therapeutic work</td>
</tr>
<tr>
<td>DSM IV criteria</td>
<td>Therapeutic family work</td>
</tr>
<tr>
<td>Psychotherapy</td>
<td>Mobile clinics</td>
</tr>
<tr>
<td>Cognitive therapy</td>
<td>Outreach program</td>
</tr>
<tr>
<td>Exposure therapy</td>
<td>Crisis Intervention</td>
</tr>
<tr>
<td>Stress inoculation training</td>
<td>Pharmacological Therapies</td>
</tr>
<tr>
<td>Eye movement desensitization and reprocessing</td>
<td></td>
</tr>
<tr>
<td>Imagery rehearsal therapy</td>
<td></td>
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<tr>
<td>Psychodynamic psychotherapy</td>
<td></td>
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<tr>
<td>Group therapy</td>
<td></td>
</tr>
<tr>
<td>Pharmacological Therapies</td>
<td></td>
</tr>
</tbody>
</table>

(Rhoads, et al. 2008).

(Belize Ministry of Health, 2008)

**Post Traumatic Stress Disorder and Belize Flooding**

Epidemiological reports from the Ministry of Health showed an area of major concern is that of the mental health of people affected by the flooding.

A number of persons have been encountered who have been severely traumatized by this disaster and are experiencing mental health issues as a direct result. For example Psychiatric Nurse Practitioners (PNP) deployed to the Sittee River and Hope Creek Villages encountered over 34 patients with suffering from stress related complaints such as post traumatic stress disorder (PTSD) (45%), anxiety (21%), depression (12%). One person had a relapse of psychotic depression.
The mean age of the complainants was 33, with the youngest being 14 years of age, and the eldest, 79 years of age. Seventy (70%) of complainants were female the breakdown of these complaints is displayed in the following table.

### Mental Health Issues by Sex and Type of Complaint

<table>
<thead>
<tr>
<th>Sex</th>
<th>PTSD</th>
<th>Anxiety</th>
<th>Depression</th>
<th>Flash Backs</th>
<th>Insomnia</th>
<th>Psychotic Depression</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>9</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>33</td>
</tr>
</tbody>
</table>

Several stress-related complaints such as tension headache and insomnia were also reported via this category. This serves to reinforce the importance of the psychological support in this disaster response (Dr. Aisha Andrewin, 2008).

PTSD accounted for 45% of the mental health complaints within 72 hours post TD 16. The other mental health related symptoms are all contributing symptoms to PTSD as per the DSM IV-TR and therefore need to be carefully monitored. The Ministry of Health in Belize offers psychological support to those requiring assistance via Port Loyola Hospital in Belize City. Psychological assistance is available to residents of Belize at no cost as it is covered by the government. The Belize Red Cross also provides Stress Management and Psychological Support documents to the different communities they visit. This document gives a breakdown of the different types of stress that can be experienced during a disaster. The document also gives a variety of different exercises that can help counterbalance stress and the signs to watch for involving PTSD (Belize Red Cross National Intervention Team, Belize City, 2009).

## Health Related Illnesses and Flooding

Health related issues play a significant role in recovery and stress related to natural disasters. Edwards et al. (2007) talk about medical need in their primary care facilities post Hurricane Katrina.

The greatest medical need for displaced adult disaster victims is continuation of chronic disease care, not acute care. After 2 weeks, 44% of the evacuees eventually sought medical help, most often for chronic disease care. Many admissions were for exacerbations of chronic illnesses in evacuees who were unable to retrieve medications from their homes (Edwards et al., 2007).

Edwards talks about how countries need to have a disaster plan in place to allow for doctor’s administration of medication to patients with ongoing medical ailments. Having medications on hand is an important part of patient health and well being. Edwards said that the most common request was for prescriptions for essential medications that were left behind, such as insulin. Edwards said that the most common acute illnesses seen were for skin infections (primarily the feet), followed by vaginitis and respiratory illnesses.

According to the Center of Disease Control (2005) the most prevalent infectious diseases seen post Katrina was: skin or wound infections (15.4%), acute respiratory infection (12.1%), and diarrhea (3.5%). The most prevalent non-infectious diseases seen were: skin rashes (7.2%), heat related effects, due to mildew and wet clothing next to body heat (5%), non-diarrhea gastrointestinal (5%), renal difficulties, such as kidney stones and failure (2.1%). According to the Center of Disease Control (2005) injury due to post disaster climate is another category that causes numerous medical illnesses. The main contributors to illness as a result of injury are: falls (23%), bites/stings (15.4%), vehicle related (7.2%), intentional injury (2.1%) and toxic exposure (2%).

The Center of Disease Control (2005) also talks about epidemiological outbreaks that have not affected the USA or Canada but are prevalent in developing countries after a disaster. Outbreaks of diseases such as cholera and measles have happened after extensive flooding in developing countries. Other illnesses and factors that can result from flooding are: asphyxiation, crush injuries, drowning, Hepatitis A, hypothermia, and...
potential for leptospirosis, respiratory infections, tetanus and even death (Nursing Forum, 2006).

**Health Related Illnesses as a Result of TD 16 in Belize**

According to the Ministry of Health in Belize the most common illness suffered following the flooding was from the Cayo District.

Of the total 149 cases reported, 38.2% of these have been cases of fever and cough, followed by fever cases (14.8% of total), minor and mild injuries (13.4% of total), skin infections (10.1% of total), fever and rash (7.4% of total), watery diarrhea (6.7% of total), fever, vomiting and abdominal pain (5.4%), bloody diarrhea (2 cases), pink eye (3 cases) and 1 snake bite (Ministry of Health Flood Report, 2008).

According to the epidemiological update reported by Dr. Aisha Andrewin (2008), the most common complaints in the Belize Rural District as a result of TD 16 were:

Skin infections comprised the highest proportion of complaints, accounting for 124 cases in males (62.9%) and 105 cases in females (56.1%). Fever & cough was second highest with 29 cases (14.7%) for males and 34 cases in females (18.2%) (Andrewin, 2008).

When broken down by age group,

294 complaints (68.1%) came from persons over the age of 5 and 117 complaints (27.1%) came from persons under the age of 5; this was not given for the remaining 21 persons (4.9%). Skin infections also accounted for the highest number of complaints in both age groups, with 44 cases (37.6%) in the under 5’s, and 193 cases in those over 5 (65.6%). This was followed by watery diarrhea in those over 5 with a total of 38 cases (12.9%) and fever and cough in those under 5, a total of 43 cases (36.8.0%) (Andrewin, 2008).

According to the Ministry of Health (2008), in the communities of May Pen and Flower’s Bank (15 complaints) and Lemonal (54 complaints), the main complaint was that of rashes and skin irritation. All three communities also had complaints of fever or fever and cough. In Rancho Dolores the main complaints were those of fever and cough (26 complaints), followed by skin infections/rashes (10) and watery diarrhea (5). All of the communities also experienced a substantial number of “other respiratory” ailments resulting from TD 16.

A large number of persons had respiratory symptoms such as cough & cold and sore throat in the absence of fever. The range of diagnoses given to these complaints included cough, common cold, sinusitis, pharyngitis etc. (Andrewin, 2008).

According to the MOH (2008), May Pen and Flowers Bank had 26 reported cases which accounted for 16% of their population; Lemonal had 25 reported cases which accounted for 15% of their population; and Rancho Dolores had 16 reported cases which accounted for 10% of their population.

Overall, according to the Ministry of Health (2008), skin infections were the most dominant occurrence across the Belize River Valley with 43% of the reported illness cases. The skin infections were expected to last as long as the flood waters did and the infections were “predominantly fungal with 4 cases of scabies reported and about 10 cases classified as bacterial” (Andrewin, 2008). Skin infections were followed closely by respiratory complaints which accounted for 40% of the complaints. These were expected due to the moistness caused by the floods. The MOH was also prepared for other resulting illnesses due to the conditions being perfect for the proliferation of mold which can lead to exacerbation and/or triggering of asthmatic attacks. Vector-borne disease such as Malaria & Dengue now come to the fore as major threats at this time as many stagnant flood waters remain on the ground in most areas. Leptospirosis through rat infestations should also be borne in mind if garbage disposal is improper (Andrewin, 2008).

**Conclusion**

All research shows that managing a disaster situation is a heavy burden on any country. Mental and physical health issues play a substantial role in recovery and well being of persons within the communities affected. It is imperative in post-disaster situations to move quickly, utilizing previously established protocols for obtaining effective and efficient health services for communities affected by future disasters. It is also important that agencies and
governmental organizations work together to form a uniform distribution of both medical and mental health facilities to give the communities and country the best care possible.

References


A baffling aspect of natural disasters is that some residents choose not to evacuate their homes, even after authorities issue orders to do so. Why do certain individuals choose to stay in an at-risk area when their lives are in danger? This is a perplexing psychological phenomenon that seems to have many elements. By identifying those at risk for not evacuating, strategies can be implemented that address the identified evacuation issues, and in turn, provide access to the resources necessary to execute a successful evacuation. The literature on this topic provides a wide range of explanations for why people do or do not evacuate.

1.0 Models of Evacuation Behaviour

Some authors have identified various factors relating to evacuation behaviour and conceptualized these factors into models. Gershon, Qureshi, Rubin, and Raveis (2007) developed a model to help understand behaviour specific to high-rise evacuation. This model identifies individual, organizational, and environmental factors involved in the initiation of evacuation. Sorensen, Vogt, and Miletí’s (1987) model highlights demographics, social ties, risk sensitivity, perceived threat, and situational characteristics as important factors. The Citizen Corps (of America) used the Extended Parallel Process Model and the Stages of Change/Transtheoretical Model as a basis to develop their own Personal Behavior Change Model for Disaster Preparedness. This model focuses on “personal motivation factors and identifies ways to target individuals based on their motivation for, or perceived barriers to, preparedness” (Citizen Corps, 2006, p.2).

Each of these models presents a way of looking at and predicting evacuation behaviour based on various factors and motivations. The key elements in influencing evacuation as put forth by these models are: individual factors relating to general demographics, prior experience, physical ability, culture, trust in government, and religion. Knowledge, awareness, and perception of threat are indicated as contributors to personal preparedness. One’s personal factors are then influenced by the specific situation, environmental cues, and social cues.

2.0 Process of Evacuation Response

Current literature shows that a main reason people state for having decided against evacuation is that they were confident in the safety of their homes and they did not see the hurricane or flood as a threat (Baker, 1991; Riad, Ruback, & Norris, 1999; Nozawa, Watanabe, Katada, Minami, & Yamamoto, 2008). This confidence could stem from previous experiences in which their home was never damaged by a storm or reached by flood waters. Many people also feel that if flood waters do reach their home they can relocate to the second floor and will be fine (Nozawa et al., 2008).

Protection motivation theory states that one’s response to a message is dependent on the perceived magnitude of the consequences of the event, the probability of these consequences, and the value of the recommended response (Beck, 1984). If information is high on each of these components protective motivation will be high, but if any one of these is low protective activity will be less likely (Beck, 1984). For example if the probability of severe flooding is low or the perceived magnitude of the consequences is low, it is likely the resident will not evacuate. Work by Riad et al. (1999) also refers to protection motivation, stating that the results of their study are consistent with the theory.

Wilson, Temple, Milliron, Vazquez, Packard, and Ruby (2008) mention that many people view floods as “predictable periodic phenomena, instead of probable random phenomena…and
believe if a major flood disaster occurs in a certain year, no major flood disasters will occur for some time after” (p.3). In fact, the probability of these events is the same every year, and large floods can occur in consecutive years. This lack of understanding of the unpredictability and destructive magnitude of storms may give people a false sense of safety in times when they should be on alert.

3.0 Factors Associated with Evacuation Behaviour

3.1 Personal Factors

Demographics
Although many studies of evacuation behaviour look at demographics as a possible predictor, there is usually found to be no significant association between age, marital status, occupation, presence of children in home, or education levels and response (Baker, 1991; Burnside, Miller, & Rivera, 2007).

Resources
Inadequate social or economic resources are another reason people may choose not to evacuate (Riad, Ruback, & Norris). This could include lack of transportation or lack of a place to go (Baker, 1991). Many people, who stated they have nowhere to go, may not consider evacuating to a shelter an option. In a survey conducted by the Harvard School of Public Health (Blendon, Buhr, Benson, Weldon, and Herrmann, 2007), it was found that of the 5,046 coastal residents of the United States who were interviewed, 68% worry that shelters would be unsanitary, 66% believe there would not be enough clean water to drink, 65% are worried about crowding, and 62% are concerned about being in close proximity to those who are ill. Those with low economic resources may choose to ignore evacuation warnings in order to stay and fulfill obligations to their employer in order to avoid job loss (Baker, 1991).

Perception
For some, the general inconvenience of evacuation discourages compliance with orders to do so (Baker, 1991). There is much planning, packing, relocating, finding transportation, and other arrangements that may influence the decision to evacuate or ‘shelter-in-place’ instead. Nozawa (2008) also suggests that some believe it would be more dangerous to attempt an evacuation than to just stay in their homes.

Social Ties
Community involvement in disaster and evacuation planning has been suggested as being essential in developing an effective evacuation plan. It has been found that the greater one’s contacts and ties to the community, the more likely one is to receive information regarding evacuation (Riad, Ruback, & Norris, 1999). It has also been suggested that appeals from friends and family influence a person’s decision to evacuate (Baker, 1991). Riad et al. (1999) suggest that social influence and an individual’s support system allow for more substantial offers of assistance and emotional support, and result in a higher likelihood of evacuation.

Family Evacuation Plans
There is a strong correlation between behavioural intentions and actual behaviour when that behaviour is under personal control (Kang, Lindell, & Prater, 2007); thus people who have a plan are more likely to evacuate (Riad, Ruback, & Norris, 1999; Burnside et al., 2007). Burnside et al.’s (2007) telephone survey results showed that out of the respondents with evacuation plans were 22.4% more likely to evacuate compared to those without one. In addition, Nozawa et al. (2008) indicates that disaster-readiness and knowing how to contact family members in an emergency are two factors that strongly contribute to evacuation behaviour.

3.2 Community Factors

Community Plan
Having community representatives working alongside officials on every level of disaster management is essential in communities (Cordasco, et al., 2007). It has also been indicated that when a community works together and pools their resources to take care of themselves, better results can be achieved (Naim, 2007). Naim (2007) also suggests that

“effective community mobilization involves: a shared vision, a common understanding of the problem, leadership, collaborative partners, and community participation” (p. 23).
Encouraging active and enduring participation in communities is not always an easy task however. Clary, Snyder, Ridge, Miene, and Haugen (1994) suggest that the most effective way to encourage participation is to find out the motivations of the target population and create messages that trigger these motivations as well as evoke positive emotions. Messages need to “speak to” the potential participants and focus on issues that are important to the individual, making them feel good about participating and eager to do so. Involving community members would have many benefits including providing inside knowledge of the vulnerable society, having direct contact with residents, and having people involved that residents already respect and trust.

3.3 Organizational Factors

Information/Communication

Distrust of authorities has been cited as a reason many people do not listen to evacuation warnings (Cordasco, Eisenman, Glik, Golden, & Asch, 2007; Drabek, 1999). Among poorer people and minority groups, it has been found that officials are not given much credibility or looked at as a trustworthy source of support (Drabek, 1999). By having evacuation orders given by an untrustworthy authority figure, compliance levels may be drastically lower than needed. When people do not trust officials they may look to their neighbors for advice. If they see that those living near them have decided not to leave they may choose to follow their actions and remain home; this is known as the “conformity effect” (Baker, 1991).

Advice or orders from public officials, and the way they are worded and disseminated, affect evacuation rates more than any other factor (Baker, 1991, p.296).

3.4 Barriers to Evacuation

Pets

Many people choose not to leave their homes because they have pets that they are unable to evacuate (Baker, 1991). Pet owners develop an emotional attachment to their pets; they are companions and friends who provide comfort and loyalty and contribute to social well-being (Sable, 1995). Many shelters do not accept animals, so those evacuating with pets have nowhere to go, thus resulting in the possibility of remaining in one’s home.

Livestock

For many people in developing countries, livestock are the main livelihood; they provide food, fertilizer, offspring, weed control, transportation, and are a major economic resource (Heath, Kenyon, & Sein, 1999). Small farmers therefore depend on livestock to feed and support their families. Flooding can cause the starvation, disease, and drowning of livestock if they are not moved out of dangerous areas (Heath et al., 1999). Because of the potential loss, farmers may ignore evacuation orders to attempt to protect their livelihood. Evacuation planning for livestock would decrease losses post-disaster and encourage people to evacuate themselves. Locating available higher ground and the construction of holding facilities could be possible options (Heath et al., 1999).

Property Damage/Theft

Another point evident in research is that many people choose not to evacuate in order to protect their property, either from the storm itself or from looters (Baker, 1991; Riad, Ruback, & Norris, 1999). In terms of looting, those who lack social ties within their community may have distrust toward other members and fear leaving their belongings (Wilson et al., 2008). The general desire to stay may be considered part of territorial defense; “territorial functioning refers to sentiments, cognitions, and behaviors that are highly place-specific and socially and culturally maintained” (Taylor, 1989 as cited in Riad, Ruback, & Norris, 1999). This may mean that if one is sentimentally tied to one’s property and this feeling overrides the need to evacuate, then evacuation may not occur. In referring back to protection motivation theory (Beck, 1984), if a resident is analyzing the negative effects of leaving their home and they view the probability of looting to be high, they will be less likely to evacuate.
4.0 Programs and Strategies to Facilitate Evacuation

4.1 Programs/Strategies to Facilitate Advance Preparation

Education and Changing Attitudes
Pictures may work better than words in emphasizing the potential destruction an oncoming hurricane can cause. By viewing pictures of damage past disasters have caused, the possibility of tragedy is brought closer, and those images stay in your mind longer than words (Nozawa et al., 2008).

Professors Yoshinari Hayashi and Reo Kimura from Nagoya University, Japan developed a method of converting earthquake victims’ past experiences into educational materials. Although it is imperative that people prepare themselves for the possibility of a natural disaster, Hayashi and Kimura (2007) realized that it is difficult to envision a disaster that one has never experienced; therefore, they created visual representations of the personal accounts of twenty survivors of the 1945 Mikawa earthquake. An artist who sat in on the interviews translated each account into picture sequences which have since been used in panel displays at local high schools and community festivals to convey concrete information on an earthquake disaster. The pictures make a strong impression on audiences and are effective materials for programs focused on earthquake disaster mitigation, thus generating awareness for earthquake preparation (Hayashi & Kimura, 2007).

The motivation to evacuate can be greatly increased by having a vivid image of the possible destruction storms can cause (Burnside et al., 2007). By analyzing data collected through a telephone survey, Burnside et al. (2007) found there to be

an 11.6% increase in the likelihood of evacuating if respondents had viewed a large quantity of visual images of damage as opposed to few or none (p.734).

Television and Radio
Television and radio have been indicated as important sources of information when preparing for evacuation (Burnside et al., 2007). The strength in the mass media lies in the fact that they are viewed as being somewhat independent of the government and can garner the attention of a large portion of the population (Perry & Lindell, 1991 as cited in Burnside et al. 2007).

Combining the idea of visual images and past experiences with the media as an outlet may be an effective strategy. Exposing the public to vivid accounts of the experiences of storm victims on radio programs or television shows, or even showing commercials with snapshots of past destruction could trigger motivation in people that written text or impersonal lecturing never could.

For many decades radio has been used as a teaching tool in many developing countries. Programs have been developed specifically for different target populations on many different topics and have been aired so community groups can listen to programs together and learn more about specific topics (Nwaerondu & Thompson, 1987). This has been an extremely successful method of bringing information to parts of the world that would not have otherwise been exposed. Also having groups listen to such radio forums together they can discuss the information and how it can best be utilized in their community and come up with appropriate strategies together (Nwaerondu & Thompson, 1987).

Family Plans
The US Federal Emergency Management Agency (FEMA) suggests that a family plan should have several components (Federal Emergency Management Agency, 2009). First every household should sketch a map of each possible exit or ‘escape route’ out of the home in case of a sudden emergency; each child should be familiar with this map. A communication plan needs to be developed; each family member needs to know how to contact others in the household when disaster strikes. ‘Contact cards’ work well for this, listing each family member’s contacts and important phone numbers. If there is an individual with special needs residing in the household a distinctive plan needs to be developed specifically for that person, addressing their individual needs and concerns. Since pets are not allowed in shelters an evacuation and shelter plan is essential to protect the animals in
your home; a place for them to stay should be in place ahead of time, and a bag with food and other necessities should be ready. Livestock is a main concern to farmers and should also be included in evacuation planning. It should be ensured that each animal has some form of identification to help facilitate return. Plans should be in place ahead of time concerning where the animals will go and how they will get there and back. Other points FEMA emphasizes are to: arrange transportation (if you plan to take a personal vehicle, keep the gas tank full), keep a battery powered radio on hand to listen to updates, plan to leave early enough to avoid severe weather changes, and have an outside contact who knows where you are going.

In Belize, NEMO emphasizes a need to have a disaster kit to take with you to a shelter or other evacuation location. Kits should include a supply of water (at least one gallon per person per day), a change of clothing, rain gear and sturdy shoes, blankets or sleeping bags, a first aid kit and prescription medication, a battery-powered radio, flashlight and plenty of extra batteries, special items for infants, elderly or disabled family members, sanitary supplies (toilet paper; feminine supplies, soap, etc.), personal identification documents, legal documents, cash, and credit cards (National Emergency Management Organization of Belize, 2009).

4.2 Programs/Strategies to Address Awareness and Understanding

Dissemination of Warnings

Baker (1999) mentions that having authority figures visit each household personally to disseminate evacuation warnings is most effective in encouraging residents to leave because it ensures everyone hears the message, receives accurate information, and are given the opportunity to inquire about their uncertainties. Burnside et al. (2007) add that “as information from public officials increased, so did the likelihood of evacuating” (p.734). Wording of evacuation orders should be specific, consistent, and urgent to emphasize the need to leave the area (Baker, 1991; Drabek, 1999). Drabek (1999) suggests that in order to have an influential effect, disaster warnings should include: who the warning is being issued by, what the threat is, what geographical area is threatened, when the threat will occur, how probable the event is, what the high risk locations are, and what specific actions should be taken (p.519). If warnings lack relevant information and are vague in their delivery, they are more likely to be ignored (Wilson et al., 2008). Wilson et al. (2008) adds that warnings should not be given too soon because if residents evacuate and the threat turns out to be minor, they may lose trust in future warnings. Media can be used as an additional outlet to inform the public of potential danger. When individuals are debating evacuating their homes, many look to the media for extra information to help their decision (Burnside et al., 2007).

5.0 Conclusion

Understanding why some humans choose not to make their lives a priority in disaster situations is an important phenomenon to understand. By exploring each possible reason people may not evacuate, methods to counteract the current behaviour can be implemented. Even the smallest changes in current disaster preparation strategies, such as utilizing the stories of past victims and publishing pictures of disasters close to home, as well as talking more with communities and focusing on planning, may alter people’s perception and encourage them to adhere to evacuation warnings. Changes do not have to be expensive are elaborate to produce as a result, they must trigger emotion and be practical and easily implemented. By encouraging evacuation the lives of residents as well as rescue workers can be saved in the future.

References


Vulnerable Populations in Disaster Situations  
(by Chelsey Andrews)

Chelsey Andrews graduated in 2005 from Vancouver Island University (formerly Malaspina) with a Bachelor of Arts degree and hopes to further her education with a graduate degree in International Development. Partially as preparation for this goal, Chelsey participated in the Belize field project to gain experience working on humanitarian issues overseas. Eventually Chelsey would like to work with agencies in Canada and internationally on community capacity-building and programming for vulnerable populations. Chelsey is completing a certificate in International Community Development through Mount Royal College. Chelsey and her son Kai are currently living in Campbell River, British Columbia. She was a member of the program evaluation group of the VIU Belize 2009 field team.

Belize is frequently affected by tropical storms, hurricanes, and severe flooding. Belize has limited financial and human resources to prepare for, mitigate, and deal with the effects of recurrent natural disasters. Despite resources being already stretched to the maximum, it is essential and just that the special needs of vulnerable people be given adequate priority in emergency situations.

The focus of this review is on how people at the community level may successfully assist all members of the community during an emergency, especially those who may be particularly vulnerable. The Canadian Red Cross (2007) quotes Public Safety Canada’s definition of vulnerability as: “the propensity to suffer some degree of loss (e.g., injury, death and damages) from a hazardous event” (p.10). Sometimes in disaster research the term “vulnerable” is used to refer to a community within a specific geographical location, or even the social, political, economic, or other, structure of a community (Comfort, Wisner, Cutter, Pulwarty, Hewit, Oliver-Smith, Wiener, Fordham, Peacock & Krimgold,1999; Enarson & Walsh, 2007; Kiefer, Mancini, Morrow, Gladwin & Stewart, 2008). One researcher describes vulnerability as “the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard” (O’Hare , 2001, p.25).

Thus vulnerability can mean many things, and can change with the circumstances to include groups who might not be considered vulnerable otherwise. Kailes and Enders (2007) state that, although there is not much agreement as to what actually constitutes vulnerability in disaster management, those with special needs do represent a large and complex variety of challenges.

To address this topic it is important to define and identify the term “vulnerable” as it is used in this review. As stated by Comfort et al. (1999, p. 42): “research has shown that specific…demographic groups are more vulnerable to loss, or face greater difficulties during recovery from disaster”. Using this statement as guidance, in this review the term vulnerable is used to include: women, children, seniors, and those who are disabled or have ongoing medical needs. Examples from existing literature will illustrate how and why each of these groups is disproportionately affected by disaster situations. And as Morrow (1999) mentions it is useful to remember that, far from being mutually exclusive, these [vulnerabilities] tend to occur in combinations, intensifying risk exponentially (p.2).

This literature review examines the effects of disaster (and especially flooding), on these vulnerable groups in countries around the world. It also explores successful community-based strategies that deal with keeping vulnerable people safe during disasters, and assisting them in the recovery phase. The review illustrates how social capital, or relationships between people, can be strengthened so that communities can provide for the needs of their own vulnerable people. Considering that Belize as a developing country has limited financial resources to expend on disaster management, the value of strong social capital with extensive bridging capacity is immense.

Ideally, no person should have to deal with the hardships of a disaster on their own, and this especially applies to those people with limited...
resources, potentially harmful disabilities or vulnerabilities, and special needs. If there is adequate awareness about vulnerable people and adequate support systems are in place, communities can work towards a situation where everyone has the support they need, before, during and after disaster.

**Identification, Not Labeling**

The identification of vulnerable people in emergency management provides a baseline of what needs must be met in order to successfully assist all of a community’s members during times of disaster and recovery. However, as Lien (2009) discusses,

> the concept of vulnerability might, despite good intentions, become a means by which some segments of the population are continually portrayed as ‘different’, weak and without ability to influence their own destinies (p.99).

Lien suggests that people who live with reoccurring disasters do naturally tend to have a propensity for resilience and adaptability. Although some people may face greater difficulty in preparing for, withstanding, and recovering from disastrous situations, these people are not usually helpless or weak in their own right. In particular, Lien defends the people of the informally-settled Char lands in Bangladesh, stating that although they are considered extremely poor, their cohesive community ensures that they support and help each other during difficult times such as the repeated flooding of the plains on which they dwell. Labeling people as vulnerable may lead to a situation where negative stereotypes and local prejudices are reinforced within the community (Lien, 2009).

In a document produced for Public Safety Canada, emergency managers are warned against labeling those whose vulnerability may appear self-evident. The report cautions that this “knowledge” may not be useful if it is based on misinformation, uninformed stereotyping, or is simply too general (Enarson & Walsh, 2007). Enarson and Walsh also note that it is sometimes difficult to identify vulnerable populations, such as the mentally ill, people living with AIDS, and street children, because of stigma, fear, privacy issues and mistrust of authority.

When used carefully, the practice of identifying certain groups of people as having special needs can help disaster managers assess the community’s capacities and deficits in social resources (Sphere, 2004). With this information, first responders, aid agencies, governments and other recovery assistants should be better prepared to support everyone in the community with their specific needs, including those who are the most vulnerable.

**Identifying Vulnerable Populations**

**Children**

Children are often included as one of the most vulnerable groups when it comes to disaster management planning. According to Rassin, Avraham, Nasi-Bashari, Idelman, Peretz, Morag, Silner, and Weiss (2007) it is important to recognize children are not only a large proportion of the population but are also more vulnerable because their physical, emotional, and social development. During an emergency situation, they are “more exposed and vulnerable, and their coping abilities and needs in times of crisis are not the same” (p.36). During and after a disaster, children can lose their sense of security and have to rely on strained and exhausted parents for support which might not be there. They may also exposed to physical strains, such as lack of nourishing food and clean water, and having to sleep in an unsanitary and crowded shelter (Delica, 1998).

Morris and Edwards (2008) points out that, children of different ages will not necessarily be subjected to the same vulnerabilities. Very young children are especially vulnerable to health concerns and nutritional deficiencies. It is especially important for school aged children to continue to have access to education. And adolescents’ whose lives are disrupted by disaster may be especially vulnerable to violence, abuse, sexual exploitation, teenage pregnancy, HIV/AIDS, and child labour. Even in the United States, children suffered after disastrous Hurricane Katrina: in New Orleans one year after the storm only 29% of schools were opened (Colten, Kates, and Laska, 2008).
Because most children do spend a large portion of time in an educational setting, it is important to consider the potential for preparing children to deal with disasters by including it in the school curriculum (Beckjord, Stern, Meredith, Shugarman, Chandra, Tanielian, Taylor, Parker, 2008). However because there are some children who do not attend school for various reasons, disaster planners must discuss other ways of reaching those children and their families. For example children with disabilities are especially at risk. According to the Pan American Health Organization, in the Caribbean, only 30% of disabled children are attending school (Vasquez, 2008).

**Women**

Women are often considered a vulnerable group within at-risk populations because disasters tend to affect women in a disproportionately negative way. Morrow (1999) suggests that there are several reasons why this may be. She notes that women are very likely to be the caretakers of children, the elderly and disabled people. Heavy care-giving responsibilities (both in the home and in disaster responding organizations) mean that women will be less able to help themselves during an emergency. This challenge is especially significant if women are single parents, as families headed by a woman are much more likely to be poor. Women with many dependents are also at increased risk of not being able to successfully respond to and recover from disaster. The external responsibilities during a disaster, and the lack of an another capable adult in the home also means that it is difficult for caretaking women to actively seek relief and wait (in line-ups and behind government “red tape”) for assistance (Morrow, 1999).

Myers (1994) also discusses several reasons why women in less developed countries may be more vulnerable during disasters. In terms of preparedness, women in less developed countries are more likely to be illiterate and unable to read or understand available disaster management educational material. Language may also be a barrier; in some small rural villages, it is common that women use only their traditional language to communicate. If this is the case the language used by government and media for delivery of emergency warnings and instructions may not help these women. The role of women in society as caretaker also means that they are more often preoccupied and less able to attend training or workshops aimed at educating people about disasters (Enarson and Walsh, 2007). Providing daycare while women attend community training is one proposed solution for this barrier (Delica, 1998).

In the recovery stage of the disaster situation, women are also more likely to suffer. Again this vulnerability is compounded if the woman is the head of a household (Enarson, 2006). According to Enarson, women’s lives become much more difficult in the wake of disaster. Simple housekeeping duties become much more burdensome when there is a garden to re-plant, clothing and possessions to repair and replace, ill or traumatized dependants to care for, a lack of food to prepare, and a home which needs to be cleaned and fixed. Women are also more likely to participate in helping others long after the disaster has passed, either as volunteers or in professional profession such as teaching, health care, and community advocacy.

Women who are pregnant and breast-feeding and those who are elderly have notable vulnerabilities. Expectant and lactating mothers have requirements ranging from needing to avoid toxins and needing extra nutrition, to being in active labour and requiring immediate medical assistance (Kailes, 2007; Delica, 1998; Mokdad, Mensah, Posner, Reed, Simoes & Engelgau, 2005). And older women are more likely to have chronic medical conditions and be stigmatized as incompetent and disadvantaged by other discrimination (Vasquez, 2008).

**Seniors**

The United Nations identifies anyone over the age of 60 as a senior citizen. The American Medical Association (AMA) says that one of every six people over 65 has dementia. In the United States, over half of all adults over the age of 65 self-identify as having some type of disability (McGuire, Ford & Okoro, 2007). The AMA published a report which says that in the United States, 74% of all the people who died as a result of Hurricane Katrina were over the age of 60 (Baylor College of Medicine, 2006). The Pan
American Health Organization states that “men and women 60 years old or older living in Latin America and the Caribbean are the fastest growing population group in the world” (Vasquez, 2008, p.2), meaning that more people in this geographical area are living longer lives than in previous times.

These statistics, and others, indicate how important it is for disaster managers to identify the special needs of seniors. Morrow (1999) makes this point by saying “not all elderly are frail... but it can be generalized that older residents are more likely to need disaster-related assistance” (p.4). Considering this, it is also worth noting that some seniors certainly are physically fit and healthy. And the life experience and wisdom of senior citizens is also highly respected in many cultures. Seniors are a unique resource within any community and can be a great source of family strength and community resiliency, especially during times of crisis (Vasquez, 2008).

Seniors who are frail in some way are those who should be recognized as vulnerable by disaster managers (Baylor College of Medicine, 2006; Rosenkoetter et al., 2007; McGuire, Ford & Okoro, 2007). Frailty in seniors may mean that they are impaired physically, have diminished sensory awareness, have special dietary needs or they need assistance performing daily activities (Baylor College of Medicine, 2006) or that they have at least one chronic condition and need ongoing professional medical care (Rosenkoetter et al., 2007). Seniors become more vulnerable to disaster as they become less capable physically. For example, if a senior has limited mobility they will likely need assistance with evacuation (McGuire et al., 2007). Reliance on medication, medical equipment and devices, and other forms of assistance also render seniors more vulnerable during a disaster.

Older people who also have serious medical conditions are often dependent on community agencies and rely on an informal network of family, friends, neighbours and caregivers to help them (Hine, 2005). If, during an emergency, elderly people in the community lose contact with their support networks they become additionally vulnerable because they are alone dealing with the disaster, and they are also lacking the support they normally receive for their condition or special needs (Gulitz, Kurtz, & Carrington, 1990). The Sphere Humanitarian Charter and Minimum Standards in Disaster Response also stresses that social isolation may be the most significant form of vulnerability for seniors in times of disaster (Sphere, 2005).

**Disability and Medical Needs**

Disability is a term that covers a very broad spectrum of conditions and can apply to men and women, children and seniors. Disabilities can be physical, meaning they affect a person’s hearing, vision or mobility, or they can be cognitive, affecting a person’s mental, or emotional, health and development (Davis, 2004; Parr, 1987). Medical needs can include

…management of unstable, terminal or contagious health conditions… managing medications, intravenous (IV) therapy, tube feeding ... administering dialysis, [or] oxygen ... and operating power-dependent equipment to sustain life (Kailes, 2007, p.234).

Preparations must be made for those whose health is already compromised and are therefore more vulnerable to the stress and disruptions caused by disaster (Mokdad et al. 2005).

When emergency managers are formulating emergency plans, it should be established that “disabled people have the right to expect an equivalent level of safety protection as able-bodied persons” (Parr, 1987, p.149). Emergency management plans should take the limitations and challenges of disabled people and those with medical conditions into consideration (Singer, 2005).

For instance, mobility limitations may make it difficult to climb up and down stairs or to move quickly over long distances. Vision impairments might impede the reading of signs or the traversing of unfamiliar or altered terrain. Hearing limitations could prevent one from following warnings or instructions. And a variety of mental disabilities might impair an individual’s ability to appreciate or respond to an emergency (Davis, 2004, p.11).

People with disabilities and serious medical conditions are often reliant on people, equipment or medication for support, which also puts them...
at extreme risk if any of these support systems becomes disrupted during an emergency (Parr, 1987). When people depend on external support, it is imperative that this support continues during times of great stress and displacement. As Parr (1987) states, “If the dependence patterns are disrupted... disabled persons are placed in an extremely vulnerable position” (p. 149). As mentioned by Davis (2004), a major obstacle for some people could be that they do not have the ease of mobility that others might. If, due to an emergency, it is necessary to evacuate a place quickly, or by an uncomfortable mode of transportation (such as climbing down slippery banks into a rescue boat with a high bow or sides), it is clear that someone with mobility issues is going to find it more difficult than someone fully able-bodied.

During a widespread or extremely severe disaster, it is possible that most healthcare personnel and medical facilities will be expected to deal with the immediate needs of the injured. While the emphasis is on providing primary acute care, the ongoing needs of people with existing disabilities and medical conditions may be largely neglected (Parr, 1987). In fact, it has been noted that “lack of access to routine health care is a leading cause of mortality after disasters” (Mokdad et al., 2005, p.1). For this reason and others, it is imperative for disaster planners to recognize that without proper care and accommodation, it is possible that a stressful disaster situation could end up exacerbating the conditions of people with previous disabilities or medical conditions (Singer, 2005; Kailes, 2007; Gulitz et al., 1990).

Preparing Vulnerable Populations for Disasters

If an event causes casualties and psychological trauma, property damage and other economic losses, or negatively disrupts the lives and routines of people, it can be considered a disaster. And because disasters are defined by their association with people, Quarantelli (1999) states that, “all disasters are initially and essentially social occasions [and] planning for them has to be primarily by social means” (p. 10). Thus, in order for communities to be ready for disastrous situations, planning, preparation and education has to include all citizens, especially those who are most vulnerable, and must start at a household level (Beckjord, Stern, Meredith, Shugarman, et al., 2008; Fox, White, Rooney & Rowlan, 2007; McGuire, Ford, & Okoro, 2007; Pushpanath, 1994).

Not only is a bottom-up approach to community preparedness more effective (Shaw & Sinha, 2003; World Health Organization, 2005), but it also draws on the strengths and resources (Cottrell, 2005) of the people and allows them to empower themselves (Myers, 1994; O’Hare, 2001; Pushpanath, 1994). The people affected by disaster are certainly aware of their own needs, and those people should be encouraged to speak out about their needs and also motivated to strive towards securing those needs (Shaw & Sinha, 2003).

Disaster managers can ensure all people are included in emergency plans by being aware of the vulnerabilities present in the community and by acknowledging the unique challenges and obstacles these people may face (Davis, 2004; Fox et al., 2007; McGuire et al., 2007; Keifer, Mancini, Morrow, Gladwin, Stewart, 2008). They also need to acknowledge that people with special needs and additional vulnerabilities have equal rights and should have equal access to the opportunity to prepare for and survive an emergency (Davis, 2004).

Education for Community

One of the first steps to preparation is education. All people within a community need to be educated to what the inherent risks are, and how best to prepare for and deal with them. People who are adequately educated and prepared when disaster strikes are more likely to be part of the solution, and less likely to be part of the problem (McMahnon, 2007). When emergency management professionals provide reliable and timely training to the public it will build a larger base of people within the community who are prepared and competent in handling complex disaster situations (Robinson & Gerber, 2007). Additionally if disaster response training is provided to those who advocate for the needs of vulnerable populations, it can add institutional and industry-specific groups to the emergency
service resource-base and add valuable and timely support for vulnerable people in times of disaster (Davis, 2004).

When attempting to inform a community of risks or preparation plans through mass media, Davis (2004) says that it is important to use a variety of educational materials and to utilize more than one type of delivery. For example, pamphlets distributed to households may not be entirely effective, because some citizens may be sight impaired, and some might be illiterate or unable to read in a language other than their mother-tongue (Myers, 1994; Norris, 1987). When hosting informational meetings or emergency management educational seminars, it is important to take into consideration the cultural norms of the community in regards to women’s duties and schedules, so as to maximize the availability of potential attendees (Delica, 1998; Earanson, 2006). Also, the natural ability of women as informal educators should be tapped and promoted as a trustworthy and reliable source of information for the local people (Myers, 1994).

Disaster management and education should, if at all possible, be attached to issues which are of concern to the community. In any community, people will be meeting and planning and holding events that are of interest to them. The key to community involvement and a receptive audience for emergency management education is to integrate it into the current and relevant values of the community (Quarantelli, 1999). Quarantelli stresses that this point is especially important in developing counties because “mitigation is often already latently embedded in those activities that are routinely undertaken in the typical community in developing societies” (p. 15).

**Education for Children**

Building a culture of preparedness within children’s schools and ensuring that children’s unique rights are incorporated into disaster planning is one way to protect children from the harm that disasters may bring (Morris & Edwards 2008). According to Beckjord et al. (2008) and the World Health Organization (2005), making disaster risk education part of school curriculum may be an effective way to teach school aged children about the dangers of disaster situations. Not only will the children learn how to prepare for and respond during a disaster, but it is assumed that this information will be shared with parents and other siblings (Beckjord et al., 2008).

According to Beckjord et al. (2008), communication with children, as with most vulnerable populations, is

…most likely to succeed when messages are provided early, often, in multiple formats (e.g., television, print …audio, Internet, interpersonal), and when the content of messages and their presentation are tailored to be locally and personally (including linguistically) relevant (pg.5).

**Emergency Preparedness Kits**

The Canadian Red Cross (2007) suggests that all people (but especially those with special needs) should have an emergency preparedness kit assembled and available for quick retrieval. The contents of the kit should be adequate to last the individual three days (a realistic amount of time that it could take for emergency responders to reach individuals cut off by a disaster). Some suggested items for the emergency kit are: flashlight and batteries, radio, first-aid kit, candles and matches/lighter, important papers (identification), non-perishable food and bottled water, blankets, toilet paper, medication, whistle (to attract attention, if needed), and playing cards (Canadian Red Cross, 2007).

Rosenkoetter et al. (2007) makes a similar recommendation for people with medical needs and disabilities, saying it would be helpful for these people to have an emergency plan in place which includes a kit of essential medicine and supplies, their medical history and information, as well as the information for an emergency contact person. Although having an emergency stock of food, medication, and other supplies is likely a very good idea, McMahon (2007) argues that this is probably not reasonable for households of limited financial means.

**Special Needs Registry**

Many emergency management officials advocate a voluntary registry of people who may have a difficult time, for one reason or another, during an emergency and especially during an evacuation situation (Fox, 2007; Rosenkoetter, et al., 2007; Gultz, Kurtz, & Carrington, 1990;
Parr, 1987; McGuire, Ford, & Okoro, 2007; Morrow, 1999). The general consensus is that people with special needs who are listed on a registry are able to receive assistance more quickly and efficiently during times of disaster than those who are not listed. The creation and possible uses of a special needs registry are explained in the National Organization on Disability’s Emergency Preparedness Initiative as follows:

...people meeting specified criteria voluntarily list themselves, making the local emergency authority aware of their presence. Some jurisdictions employ this registry only as a means of pre-emergency outreach. Others use it to alert citizens of impending emergencies. Still others rely upon it to assist in evacuations or provide emergency services such as transportation or health care during a disaster (Davis, 2004).

A special needs registry can certainly be a useful tool, but simply offering the registry does not ensure that everyone who needs extra assistance will be listed. Some people are reluctant to self-identify as being vulnerable, and some with disabilities may not feel that they will require special assistance. Additionally, some may not think to register until after a disaster, and some might not be aware of the registry at all (Davis, 2004).

Collaboration with community-based organizations that have regular contact with these people may help to encourage people to self-identify and to inform people with special needs about the registry (Fox, White, Rooney, & Rowland, 2007). Keifer et al. (2008) recommend utilizing local sources such as faith-based organizations, social and health services agencies, clinics, and neighbourhood associations in order to connect with and engage vulnerable populations.

**Telephone Notification**

In the National Organization on Disability’s Emergency Preparedness Initiative, Davis (2004) explains the idea of a “phone tree”. A phone tree is a pre-arranged plan for a network of individuals and organizations to contact one another in a time of emergency. The emergency management phone tree is normally conducted as a top-down exercise. In this arrangement, the instigating call would come from the top of the emergency management network. This representative (usually at the government level), would be responsible for making contact with several other individuals or organizations, who would then call others, and so on. The branches would soon fan out to include as many individuals as previously planned for. The idea is that people who are vulnerable will be contacted before an emergency, in order to prepare them, or in the aftermath, in order to see if they require assistance. The success of the system is based on the reliability of those within the chain.

Davis (2004) also explains how the same type of system can be used in reverse, so that people who are especially vulnerable and have special needs can reliably contact those in higher roles of emergency management. This gives people in the community a way to express concerns, or explain discrepancies in needs and actual services received. This is an empowering system which also allows vulnerable populations to have their voices heard. It gives emergency managers a way of collecting pertinent and timely information that can be used to make life-saving decisions in the future. Another similar type of system is called the reverse 911. It uses a combination of GIS and database technology to initiate calls or text messages to a list of people within a specific area (Fox, et al., 2007; Keifer, et al., 2008). According to Fox, et al. this system works well in conjunction with a special needs registry.

**Involving Vulnerable Groups**

While it is clear that disaster management plans should include the special needs of vulnerable people, it is impossible that all scenarios involving vulnerable people can be imagined and thus planned for. In order to ensure preparation for as wide an assortment of needs as possible, vulnerable people need to be involved in planning for disasters (Davis, 2004; Pushpanath, 1994; Fox, et al., 2007; Kailes & Enders, 2007). According to Beckjord, et al. (2008), evidence suggests that the general public (including those with special needs and vulnerabilities) want to be involved in emergency planning within their community. Davis (2004) says that “involving and listening to people [with special needs]
assures the best insights for addressing their needs” (p. 12).

Within most communities it is common to find grass-roots organizations that have formed to meet the needs of, or develop a bond between, people with certain characteristics or interests. Common bonds for these types of organizations could be the very issues used to identify people who are vulnerable to disaster. Activity groups for seniors, advocacy groups for people with disabilities and women’s organizations are all examples of common active “special-needs” community groups. These community level initiatives are sometimes complimented by larger NGOs working on the same issues (Robinson & Gerber, 2007). Any of these organizations can be a great source of ideas and participatory enthusiasm in disaster management activities and planning.

Advocacy groups and associations are definitely a valuable resource for disaster managers who are seeking to involve members of these groups in emergency planning activities (Beckjord, et al., 2008; Fox, et al., 2007; Keifer et al., 2008). Davis (2004) suggests that emergency managers should ensure that they understand and prepare for the special needs of vulnerable populations by developing meaningful partnerships with community groups representing people with those needs. As explained by Fox, et al. (2007), emergency managers must put effort into reaching out to the vulnerable within the community, but in order for this to be a successful endeavour, there also has to be a strong emphasis on encouraging those with special needs to be pro-active in the disaster plans for their community.

**Geographical Information Systems (GIS)**

Emergency managers can use vulnerability data collected from their community and combine it with spatial and housing data, and hazard-related databases (such as flood levels), and produce a map of areas in which vulnerable people are most at risk (Morrow, 1999; Fox, et al., 2007). When explaining the usefulness of GIS for emergency planning and educating communities, Kiefer, et al. (2008) state that:

GIS, in concert with census or other data, can be used to effectively plan for evacuation pickup points and evacuation routes. It is used to target areas within a community for special proactive planning and outreach- areas with significant special needs or elderly populations, etc. The public needs to know about areas impacted by the disaster, incident escalation and future potential, situations status, evacuation routes, shelter locations, food and water locations, etc. (p. 38-39).

GIS technology can be utilized to develop highly effective communication strategies as well. For example, the mapping technology could identify where vulnerable people are most densely located, and an educational campaign could be targeted to this area (Beckjord et al., 2008; Morrow, 1999). When complex GIS data is turned into an easy to decipher map, the information it represents becomes more accessible and comprehensive for the general public and can be delivered quickly through many forms of media (Kiefer, et al., 2008).

Although GIS, as a new technology, promises to be critically important for vulnerable populations involved in disasters, Kiefer et al., (2008) note there are indeed some barriers to its widespread use. Some of the problems associated with GIS include, “lack of user-friendly software, high cost of the software (~$10,000), and availability of the data” (Kiefer, et al., 2008, p. 39). GIS software usually also requires that staff be trained to use this software. Morrow (1999) argues that vulnerability mapping is a critically important and powerful tool: if the barriers to using GIS cannot be overcome, communities should consider a “low-tech” version (such as the three-dimensional wood and dough map made during a grassroots mitigation project by residents of the Philippines), so that they can still benefit from identifying community risk and vulnerability and comparing those with available resources.

**Special Needs Awareness Training**

Hurricane Katarina battered the Gulf Coast of the United States in 2005. The world watched anxiously as, even in one of the most powerful and wealthy of all nations, the burden of disaster fell severely on the most vulnerable populations. System and human failures led to the suffering of many poor, marginalized, elderly and infirm members of the affected population (Colten, Kates & Laska, 2008; Fox, et al., 2007). Since
that devastating experience, many disaster managers have focused on increasing the sensitivity of public officials involved in disaster response (Colten, et al., 2008), so at least on a human level there will be more awareness and capability in dealing with vulnerable people’s special needs.

First-responders and volunteers who have gone through special-needs awareness training will be more conscious of correct and respectful protocol in dealing with vulnerable people during disaster situations. They will also be more able to quickly identify vulnerable people and to help provide for their needs during an emergency (Davis, 2004; Robinson & Gerber, 2007). Training for responders and volunteers may come from the special-needs groups themselves, or from a governmental department. In the United States, FEMA now provides “Special Needs Population courses” (Fox, 2007, p.203) and online courses on the same topic for emergency managers.

Assisting Vulnerable Populations in Recovery from Disasters

There are many needs that must be met so that vulnerable populations can carry on being functioning members of the community after a disaster. Communities and emergency managers should make sure support is in place for the aftermath of the disaster so that people who need extra assistance to rebuild their lives can access the resources they need. The elderly, women, children, and disabled people all have the right to safety, a productive life and dignity, and in the aftermath of a disastrous event this should be possible to achieve with support and assistance from their communities.

Informal Support Networks

In the immediate aftermath of a disaster, providing ease of access to available resources (such as evacuation vehicles and shelters) is an important way to keep vulnerable people safe. However, it is not always possible for emergency responders to assist people who need extra help immediately, or to give each vulnerable person the one-on-one support they may need. For this reason, and in order to ensure that all people are taken care of and accounted for during a disaster, the US Federal Emergency Management Organization (FEMA) “recommends that people with disabilities create a self-help network of family, friends and neighbours to assist them during emergencies” (McGuire, Ford and Okoro, 2004, p. 53).

An important factor in determining whether or not vulnerable people will successfully recover from disaster is the number of healthy and resourceful adults in their home with available time to devote to the numerous and exhausting household response and recovery tasks and activities (Morrow, 1999). During an emergency when resources are stretched to their limits, vulnerable people with reliable support networks in place are going to be a step ahead in the path to recovery.

Shelter Management

Accommodating large numbers of people during a disaster can be a difficult undertaking. But emergency managers should ensure that shelters are prepared to provide for the needs of all people, including those with medical conditions, disabilities and other special needs (Kailes & Enders, 2007). For example, are the evacuation shelters and their toilet facilities wheel-chair accessible? Will transportation be provided for people who must evacuate but who are unable to drive or walk long distances to the shelter? It is important that before disaster strikes, decisions are made about whether emergency shelters will be divided into different classes based on medical needs, and how much medical oversight will be needed at each shelter (Davis, 2004). Team member Jacqui Jones also addresses medical needs in this volume.

One example of special sheltering is described by Gulitz, Kurtz & Carrington (1990). After a major evacuation in Florida, during which some inadequacies in the sheltering system were noted, Hillsborough County developed a new approach to shelter planning for people with special needs. They decided that to provide the most adequate care for those with medical needs was to create and designate “Special Care Shelters”. Vulnerable people and their caretakers stay in these shelters which are planned and operated by the local health department. They are stocked with
supplies such as cots, blankets, medicines, provisions for special diets, oxygen, and first aid kits. Special emergency generators have been installed for the safety of those who depend on electricity to power life-sustaining devices. These shelters are staffed by at least one doctor and an emergency medical technician. They also have an agreement with a nearby pharmacy for special orders.

Safe shelter is a necessity during a disaster, and for those living in a temporary shelter another of the most basic needs must be met: access to food. If food security is already poor in the area, and the disaster disrupts this further, malnutrition could be a serious risk factor (O’Donnell, Bacos, & Bennish, 2002). In Bangladesh, recurrent flooding “is thought to put an affected population that already has marginal food security and poor nutritional status at a very high risk of severe food shortages and resultant malnutrition” (O’Donnell et al., 2002, p.230). O’Donnell et al., also state that preventing malnutrition, especially in the most vulnerable, may reduce mortality in disaster situations. Pregnant and breast-feeding women should be of special concern while in shelter as they require nutritious food and more of it, and families with more children should receive more food to ensure everyone is adequately fed (Delica, 1998).

**Childcare Groups**

After a disaster the income earned by women outside of the home usually becomes even more important for families that are struggling financially. But without reliable childcare available, either women will not be able to seek or return to work because they must remain home to care for small children or, older siblings (usually girls) will have to miss school to care for the younger ones while the parents are away (Enarson, 2006).

When children’s lives are disrupted by disaster they often cannot attend school for some time. In a document titled “We the Children”, UNICEF (2001) says that “education must be an integral part of responses to emergencies, particularly as it can help restore a sense of stability in situations where children are likely to be traumatized” (p.58). If formal school-based education is not available then informal community daycare and activities for affected children may be the next best thing as they wait for daily routines and norms to resume (Delica, 1998).

Not only does community childcare offered after a disaster help children resume play and learning, but it also gives parents who are dealing with the hassles and stresses of disaster a chance to get things done or have a much needed rest (Delica, 1998). Children displaced to emergency shelters usually face boredom and stress when forced out of their homes and removed from their daily routine. These are the children that may benefit most from this added structure and familiarity (Delica, 1998). Older children can be given duties related to interacting with the younger ones and from it they can gain a sense of purpose. And engaging children of all ages in supervised and directed play will mean they are more likely to stay out of unsafe situations (such as playing in flood waters) which may negatively affect their health (Morrow, 1999).

**Functional Support Coordinators**

In “Moving Beyond Special Needs” Kailes and Enders (2007) describe functional support coordinators (FSC) as advocates at the governmental level for people with functional difficulties. These government employees could serve as point people, who are

...vested with the responsibility, authority and means to provide leadership, guidance, and coordination and resource management for emergency preparedness, disaster relief and recovery operations... [They] should have experience in implementing the values and goals of independent living and self-determination, implementing human and civil rights policies and procedures, and providing for people’s complex function-based needs (p. 235).

These persons would ensure that planning and implementation of disaster response includes operational tasks meant to meet the needs of people who will have additional challenges during an emergency. Another responsibility would be to build a team of skilled and qualified experts to carry out the task of ensuring the health and safety of those with additional health and functional needs.
Utilizing Social Capital

In the aftermath of a disaster, volunteers from the civic and private sector as well as non-governmental organizations (NGOs) and faith-based organizations are willing and able to play an important supportive role in response and recovery efforts. In New Orleans after Hurricane Katrina, it was these groups which provided “most of the initial evacuation capacity, shelter, food, health care, and rebuilding—and much of the search and rescue, cleanup, and post-Katrina funding” (Colten, Kates, & Laska, 2008). However, in the chaos which often follows a disaster, these groups are sometimes ignored, discredited, or inadequately utilized by the government planning and response team (Kailes and Enders, 2007).

In involving civic organizations, educational institutes, advocacy groups, neighbourhood associations, the private sector, and faith-based organizations in planning will help emergency managers build more thorough and relevant strategies to keep local residents safe and support them in recovery. And anticipating the influx of volunteers and being prepared to direct them towards useful activities will strengthen the overall response and avoid duplication of efforts (Kailes and Enders, 2007; Dynes, 2002).

Conclusion

It is commonly acknowledged that people who are considered most vulnerable in relation to disasters are most often the same people who face challenges on a day-to-day basis while supporting themselves and their families. Those who are elderly and frail or too young to care for themselves, and those with medical needs and disabilities, as well as women with excessive responsibilities and burdens have all been shown to be more vulnerable during disaster situations.

All people have rights to survival, health and safety, and emergency managers have a responsibility to be prepared to meet the needs of vulnerable people during and after a time of crisis. Kiefer, et al. (2008) says that “having a thorough understanding of the more disadvantaged and vulnerable portion of the community will allow community leader to shape programmatic approaches to enhance their region’s resilience” (p.62) to disasters. Knowing the community and utilizing the available social capital within are important ways to support those who need assistance the most.

References


Crime during Floods and Storms
(by Courtney Decker)

Courtney Decker graduated from Vancouver Island University as a Criminology major in 2010. She served as President and Vice President of the Criminology Students Association. Courtney was a member of the program evaluation group of the VIU Belize 2009 field team and researched her passion: the fear of crime and victimization. Courtney is currently residing in Victoria, BC where she is working in the field of Corrections in Adult Probation focusing on rehabilitation, conflict analysis and violence prevention. Courtney hopes to pursue graduate studies within the next year and to pursue a master’s degree in conflict analysis and management with a view of restorative justice. Courtney is an advocate for restorative justice programs and the significance of conflict resolution to manage groups of conflict in a variety of international and domestic arenas.

Disasters, including those caused by natural hazards, are a threat to people and property (Wisner et al., 2003). Disasters can also increase vulnerability to crime (Quarantelli, 2008). There is an ongoing debate among academics as to whether the vulnerability to crime increases, decreases, or changes significantly during a disaster. Researchers have argued about the extent to which antisocial behaviours are aggravating factors during such disasters (Tierney, 1999).

Disasters do increase the opportunities for crime. During floods and other storms, lives and property are at risk (Wilsner et al., 2003). Additionally, people often have to evacuate, leaving their homes behind. This makes their housing and personal belongings more vulnerable to theft, damage, or displacement.

Fear of crime is also an issue. When there are opportunities for crime to occur, there is also a potential heightened fear of crime among community members (United Nations Interregional Crime and Justice Research Institute, 1995). The fear of crime tends to be high when it is sensationalized in the media or during times of distress and vulnerability (UNICRI, 1995). Media may over-emphasize isolated events or repeat crime myths during disasters. This can create stress and more challenges among locals in communities (Hansen et al., 2004).

The response to disasters in Belize involves multiple agencies including NEMO and its partner agencies, the National Police, Belize Defense Force, Coast Guard, and agencies such as the Belize Red Cross. However, this response suffers from a lack of adequate financial resources and basic resources for crime control (Hansen et al, 2004). These deficits can limit policing during disasters and affect the level of confidence of the public in crime prevention, especially when a disaster such as a hurricane can affect much or most of the country at the same time (Hansen et al, 2004).

Geographic location can also affect crime control. Hansen suggests that, with limited police resources for investigating crime in rural areas, investigations in these areas are challenging. Hansen notes that demographics can affect crime during disasters, as many individuals move from place to place and illegal immigration often takes place from neighbouring nations (Hansen et al., 2004). Parallel to Hansen’s study, Pelling’s case studies on communities vulnerable to disasters and crime show that an increased number of transients often leads to an increased opportunity for crime (Pelling, 2003).

Crime during Disasters

Studies of disasters worldwide raise a number of questions relating to the safety of individuals, including questions about the kind of risks that individuals of the community are exposed to. The most common offences recorded during disasters include looting, sexual abuse, theft of property and crops, and vandalism (UNICRI, 1995).

Income and Socio-Economic Status

Income and socioeconomic status appear to be associated with crime victimization during disasters. Housing is an indication of socioeconomic status and is often closely linked with employment and income. Survey data from the UNICRI (1995) shows that the majority of respondents in developing countries lived in unsecured housing and those respondents
experienced more looting and theft than those living in secured homes (UNICRI, 1995).

Some scholars have questioned whether there is a connection between theft and income during disasters (UNICRI, 1995). An analysis of the recorded cases of robbery in the state of Maharashtra during disasters shows that while the overall incidence of robbery in Bombay is not high (1.4%) (UNICRI, 1995), most of the cases of robberies were reported by lower income groups (71.4%). Respondents from the lower income groups were most vulnerable to this form of crime during disasters as their homes were vacant during such disasters (UNICRI, 1995). Although the statistics show higher crime rates among lower income groups, many of those groups were living in poor conditions and potentially worse than those with higher incomes (UNICRI, 1995). Thus, the report states that most individuals in the cases in Bombay who have low incomes and living in poor conditions were more likely to leave their houses and to be victims of crime (UNICRI, 1995).

There have been a number of global initiatives to reduce these types of offences during disasters such as the United Nations’ Central Emergency Response Fund (CERF). CERF has assisted with numerous humanitarian projects all over the globe. CERF’s projects assisting with disasters and flooding in Bolivia, China, Kenya, Nepal, Ethiopia, Chad, Kenya and Cambodia, are several out of many.

In 2008, the worst flooding in fifty years caused significant losses, injury and displacement, as well as damage to housing and agriculture in Bolivia. After the peak of this emergency, the UN Disaster Management Team (UNDMT) submitted a funding proposal to CERF to cover the immediate needs (Yasukawa, 2008). The emergency in the Beni and Santa Cruz departments caused violence and the separation of families among residents (Yasukawa, 2008). UNICEF implemented working initiatives with CERF funds for a series of activities to avoid and to mitigate the effects of sexual violence occurring in camps in the aftermath of disasters. Although this particular study involved hundreds of residents in shelters during disasters which may result in more of an increase in crime, theft is the most common crime during a disaster. The methodology was applied to children in conjunction with NGOs in 25 municipalities of 5 departments, with educators and volunteers, who were trained and equipped. These activities included providing resources to diagnose and overcome the emotional damage, the losses from damage and violence to promote the rights of young children, and to provide practical information to prevent sexual abuse in shelters (Yasukawa, 2008). The therapeutic activities were culturally appropriate to emergencies of the western part of the country and materials were directed to parents and leaders about the good treatment of neighbours and the prevention of commercial sexual violence (Yasukawa, 2008). This crime prevention contract set up with NGOs provided technical assistance to UN discussion tables in five municipalities of high disaster vulnerability with the specific focus of mitigating commercial sexual violence (Yasukawa, 2008).

On August 30 2008, Hurricane Gustav hit western Cuba in full force. Hurricane Gustav crossed western Cuba on the night of 30 August 2008. It was reportedly the “most devastating disaster to have ever hit Cuba” reaching “…category four on the Saffir-Simpson scale” (McDade, 2008, p. 1). Cuba was not prepared for the seriousness of this disaster. The property and houses of residents living in the affected areas were seriously damaged (McDade, 2008). The sexual exploitation during Hurricane Gustav was similar to those in Haiti after the high number of powerful storms hit in 2008. CERF funds were used to provide technical support for the establishment of a community network for child protection in three urban areas affected by the flooding: Port au Prince, Gonaives, and Les Cayes (Boutroue, 2008). Volunteers were specifically trained to support IBESR in its mandate to monitor and respond to cases of abuse and violence in emergency shelters (Boutroue, 2008). Through this collaboration, vulnerable children were labeled as the highest risk of being exploited during crisis situations (Boutroue, 2008). Rapid support was provided to the affected households and particularly to vulnerable children (Boutroue, 2008). This support also included peer to peer support with neighbours, having parental skills passed to
children from adults to the affected households into a fear-free environment.

**Vulnerability during Disasters**

Within human traditions, vulnerability has been measured by the exposure to hazards (Hewitt, 1983). A UN report launched in 2007 noted that the world’s developing countries are affected most by urban crime, insecurity of tenure, and natural disasters. The term “natural disaster” is used to refer to natural events such as earthquakes, hurricanes or floods (Blaikie et al., 1994). One question that often arises when considering individuals in a disaster is the vulnerability of those individuals. What makes people vulnerable to a disaster or more vulnerable than others? This often means analyzing the links between poverty and vulnerability to understand who might become a victim of crime and in what geographic area depending on where those vulnerable reside (Blaikie et al., 1994).

Vulnerability to disasters and crime can vary among households and individuals. The 2004 edition of the book *At Risk*, by Blaikie et al., is focused on natural disasters as those that signal the failure of mainstream “development” (Blaikie et al., 1994, p. 22) in households. They provide two analytical models as tools for understanding vulnerability; the vulnerability to crime during a disaster at an individual’s state or the household’s state (Blaikie et al., 1994). His first model links remote and distant ‘root causes’ to unsafe conditions in a progression of vulnerability; no access for relief and safety, no pre-disaster planning, no security present and individuals without the means to protect their health and safety during disasters (Blaikie et al., 1994). The other model uses the concepts of access and livelihood to understand why some households are more vulnerable than others; households in areas with more criminal activity, those households in areas that are easily accessible to outsiders and those individuals who may be more poverty stricken that others that do not have the means for security around their household (Blaikie, 1994).

Mark Pelling, author of *The Vulnerability of Cities, Natural Disasters and Social Resilience*, has reviewed the utility of livelihood approaches to understanding pathways through which crime can be a factor during a disaster (Pelling, 2003). The work of three authors, Blaikie et al. (1994), proposed an asset vulnerability framework for households at risk of crime. Through both Blaikie and Pelling’s work, the aim was to identify those most pertinent aspects of household assets that shape the livelihoods of those individuals during a disaster. Through identification, the profiles that shape the livelihoods of those vulnerable would help them cope with the risks and of crime in the disaster area (Pelling, 2003).

Pelling concludes that during a disaster, not only do vulnerable households create opportunities for crime to take place, but that the community is the key actor as well as the primary beneficiary (Pelling, 2003). Within the affected community, priority attention is often given to the most vulnerable (Pelling, 2009). He refers to a multitude of community stakeholders such as the police, the military, transportation services and emergency services that are brought together to maximize the local resource base (Penner, 2003). These particular agencies and organizations link vertically with the national and international levels to address the complexity of the vulnerability issues.

**Community Collaboration and Crime Prevention**

Community collaboration has been suggested as important for crime prevention. Mark Findlay, a scholar who has researched the *Futures for International Criminal Justice* is an advocate for community collaboration for crime prevention. Findlay states that during disasters communities pull together and are more likely to stop crimes from occurring. Collaboration within rural communities during times of distress may also increase the response from stakeholders and to crime (Findlay, 2008).

Recent innovation in managing criminal opportunities and risks in rural areas has included community characteristics at a relatively superficial level (Pelling, 2003). Pelling’s example of this includes housing, poverty, tenure, community construction form and populations in the geographic proximity of the disaster area. Although these factors are normally associated with risks, Pelling implies that the management
of these issues often has researchers overlooking the underlying causes of criminal opportunities (Pelling, 2003).

In comparison to Pelling’s concepts, Wilsner (1996), a scholar who studied the geography of vulnerability and risk management in Tokyo, states otherwise. Wilsner notes that there are some key indicators to vulnerability, such as homelessness, living in poverty stricken areas, or visible psychological states. Unlike Pelling, Wilsner suggests that those vulnerable to crime during disasters remain unseen in the community and are not significantly affected by crime (Wilsner, 2003). Wilsner’s research also suggests that notion of vulnerable and poverty stricken individuals being affected more so by crime is a myth.

Through these arguments, it is apparent that natural disasters can create vulnerability among almost anyone. But the question remains, who is vulnerable and what makes one more vulnerable to crime? It is suggested that through community involvement and planning, negative contributions that may arise from disasters might be minimal depending on the amount of community involvement (Findlay, 2008). The risks of criminal opportunities and health problems within a community can be mitigated and should be further investigated based on these different views.

**Migration and Criminal Opportunities during Disasters**

Trotz’s case study in Albouystown (1995) is similar to the small communities in Belize. Albouystown was recorded as a destination for an influx of migrants coming into rural areas during both disaster and non-disaster times. A small community located in the south of Georgetown, Guyana, Albouystown remains as one of the most densely populated communities in Guyana (Trotz, 1995). There have been major obstacles to improving the conditions of housing, resulting in further vulnerability as there is more access for breaking and entering and crime during hazards and flooding (Trotz, 1995). Trotz discussed the vulnerability in Albouystown as indicators of household access to economic, social and physical resources, through describing those household losses in response to past disasters and the community’s potential to overcome damages and losses due to crime through community engagement (Trotz, 1995).

Trotz’s study in Albouystown also included the issues of migration and transiency much like the research findings in Belize by Hansen and his colleagues. However, Trotz’s perspective on the transience of community members and outsiders is a positive one (Trotz, 1995). Trotz states that transience is likely to restrict the building up of social networks that results in higher security. Based on Trotz’s research, higher security works to mitigate the opportunities for crime (Trotz, 1995). His basic theoretical model suggests that although higher transiency will decrease social ties, security might increase due to dysfunction in a community. Trotz’s research shows that the increased level of security will reduce crime. More positively, security in Albouystown mainly came from the high number of community members striving to work together from a loss of ties to increase stability during a disaster (Trotz, 1995). Although distress due to the impacts of a disaster can cause a fear in crime, Trotz’s research in Albouystown shows how community security can also reduce the fear of crime (Trotz, 1995).

**Reducing Crime through Community Organization**

Communities with strong community organization are more able to prevent crime. Poor community organization, on the other hand, provides fertile ground for crime. In less developed countries it is important to know what relations actually exist within communities and how policing decisions are made (Clinard & Abbott, 1973).

Poverty is often used to explain why people have little time and energy to invest in preventative measures (Pelling, 2003). Also, in Albouystown, during floods and other disasters, this issue likely surfaced from a lack of trust in local leaders (Trotz, 1995). These community leaders have had a history of being mistrusted due to low accountability in measuring their power and presence during disasters (Trotz, 1995). Trotz states that the importance of government involvement in the community is reflected in the membership within that community. For
example, if government stakeholders provided increased security, the support from community leaders must be present to create a sense of high “community involvement” and support. Positive involvement by community leaders may in turn, reinforce community security resulting in less crime and disorganization.

Given the noted exposure to flooding in Alboustown, and adoptions of households at risk, Pelling asks: “to what extent have households come together and organized to reduce the vulnerability to crime?” (Pelling, 2003, p.134). Demographics of group membership show the key role played by women, members of churches and also community groups (Pelling, 2003). Where communities appear to be full of positive and frequent social interaction, 83% of the respondents in Trotz’s case studies spoke of their neighbours on the day of the survey. These social contacts were readily translated into positive informal actions to improve the security in their communities (Trotz, 1995). Thus, in less developed countries and rural areas, the more formal and informal actions between community members parallels to controlling and organizing communities.

The neighbourhood social control perspective includes mechanisms to decrease community residents’ fear of crime (Gibson et al., 2002). Awareness and education among community residents, relationships between government institutions and neighbours, and the willingness to intervene for the common good will result in a strengthening of community control and organization during disasters (Gibson et al., 2002). The fear of crime is increased by the media through repeated crime victim stories and sensationalized topics (McGarrell et al., 1997). The efforts made by the media results in curiosity and in discussions among neighbours and an increased fear during times of distress (McGarrell et al., 1997). McGarrell suggests that criminal opportunities can be reduced if neighbours share similar values, and are willing to address crime, and local police and city government are responsive to neighbourhood and resident needs.

Clinard and Abbot’s hypothesis in their study of *Slum Community Organization* is similar to McGarrel’s research findings in the effectiveness of “knowing your neighbours” (Clinard & Abbot, 1973). It was hypothesized that effective control of property crime, especially within a rural community, requires sufficient knowledge of and friendship between neighbours (Clinard & Abbot, 1973). The four factors in Clinard and Abbot’s hypothesis in mitigating crime through neighbourhood organization included, one; a general tendency to reject stealing from neighbours, two; neighbours will help informally to guard one another’s property, three; strangers can be readily identified, and four; residents will help someone in the community if help is needed (Clinard & Abbot, 1973). The bonds between neighbours in rural communities are strong, especially during times of distress (Clinard & Abbot, 1973). These community structures amongst neighbours will aid and facilitate in the growth of such a unity in a community and will create a high degree of “cultural integration” (Clinard & Abbot, 1973, p. 150) to increase friendships.

**Neighbourhood Watch**

Attempts have been made across the globe to minimize crime and the fear of crime through focusing on mitigating theft and vandalism. Organized groups within communities have made attempts to minimize crime concerns in a community through specific programs such as Neighbourhood Watch. When suspecting criminal activities in a neighbourhood or community, members involved in the program are encouraged not to intervene but to contact authorities. The organized group of citizens is devoted to theft- and vandalism-prevention within a neighbourhood. This program has been built on the concept of “Town Watch” from Colonial America (Holloway, Bennett & Farrington, 2008).

The most frequently suggested mechanism by which Neighbourhood Watch operates is by residents in the community looking out for and reporting suspicious activities to the police (Holloway et al., 2008). Research has suggested that surveillance might reduce crime, including initiatives such as Crime Prevention through Environmental Design (Lilly et al., 2007), because of its “deterrent” effect of decision making and perception of offenders. Thus, having residents watching for and reporting suspicious
activities will likely deter offenders if they are aware of the likelihood of local resident surveillance (Holloway et al., 2008). Through offenders acknowledging that their behaviours are being examined by local residents, they may perceive this as increasing their risks of being cause, therefore; those criminal behaviours will be minimized (Holloway, et al., 2008).

A variety of structural factors in explaining the fear of crime have been identified. Where there is high community crime, high community disasters and high population transiency (outsiders), there is an increased level of fear (Sampson, 2001). Identifying the individual, community, and structural correlates of the fear of crime has gained importance, as individuals’ feelings of fear and anxiety regarding their personal safety, especially during disasters, may be increased by disasters (Sampson, 2001).

**Fear of Crime**

**Fear and Perception**

Residents can feel afraid of becoming victims of crime even when the actual probability of being a victim is low (Hale, 1996). Based on several research studies, it is evident that the fear of crime can often outweigh the actual occurrence of crime (Ferguson & Mindel, 2007). Ferguson and Mindel’s findings reveal that the fear of crime is both an emotional and cognitive response to crime-related perceptions. Disorderly situations that put people at risk tend to aggravate the fear of crime, such as a disaster (Renauer, 2007). Several recent studies have shown the disparity and difference between the fear of crime and perceived risk of crime as distinct outcomes in a community (Ferguson & Mindel, 2007). The fear of crime refers to an individual’s emotional response to a real crime incident; a perceived risk of crime is from an individual’s assessment of their own community. Disparity between fear and perception suggests that an individual’s fear or perspective of their surroundings is not conclusive a criminal occurrence.

D. R. Singh’s survey from an international crime (victim) survey in Bombay, questioned the extent to which the public is concerned with crime (United Nations Interregional Crime and Justice Research Institute, 1995). Results showed that the majority of the respondents (92.8%) had not discussed crime problems with friends or relatives. Singh suggested that these results proved that either the crime problem was not as serious as residents believed or that the residents themselves have never experienced crime (UNICRI, 1995). Those respondents who had discussed the problem (7.2%) may either have been victims of crime or knew someone who had been a victim. These disparities demonstrate how the fear of crime can be perceived differently if one has been a victim, knows a victim, or perceives that their community has issues of crime (UNICRI, 1995).

Brian Renauer’s study on reducing the fear of crime addressed whether participants perception of crime creates a level of fear in a community (Renauer, 2007). The perception of the lack of control in neighbourhoods in Renauer’s research was more strongly related to the fear of crime than to individuals’ actual experiences of crime (Renauer, 2007). The “informal social control perspective” (Renauer, 2007, p. 21) was the tool used to analyze the fear of crime, also referred to as “community concern model” or “urban release” (McGarrell et al., 1997, p. 481). Under Renauer’s model, the fear of crime is more than just a response to a personal experience of being a victim; it is also a consequence of the level of social control that is perceived by urban residents (Renauer, 2007). Renauer found that fear results when residents become concerned that the mechanisms used for controlling a community are no longer effective and the values and standards in the past are no longer used. From his research based on the fear of crime, Renauer suggests that a lack of control and organization within a community results in community members’ fear of being a victim of crime (Renauer, 2007).

Disorder in a community, particularly during disaster, is one of the largest influences on the fear of crime (Rollinger, 2008). The risk of crime coupled with the lack of stability in a community makes controlling crime challenging (Rollinger, 2008). For example, if there are low levels of community trust, information about risks within the community and distrust in the environment become present (Rollinger, 2008).
Effects of Fear

Whether realistic or not, the fear of crime itself greatly magnifies the human effects of a disaster. The feelings associated with the fear of crime in a community have a number of negative effects on an individual and group life (Hale, 1996). The fear of crime can affect public health and psychological well being, alter community activities, habits, contribute to withdrawal from certain areas in a community and decrease neighbourhood stability (Hale, 1996). Fear of crime includes a range of emotions such as community members believing that crime is present in their community, anger about the belief of crime in a community, and feeling threatened by their fears and anxiety about the risks in their community (Warr, 2000). Concerns about crime can be different from the perceptions of the risk of being a victim; concerns include individual assessments about a crime problem (Warr, 2000). Individuals in a community that feel vulnerable to crime are likely to feel that they are targeted and unable to control the possibility of being a victim (Warr, 2000). Residents may choose not to evacuate and leave their belongings behind because they have a high fear of crime occurring, even when the actual risk may be low.

If present, the fear of crime can be a significant social problem (Gibson et al., 2002). The fear of crime is in need for specific understanding and direct societal response (Gibson et al., 2002). Although feelings and concerns may be complex, measuring the fear of crime in a community can be a simple task (Warr, 2000). Disaster agencies need to understand both the levels of crime and the factors that increase fear of crime.

Reducing the Fear of Crime

Silver and Miller (2004) also refer to informal social control in their research on the fear of crime. Silver and Miller (2004) give an excellent perspective on the fear of crime in small communities when opportunities for crime are present. Informal social control in this case refers to neighbourhood residents’ willingness to engage in behaviours aimed at preventing criminal behaviours in the local area. This control assumes willingness of neighbours to take the responsibility for one another in their community (Silver & Miller, 2004). Renauer suggested in his research that if residents in a community are willing to assume this type of responsibility for one another, a community can then reduce risk of crime. The willingness to intervene for the common good will thus reduces the fear of crime and opportunities for crime (Renauer, 2007).

Neighbourhood social control has been found to reduce the amount of fear within communities. Bursik and Grasmick (1993) define public social control as “the ability of the community to secure goods and services that are allocated by agencies located outside of the neighbourhood” (Bursick & Grasmick, 1993, p. 17). Similar to Renauer’s hypothesis, this suggests that social control within a community will reduce the fear of crime if communication is met with stakeholders helping a community in distress. When individual residents start to have less fear of crime, it spreads throughout the community.

Although social control in a community is crucial in maintaining peace and safety, there occasions when such control is lacking or breaks down, such as during disasters. When control in the community is not enough to keep peace and to maintain the control of crime, residents require assistance from the government. Some traditional theories describe how the government preserves social order during disasters by maintaining peace and order, protecting citizens, and achieving public legitimacy (Renauer, 2007). Renauer’s research on public social control concludes that social trust among residents and the existence of government authority in neighbourhoods are mutually reinforcing and jointly influence the fear of crime (Renauer, 2007). Through this research, it is suggested that through community integration with stakeholders and agencies, the fear of crime during disasters will likely decrease and remain controlled (Renauer, 2007).

These research results indicate that both informal control, especially trusting residents, and formal social control, of police encounters and police effectiveness, influence the fear of crime and confidence in police as Warr suggests. Discussions of citizen mistrust during disasters influence the fear of crime, and police and government responsibilities, including
surveillance, should be considered further for reducing the fear of crime (Renuer, 2007).

**Fear Reduction through Neighbourhood Organization**

These studies raise the question of who is responsible for addressing the fear of crime. Despite limitations in research, the research on the fear of crime indicated that both informal and formal social controls influence emotional fear of crime (Lewis & Salem, 1986). Both citizens and public authorities need to take responsibility to help reduce crime and the fear of crime during disasters (Lewis & Salem, 1986). Lewis and Salem suggest that neighbourhood social cohesion, police legitimacy, police effectiveness and government responsiveness can all be linked to the fear of crime. This suggests that programs that strengthen cooperation and organization will be important to reduce crime and fear of crime during disasters (Lewis & Salem, 1986).

**Costs of Crime**

Research suggests that government’s that seek to address the social welfare of a community often spend more funds on disaster prevention and mitigation in more populated regions of the country (Cohen & Werker, 2004). These particular governments seek for aid through other agencies during disaster times such as the Red Cross. Cohen and Werker suggest that governments with a lack of sources of external income are more likely to be influenced by an effect known as the “racket effect” (Cohen & Werker, 2004, p. 4). This means they neglect mitigation because they know they can get resources when a disaster occurs. It is suggested that the racket effect will be weaker if humanitarian aid is provided directly to the area of suffering rather than through the central government. If agencies internalize losses from theft, the severity of the disaster may be greater and the racket effect may have an even greater impact on creating unnecessary issues including theft (Cohen & Werker, 2004).

It is suggested that these results have policy implications for reducing the effects of natural disasters; theft and unfair disaster relief being the effects. Cohen and Werker suggest for implications including; the international community must be involved in disaster prevention if it requires fair distributions of disaster relief including food, water and clothing, two; disaster relief should be provided locally to reduce the significance of the “racket effect”, three; political development “in the form of more responsive governments, will naturally reduce severity of disasters through relief, and four, non-disaster payments can be given to governments but then taken away in the event of a disaster to correct incentives to profit from good times rather than bad, “particularity in problematic areas” (Cohen and Werker, 2004).

There are large spending decisions that the central government must make and consider in disaster planning and during. There must be a fixed supply to spend on disaster prevention or put aside for other spending to aid in mitigation and effects from disasters. For example, the control of theft through increased security is an increased expense. Cohen and Werker suggest that the amount must be allocated depending on the region of the country should be thought of as encompassing both “preventative and palliative measures” (Cohen & Werker, 2004, p. 5).

**Conclusion**

The research suggests that crime and fear of crime is strongly influenced by a network of voluntary controls and standards among community residents (Raneuer, 2007). As disasters can create disorganization, loss and fear, residents themselves are enforced by the residents themselves (Lewis & Salem, 1986). Neighbours are able to enforce civilization where no amount of police can enforce it alone when communities are broken down opening up opportunities for crime during disasters (Raneuer, 2007). Crime as a societal issue is a diverse and a complex problem which in turn, requires complex solutions for mitigation (Lilly et al, 2007). As individuals are exposed to crime on a global scale, education and awareness to factual reports of crime are significant to reduce the fear and opportunities for crime during disasters.
References


Victimization in the Developing World.
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Water Supply and Sanitation in Disaster Management
(by Jaimie Golob)

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This literature review explores water supply and sanitation issues in developing nations as well as disaster management in the water sector. The majority of the information is references from peer-reviewed journals, scholarly papers and articles, government and non-government documents and publications. This review provides information for a policy analysis report for low cost and no cost strategies for water supply and sanitation (WSS) for rural communities in the Belize River Valley (BRV).

Geography and Climate Background

Belize is a coastal country vulnerable to natural disasters such as floods and hurricanes. The BRV lies within the Belize River watershed and contains large areas of flat and low-lying terrain that gradually increase in elevation from the coast to several miles inland (Department on Environment, 2005).

Belize experiences wet and dry seasons (Belize NMS, 2009; Fuller, 2002). The wet season normally occurs from mid-June to November with an annual rainfall of 1524 mm; this is less than half of the rainfall of the southern region of the country (Belize NMS, 2009). Hurricane season occurs during the wet period amplifying the potential for flood risks.

While the rainy season provides a sufficient supply of water for human consumption in theory, the reality is that collection and storage is dependent on finances and the proper maintenance of large storage tanks or wells. The dry season means high temperatures and lack of rainfall that can lead to devastating droughts (2009). These seasonal variations influence water catchment strategies that can be implemented in the BRV.

Natural Disasters

The Water Supply and Sanitation Collaborative Council (WSSCC) defines a disaster as a “serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.” Not only do emergencies have immediate effects on a community, they also affect humans psychologically and disrupt long-term sustainable development (WSSCC, 2009, p. 1).

It should be acknowledged that “the magnitude of a disaster is not determined by floodwater alone but also by the pattern of vulnerability in which people live” (Khurshid, 2008, p. 2). Vulnerable populations are often already challenged with poverty issues, health issues such as HIV/AIDS, unsafe shelters for households and inadequate access to basic resources such as sanitary drinking and bathing water. Furthermore, these communities are often forced to settle and grow their crops in marginal areas and flood plains (2008).

Minimum Standards of WSS for Emergency Response

International society accepts that every human being is entitled safe water regardless of race, gender, or economic status. Numerous non-government agencies (NGOs) such as the International Red Cross, UNICEF, World Health Organization (WHO), Pan-American Health Organization (PAHO), the Water Supply and Sanitation Collaborative Council (WSSCC), and the Sphere Project among many others support this perspective and strive to improve the standards of developing nations.
However, there is a disparity in the distribution of fresh water sources throughout the globe. Clean water is a fundamental need during an emergency. Humans could not survive without the precious resource of water.

The Sphere Project has developed a Humanitarian Charter and Minimum Standards that has established minimum standards in all sectors where humanitarian assistance is required. The standards are adapted from this document include the following:

1. **Participation**
   - The disaster-affected population actively participates in the assessment, design, implementation, monitoring and evaluation of the assistance programme.

2. **Initial Assessment**
   - Assessments provide an understanding of the disaster situation and a clear analysis of threats to life, dignity, health and livelihoods to determine, in consultation with the relevant authorities, whether an external response is required and, if so, the nature of the response.

3. **Response**
   - A humanitarian response is required in situations where the relevant authorities are unable and/or unwilling to respond to the protection and assistance needs of the population on the territory over which they have control, and when assessment and analysis indicate that these needs are unmet.

4. **Targeting**
   - Humanitarian assistance or services are provided equitably and impartially, based on the vulnerability and needs of individuals or groups affected by disaster.

5. **Monitoring**
   - The effectiveness of the programme in responding to problems is identified and changes in the broader context are continually monitored, with a view to improving the programme, or to phasing it out as required.

6. **Evaluation**
   - There is a systematic and impartial examination of humanitarian action, intended to draw lessons to improve practice and policy and to enhance accountability.

7. **Aid worker competencies and responsibilities**
   - Aid workers possess appropriate qualifications, attitudes and experience to plan and effectively implement appropriate programmes.

8. **Supervision, management and support of personnel**
   - Aid workers receive supervision and support to ensure effective implementation of the humanitarian assistance programme (Sphere, Ch. 1, 2004).

Please refer to Appendix I for a detailed flow chart for Sphere standards in water supply, sanitation and hygiene promotion.

**Disaster Risk Reduction and Disaster Preparedness for WSS**

The Water Supply and Sanitation Collaborative Council (WSSCC) strives for sustainable water supply and sanitation of world populations with a strong focus on collaboration between sector agencies. The council connects issues in water supply and sanitation hygiene (WASH) in relation to disaster risk reduction and emergency response (2009).

Several reports by international agencies support disaster mainstreaming in development and integrated management for preparedness and response programs as positive solutions (Baron, 2009; WSSCC, 2009). The WSSCC emphasize that “disasters often produce a relatively low number of casualties but a high number of displaced persons and infrastructure damage” (2009, p. 2). In other words, the well-being and livelihoods are often affected for a long period of time after the immediate flood has subsided. It is imperative that basic needs such as access to clean water supply is met and can be sustained before a disaster occurs.

Long-term management strategies are needed to reduce vulnerability of water supply and
sanitation in a disaster situation (Baron, 2009; Chene, 2009; WSSCC, 2009). Pearce defines disaster management as the “process of forming common objectives and common values in order to encourage participants to plan for and deal with potential and actual disasters” (2000, p. 9). The varying phases of disaster management are emergency mitigation, preparedness, response and recovery. The success of each phase influences the outcomes of the other phases and should be managed holistically. Furthermore, resources and finances are finite and should therefore be prioritized by need and by resources available (Baron, 2009; Chene, 2009; Pearce, 2000; Sphere, 2004). In regards to the BRV, more of a focus should be directed towards emergency mitigation and preparedness to reduce the need for outside resources to aid in the response and recovery phases of a disaster.

**Integrated Water Resource Management**

Chene suggests that regions with limited water resources should adopt the concept of Integrated Water Resource Management (IWRM) especially in regions that have limited access to water resources. The Global Water Partnership (GWP) defines IWRM as:

> A process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Chene, p. 1, 2009).

Issues have arisen from this concept since it was introduced in the 1970s. Some literature in the article argues that the theory of IWRM has not been implemented in practice and the concept definition can be vague (Chene, 2009). Consideration for both anthropogenic and environmental systems is also a crucial factor in putting IWRM into practise but it is often difficult to implement (Lenton, 2004) For the BRV it would be necessary to assess the relationship between the existing water supply and quality with the desired needs of the local rural populations. Alternative strategies would then need to reflect the needs of the region’s vulnerable environment to develop a sustainable balance. Integrated management of each aspect within WSS would need to be closely linked to implement long-term strategies (Eisenberg, Scott, & Porco, 2007).

**Community-Level Capacity**

An important step in strengthening sustainable sanitary water supply and disaster preparedness at the village level is to develop a community’s self-capacity. This can be supported by linking national disaster planning with the input of organized and trained local committees to develop independence (WSSCC, 2009; Khurshid, 2008, ProVention, 2008, Adams, 1999).

Communities should also incorporate long term management of sanitation infrastructure and hygiene practices with continued maintenance of these systems (WSSCC, 2009). For instance, if water catchment tanks are provided in a central community area for all residents to use, responsibility of proper sanitation management of the tanks would be necessary for long-term sustainability.

Inter-agency cooperation and partnership is crucial for long-term solutions as well (Pelling, 2008; WSSCC, 2008; Sphere, 2004). For instance, an inventory of available water sources, catchment methods and storage tanks would need to be collected at the community level and shared with agencies. In turn, agencies providing funding and/or distribution of water systems or supplies in pre-flood and recovery phases would need to share this information.

There are several useful strategies that can assist in developing a community’s resilience to disasters. Common themes that are highlighted in *From Grassroots to Global: People Centered Disaster Risk Reduction* suggest:

- **Utilize community resources** - encourage the use of local knowledge, local skills and existing infrastructure
- **Funding** - Identify local needs through community participation, provide workshops to train community members in proposal writing and provide resources to apply for funding.
- **Education** - increase awareness about prevention, impacts and what they can do to prepare
Media - encourage media use as a tool to link the community with other stakeholders

Collaboration - identify all stakeholders, their role and their agendas through meetings to avoid duplication and gaps (Pelling, 2008).

Risk Management and Prevention

Author Samantha Rizak of *Achieving safe drinking water-risk management based on experience and reality* emphasizes that prevention is the core to effective risk reduction. She highlights that important characteristics of risk management are:

- being preventive rather than reactive;
- distinguishing greater risks from lesser ones and dealing first with the former; taking time to learn from experience; and investing resources in risk management that are proportional to the danger posed. (p.172, 2007)

A fundamental element of risk management and preparedness for WSS is the protection of water sources. Water systems should be developed and managed to withstand risk factors and challenges to protect consumers from waterborne disease outbreaks (Rizak, 2007). To do so, a multiple barrier approach illustrated in Table 1 is recommended to strengthen the prevention of contamination.

Multi-stakeholder Approach

A multi-stakeholder approach is the large-scale involvement to assist government roles in reducing disaster impacts and issues. Actors discussed at the *Workshop on Climate Change adaptation, Development and Disaster Risk Reduction* include national and local governments, intergovernmental ministries, donors and investment partners, Town and village councils, the private sector and the media (ProVention, 2008).

Multi-sectoral Approach

A multi-sectoral approach addresses climate change and disaster management involving a range of actors from various sectors holistically to “address sustainable development, poverty reduction, disaster risk reduction efforts and climate adaptation measures” (ProVention, 2008, p.7).

Table 1: Multiple Barrier Approach to Drinking Water Safety

| Source protection and selection | The best possible raw water should be used and protected to reduce contamination breaching the drinking water system |
| Treatment | Effective treatment, often involving more than one process to remove contaminants, must be effectively designed, operated and maintained |
| Distribution system | Secure storage and distribution of treated water should be provided to protect against intrusion of contaminants |
| Monitoring | Appropriate and effective monitoring performed to control operational processes and direct contamination in a timely manner to inform risk management responses |
| Response | Appropriate and effective responses to adverse conditions that are well-conceived and thorough |

Information adapted from *achieving safe drinking water-risk management based on experience and reality* (p. 172, 2007)

Community-based Approach

A community-based approach emphasizes the importance in bottom-up participation in all aspects of disaster risk management. This allows for specific needs of the community to be addressed unlike the top-down approach. Local people contribute rich knowledge in local traditions, skills and resources which in turn may strengthen village capacity building and minimize dependency on outside aid. Furthermore, local people are usually the first to respond and assist disaster-affected people (ProVention, 2008, Adams, 1999).

Emergency Response for WSS

Natural disasters are a reality for many parts of the world and are changing in pattern, frequency, and intensity with the effects of global warming (Khurshid, 2008). One third of the global population was affected by natural disasters in the twentieth century (WSSCC, 2009; Welgin, no
date). The Council emphasizes that the three main priorities of emergency water response is adequate supply of safe drinking water, basic sanitation of water, and hygiene education and awareness. Safe drinking water can be ensured with the provision of delivered water or purification devices such as chlorinating tablets or filters if pre-existing supplies have been contaminated (2009). Remote villages in the BRV are easily isolated due to flood waters overtaking road systems. Therefore, rainwater harvesting combined with appropriate treatment and storage may be an effective strategy in dealing with water supply issues. Better hygiene practices can be taught through training sessions and incorporated into school curricula (WSSCC, 2009).

The Humanitarian reform: water, sanitation and hygiene cluster uses a cluster approach, or partnership building in various sectors. The WASH sector is an example of a cluster approach whereby different agencies collaborate to effectively address challenging issues. The Sphere Project is another example of humanitarian NGOs and the International Red Cross have come together to promote accountability and responsibility through collective partnerships (Sphere, 2004).

**Water Quality and Health Impacts**

Hazardous flood waters increase occurrences of microbiological illnesses and could lead to the risk of pandemics affecting livelihoods and human well-being. Flood disasters are widespread and are more likely to affect higher populations, in particular third world populations that live in vulnerable locations where the technology for early warning systems is not in place. Populations can suffer immediate deaths through drowning and injury or through after effects of floods such as illnesses, inadequate drinking water and food sources (Cannon, 1990, Lenton, 2004).

Please refer to Appendix II for a breakdown of Water and Excreta-related Diseases and Transmission Mechanisms.

**Community-Level Model and Household-Level Model for Disease Transmission**

Studies conducted for Integrating Disease Control Strategies: Balancing Water Sanitation and Hygiene Intervention to Reduce Diarrheal Disease Burden support the conclusion that water quality intervention are closely dependant on sanitation and hygiene conditions in a community. There are several potential pathways for transmission and the study suggests that single pathway interventions may have minimal benefits (Eisenberg, 2007). People exposed to contaminated water may transmit pathogens to non-exposed people through food, improper hygiene practices and sanitation. In other words, water contamination will affect conditions regarding sanitation and hygiene and poor sanitation and hygiene practices will compromise the safety of drinking water. A house-hold level model with five transmission pathways may include:

- **Between-households**-occurs from the transmission of pathogens from a person in one household to another person in a different household. Proper hand washing/disinfection can help prevent this issue.
- **Within-household**-occurs between at least two people and is a hygiene issue. Proper hand washing and bathing can help prevent this transmission.
- **Household-to-water**-occurs from inappropriate disposal of feces and is a sanitation issue. Providing proper latrines may help prevent this issue.
- **Water-to-household**-occurs from transfer of pathogens to humans and is a water quality issue. Improving water quality and treating water before consumption may improve this issue.
- **External transmission**-occurs from a contaminated outside source entering the community through upstream water flow, contaminated food or individual(s).

Ideally, communities should have access and the capacity to store safe water in preparation for risk of disasters. However, this is not the case with
many isolated rural communities in developing (DC) and transitional countries (TC). Preventable water associated illnesses and mortality result globally in relation with other causal factors of poverty due to inadequate quantity, quality and proper hygiene of water (Strock, Songer & Fiori, 2008). Although the right to water has been established by NGOs, many developing countries lack economic resources and personnel to develop sanitation infrastructure and technology (2008). Furthermore, in situations where systems such as Rural Rudimentary Water Systems (RRWS) are developed, it is the responsibility of the community to operate and maintain the system. Whether households have access to these systems or collect their own water systems, it is the responsibility of the consumers to treat their own water and prevent health issues (Peter-Varbanets, 2008). Therefore, low-cost and/or no cost solutions and policies need to be developed for rural communities.

Safe drinking water and effective storage through water mitigation contribute to better human health and quality of life. A sufficient household supply of drinking water properly treated and stored reduces the risk of the need to consume contaminated sources and decreases aid dependency. Fecal contaminated flood waters magnify and increase microbiological illnesses thru vector-borne and water-borne diseases if not managed effectively. Therefore, sanitation and water supply are closely linked and one should not be intervened without considered each aspect (Peter-Varbanets, 2008; Sobsey 2002).

**Strengthening Household Capacity through Decentralized Systems**

In rural regions of DC and TC, centralized water systems that may be suitable for urban regions or developed nations, are usually not suitable due to high cost and residential sprawl (Peter-Varbanets, 2008). The BRV may not be considered impoverished in comparison to developing nations such as Africa. However, disparities of rural BRV households exist with large gaps between supply and demand. Decentralized systems are in practice in various countries globally to improve this issue.

Generally the water quality of the BRV watershed is alkaline-based and hardness of base flows is elevated depending on the time of year and flood stages (Department of Environment, 2005). Rural household water sources in Belize include untreated groundwater supply such as hand-dug wells and catchment of surface water sources such rain water and river water (Strock, 2008). When families have limited capacities of safe storage to capture water on a daily basis, preparing a safe supply for emergencies may not be possible. The article Decentralized systems for potable water and the potential of membrane technology and Managing Water in the Home: Accelerated Health Gains from Improved Water Supply are excellent reviews of decentralized technologies suitable for rural DC and IT regions.

**Sanitary Collection and Storage Water at the Household-level**

The microbiological quality of a water source can become contaminated if not collected, handled and stored properly. Rainwater catchment tanks and storage vessels should have narrow openings that are also large enough to access for cleaning. This is most effective if combined with an output such as spout or tap to protect the contained water from vector and fecal contamination (Peter-Varbanets, 2008; Eisenburg, 2007; Kayaga, 2005; The Sphere Project, 2004; Sobsey, 2002).
strategies can vary in receptacle size and material (Sobsey, 2002).

Historically natural materials such as animal hides and plant materials were utilized while more modern man-made materials such as metals, cement, and plastics. Not all methods are equitable in efficiency and quality. The method of collection, storage and hygiene practices greatly influence the risk for water-borne illnesses particularly during and after an emergency (2002).

**Alternative Methods for Addressing Limited Water Quantity**

**Groundwater and Wells**

Communities with limited resources often have to rely on river water or hand dug wells for their household supply of water. Wells can be operated manually by dipping, by using hand pumps and using motor pumps. Much of the time construction costs, management and treatment are the responsibility of the home owner and contribute to the capacity aims to meet family needs (Peter-Varbanets, 2008). Unfortunately, water contamination is common due to poor location, if the well is not deep enough, if there is poor drainage, and from high mineral concentrations in the soil. Furthermore, domestic, agriculture and industrial pollution can affect the quality of the water (Peter-Varbanets, 2008).

**Rainwater Harvesting**

Rainwater harvesting is a low cost and effective alternative to expensive water systems and is a traditional water source for many regions of the world (Ahmed, 2008). One of the main benefits according to Peter-Varbanets review is that “Rainwater harvesting provides water at the point of use and family members have full control of their own systems, which greatly reduces operation and maintenance problems” (2008, p. 250). On the other hand, a disadvantage of this method is that it is dependent on precipitation and can become contaminated from rooftop runoff or from storage.

A basic system consists of a collection surface such as a roof, gutters to direct water flow, and a storage tank (Ahmed, 2008). A limiting factor of this source in many case, is the lack of a sufficient storage (Ahmed, 2008; Iles, 1989). The article *Harvesting rainwater using a simple catchment surface* discusses a successful system that was introduced to a farmer’s group in Kenya. Local women were taught how to construct the catchment surface called a *sarisa* with local plastic sacks woven together. Four poles are used to elevate the surface at an angle and a bamboo-like material is split and attached to create the gutter. Finally, clay pots with narrow openings were used to collect the water (Iles, 1989).

**Gutter Systems**

The Practical Action technical notes for rainwater harvesting explain some low cost options for creating household gutter systems. Manufactured gutters are expensive and often not readily available in DC and TC. Figures 2, 3 and 4 illustrate some household options.
Alternative Methods for water quality issues

Peter-Varbanet describes the three types of decentralized systems:

- **Point-of-use (POU)** - These systems refer to the treatment of household drinking water with a treatment capacity of 2-8L per person per day. For a four member family, the household would need a treatment capacity of approximately 8-32L per day.

- **Point-of-entry (POE)** - These systems refer to the treatment all water coming into the household with a higher treatment capacity of approximately 100-150L per person per day.

- **Small-scale systems (SSS)** - These systems are smaller than centralized systems but are than POU and POE systems with a treatment capacity that can serve several households or a small village. The capacity is estimated to supply 1000-10,000L per day (2008).

POU Technologies

Several household treatment strategies are available for use in DC and TC including (for detailed descriptions and evaluations refer to Peter-Varbanet, 2008; Sobsey, 2002):

- **Physical Methods for removal**
  - Sedimentation
  - Filtration
  - Granular media filters, including sand filters
  - Aeration

- **Chemical treatment methods**
  - Chemical disinfection
  - Coagulation, flocculation and precipitation
  - Ion exchange
  - Adsorption

- **Heat and UV-based methods**
  - Boiling
  - Solar radiation
  - SODIS (heat and solar UV combined)
  - UV Lamps

Emergency Treatment of Drinking Water at Point-of-Use for the Household-level

Physical Methods of Water Treatment

WHO discusses several low cost point-of-use alternatives that are meant to be short term solutions to create safe drinking water from polluted sources until long-term options are viable. Strategies include simple straining methods, aeration techniques to increase oxygen content, storage and settlement, filtration, and disinfection through chlorination and solar disinfection. Families in the BRV may be able to benefit from some of these methods with the implementation training and awareness programs in disaster preparedness.

A multi-barrier approach is recommended. The general steps of emergency treatment comprise of straining, proper storage/settlement, filtration and disinfection. Often water may have to be pre-treated to remove turbidity (suspended matter, muddy appearance) in combination with point-of-use treatment methods to have effective results (Kayaga, 2005; Sobsey, 2002).

Practices to reduce turbidity include straining by pouring the water through a clean cotton cloth to remove larger particulate matter. Also proper settling and sedimentation allows particles to settle to the bottom of the vessel and by storing the water for day in a safe environment before consumption can reduce existing bacteria by 50%. Longer storage times will improve the water quality even further (Kayaga, 2005). In addition, different types of filtration including sand filters, charcoal filters and ceramic filters have been proven to be effective. Strock
discusses a successful case study of four rural villages in Belize whereby sand filter systems were constructed at low cost using local materials and participation (2008).

Delivery of water filtering system to residents of BRV.

Chemical Methods of Water Treatment

Options for treatment include disinfection by boiling (dependent on a fuel source), disinfection by chlorination (liquid or tablet form) and Solar Water Disinfection (SODIS).

Boiling

Boiling is a very effective method to inactivate various pathogens but may not be suitable for everyone particularly in floods due to the need for a fuel source. According to WHO water should be brought to a boil for a minimum of five minutes and twenty minutes is ideal. An additional draw back to the boiling method is that it alters the taste of the drinking water due to released air. Stirring the water or shaking in an enclosed container or bottle after it has cooled can improve its taste (Kayago, 2005; Mintz, 2001).

Chlorination

Chlorination is one of the most commonly used, most effective, and least expensive chemical for household treatment of water sources during emergencies. Mintz highlights published trials that supports this method and notes that it can reduce diarrheal illness by up to 85% and is useful for emergency response (2001). The WHO Technical notes for emergency treatment of water emphasizes the chlorine should be left to sit for a minimum of 30 minutes to kill pathogens.

Pamphlets distributed by the Belize Ministry of Health recommends 2 drops of bleach per 1 litre bottle and then vigorous shaking before letting it settle for 30 minutes.

**Solar Disinfection (SODIS)**

The SODIS method uses the sun's radiation to improve water quality and kill diarrheal pathogens. Plastic PET bottles (plastic soda bottles up to 2L) are filled with the contaminated water and are placed horizontally in sunlight for a minimum of six hours. The advantage of SODIS is that it is low cost and accessible. However, it does not increase water supply and is only useful at the household level. In addition, consistent sunlight is needed so it may not be suitable for the wet season (Kayaga, 2005; Mintz, 2001; Wegelin, no date).

Table 1 below summarizes physical and chemical methods that have been in use to treat sanitation levels for home use. Sobsey and WHO emphasize that research suggests that the most potential and accessibility for future implementation programs include disinfection by boiling, disinfection by solar heat and sunlight, disinfection with UV lamps, disinfection by chlorination partnered with proper storage and by chlorine partnered with systems of chemical coagulation-filtration (2002).

Minimum Water Quantity Needed for Households in Emergencies

Providing a clean water supply is a priority in an emergency situation. It is crucial that a proper needs assessment be calculated prior to distribution. Continuous communication and checking is emphasized between the agencies and the community to maintain an effectual water supply that meets household needs. Proper planning in the collection, storage, treatment and distribution is integral to the efficiency of limited time and finances. Potential environmental and
population health impacts of the borrowed source are also factors to consider. The WHO technical notes for *Minimum water quantity needed for domestic uses in emergencies* explain how an initial assessment can be calculated (Reed, 2005).

Table 1. Physical Methods for Water Treatment at the Household Level

<table>
<thead>
<tr>
<th>Method (a)</th>
<th>Availability and Practicality</th>
<th>Technical Difficulty</th>
<th>Cost (a)</th>
<th>Microbial Efficacy (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling or heating with fuels</td>
<td>Varies (c)</td>
<td>Low-Moderate</td>
<td>Varies (c)</td>
<td>High</td>
</tr>
<tr>
<td>Exposure to Sunlight</td>
<td>High</td>
<td>Low-Moderate</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>UV Irradiation (lamps)</td>
<td>Varies (d)</td>
<td>Low-moderate</td>
<td>Moderate-high (d)</td>
<td>High</td>
</tr>
<tr>
<td>Plain Sedimentation</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Filtration (e)</td>
<td>Varies (e)</td>
<td>Low-Moderate</td>
<td>Varies (e)</td>
<td>Varies (f)</td>
</tr>
<tr>
<td>Aeration</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
<td>Low (g)</td>
</tr>
</tbody>
</table>

Table adapted from *Managing Water in the Home: Accelerated Health Gains from Improved Water Supply*, 2002.

Table 2. Chemical or Physical-Chemical Methods for Water Treatment at the Household Level

<table>
<thead>
<tr>
<th>Method</th>
<th>Availability &amp; Practicality</th>
<th>Technical Difficulty</th>
<th>Cost (a)</th>
<th>Microbial Efficacy (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coagulation-Flocculation or Precipitation</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Varies</td>
<td>Varies (c)</td>
</tr>
<tr>
<td>Adsorption (charcoal, carbon, clay, etc.)</td>
<td>High to moderate</td>
<td>Low to moderate</td>
<td>Varies</td>
<td>Varies with adsorbent (d)</td>
</tr>
<tr>
<td>Ion exchange</td>
<td>Low to Moderate</td>
<td>Moderate to high</td>
<td>Usually High</td>
<td>Low or moderate</td>
</tr>
<tr>
<td>Chlorination</td>
<td>High to Moderate</td>
<td>Low to Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Ozonation</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Chlorine Dioxide</td>
<td>Low</td>
<td>Varies (e)</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Iodination (elemental, salt or resin)</td>
<td>Low</td>
<td>Moderate to High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Acid or base treatment with citrus juice,</td>
<td>High</td>
<td>Low</td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td>hydroxide salts, etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver or Copper</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Combined systems: chemical coagulation-</td>
<td>Low to Moderate</td>
<td>Moderate to High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>flocculation, filtration, chemical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>disinfection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table adapted from *Managing Water in the Home: Accelerated Health Gains from Improved Water Supply*, 2002.

Figure 1. Hierarchy of Water Requirements
Hygiene Education in Disaster Post-Disaster Response

In addition to economic and technical barriers, rural communities in developing nations often have a “lack of health-risk perception and related hygiene practice or any information on treatment products” (Peter-Vanbarets, 2008). Without proper hygiene education and practices implemented, water quality and sanitation interventions will have minimal effectiveness on their own (Eisenburg, 2007; Odhiambo, 2005 & Sobsey, 2002). Each aspect is closely linked to the success of the others. According to WHO, hygiene promotion during emergencies is “not a simple matter of providing information. It is more a dialogue with communities about hygiene and related health problems, to encourage improved hygiene practices” (Odhiambo, 2005, p. 1).

Conclusion

Several strategies can be implemented to improve WASH issues in disaster mitigation, disaster preparedness, disaster response and post-disaster recovery phases. It is recommended that the focus for the BRV rural communities should be in the mitigation and emergency preparedness to increase household and community self-capacity. Each community and household should have an emergency plan in the event of isolation from outside sources and aid. In addition, interagency communication is recommended to reduce gaps in water supply and sanitation and increase disaster risk reduction.

Disaster management should adopt an integrated approach among sectors and within the WASH sector itself to achieve long-term solutions in each phase. During an emergency situation, emphasis is directed to three main priorities of the distribution of safe drinking water, basic sanitation, and the provision of hygiene education. Short term and long term methods of water collection, storage and treatment at the household level have been discussed to reduce the risk of diarrheal diseases before, during and after a disaster. Furthermore, proper vulnerability assessments to establish the quantity and quality of water resources in each community are needed. It is essential that consistent evaluations of water supply and sanitation are revisited to ensure effective and sustainable solutions in the BRV.

References


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Appendix I: Water Supply, Sanitation and Hygiene Promotion

(Sphere, 2004, p. 52)
### Appendix II: Water- and Excreta-Related Diseases and Transmission Mechanisms

<table>
<thead>
<tr>
<th>Water-borne or water-washed</th>
<th></th>
<th>Faecal-oral bacterial</th>
<th>Faecal-oral non-bacterial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholera, shigellosis, diarrhoea, salmonellosis, etc.</td>
<td>Water contamination</td>
<td>Poor sanitation</td>
<td></td>
</tr>
<tr>
<td>Typhoid, paratyphoid, etc.</td>
<td>Poor personal hygiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoebic dysentery, giardiasis</td>
<td>Crop contamination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatitis A, poliomyelitis, rotavirus diarrhoea</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water-washed or water-scarce</th>
<th>Skin and eye infections</th>
<th>Inadequate water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Louse-borne typhus and louse-borne relapsing fever</td>
<td>Poor personal hygiene</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Excreta-related helminths</th>
<th>Roundworm, hookworm, whipworm, etc.</th>
<th>Soil-transmitted helminths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open defecation</td>
<td>Ground contamination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beef and pork tape worms</th>
<th>Taeniasis</th>
<th>Man-animal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Half-cooked meat</td>
<td>Ground contamination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water-based</th>
<th>Schistosomiasis, Guinea worm, clonorchiasis, etc.</th>
<th>Long stay in infected water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water contamination</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water-related insect vectors</th>
<th>Excreta-related insect vectors</th>
<th>Biting by mosquitoes, flies</th>
<th>Transmitted by flies and cockroaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria, dengue, sleeping sickness, filariasis, etc.</td>
<td>Diarrhoea and dysentery</td>
<td>Bite near water</td>
<td>Breed in water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dirty environment</td>
</tr>
</tbody>
</table>

(Sphere, 2004, p.95)
### Appendix III Overview of available POU/POE Water Treatment Technologies for DC, ICs and TC

<table>
<thead>
<tr>
<th>Water treatment system</th>
<th>Type of supply</th>
<th>Estimated costs</th>
<th>Performance</th>
<th>Ease of use</th>
<th>Maintenance</th>
<th>Sustainability</th>
<th>Dependence on utilities</th>
<th>Social acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Investment $US</td>
<td>Operational $US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiling with fuel</td>
<td>POU</td>
<td>Cook pot</td>
<td>Depends on fuel price</td>
<td>++</td>
<td>+</td>
<td>Depends on fuel availability</td>
<td>Fuel</td>
<td>++ tradition</td>
</tr>
<tr>
<td>Solar disinfection</td>
<td>POU</td>
<td>Plastic bottles</td>
<td>+, when low turbidity</td>
<td>+</td>
<td>+</td>
<td>Regular, time consuming</td>
<td>None</td>
<td>+/-</td>
</tr>
<tr>
<td>UV disinfection</td>
<td>POU</td>
<td>100-300</td>
<td>10-100</td>
<td>+, when low turbidity</td>
<td>+/training required</td>
<td>Regular</td>
<td>+</td>
<td>Electricity</td>
</tr>
<tr>
<td>with lamps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free chlorine</td>
<td>POU</td>
<td>2-8 (vessel)</td>
<td>1-3</td>
<td>+</td>
<td>+</td>
<td>EDM 100%, viruses -</td>
<td>++</td>
<td>Taste problem</td>
</tr>
<tr>
<td>Blending filters</td>
<td>POU</td>
<td>10-20</td>
<td>None</td>
<td>+</td>
<td>+</td>
<td>Required once in few months</td>
<td>None</td>
<td>Taste problem</td>
</tr>
<tr>
<td>Ceramic filters</td>
<td>POU</td>
<td>10-25</td>
<td>None-10</td>
<td>+/training required</td>
<td>++</td>
<td>++</td>
<td>Ceramic, replacement Required, time consuming</td>
<td>None</td>
</tr>
<tr>
<td>Gradientation, filtration, distillation</td>
<td>POU</td>
<td>5-10</td>
<td>100-220</td>
<td>+</td>
<td>++</td>
<td>Ceramic, replacement Required, time consuming</td>
<td>None</td>
<td>Taste problem</td>
</tr>
</tbody>
</table>

Transition and industrialized countries

- Activated carbon filtration
  - Faucet-mounted: 25-50
  - Under a sink: 50-300, 500-800
- Microfiltration\(^b\)
  - POU: 3

Ultrafiltration
- POU: 40

Reverse osmosis
- POU, 250-1000 people
- Single tap: 300-600

Bottled water
- For a family of 4 people per year: 29500
- 3600-7200

**n.a., data not available.**

a. Operational costs for POU/POE systems are given for a family of four.
b. Ceramic filters are considered separately.
Mitigating Housing Losses
(by Amy Campbell)

Amy Campbell graduated in Geography from the University of Victoria. She is currently working and living in the Comox Valley. She originated from St. Johns Newfoundland. She was part of the Geography group of the VIU Belize 2009.

This literature review is focused on the mitigation of damage to housing in flood prone areas of developing and developed countries. The literature used in this paper is collected from journals, books, academic papers, articles, government reports and government websites. This information will be used in a policy analysis on housing and relocation to mitigate floods in the Belize River Valley.

Issues

Garcia and Williams (2009) authored the Belize Country Report which reported that roughly 163 of the 263 settlements in Belize are at risk of flooding. Of these settlements, 149 are situated on floodplains which annually experience floods (Garcia, et al., 2009). In 2008, two flood disasters struck Belize: Tropical Storm Arthur and Tropical Depression 16. Together, these disasters affected 146 villages and at least 98,564 persons – approximately third of the population of Belize.

TD 16 was particularly disastrous for the Belize River Valley. The BRV experiences recurrent floods. During these floods and storms, homes and structures are weakened or destroyed. The Belize River Valley is located within a complex network of rivers, creeks and lagoons that make hydrology studies extremely difficult and complex. In this context, Belizeans must enhance the protection of houses and other structures from serious and recurrent flood damage. The main issue of the Belize River Valley is that homes and structures are becoming dangerous for inhabitants to live in before, during, and after a disaster. The government does not have the resources to keep rebuilding or restoring buildings. A solution must be created to help the people of these areas as well as save the government time and money.

Climate Change

Climate change will increase the hazards of living in flood prone areas. The twentieth century saw a consistent and significant warming of both land and ocean surface temperatures. This increase in temperature is a direct result of increased level of greenhouse gasses used on a global scale (Fuller, 2002). Traditionally, tropical cyclones and hurricanes are response to climatic conditions (Elsner, 2008). An increase in oceanic heat will raise a hurricane’s potential intensity. However an increase in shearing winds could counter this intensity by dispersing the heat in a fledgling storm (Elsner, 2008). In other words, shearing winds are high level winds that can shear off part of the cyclone and disrupt its formation.

In Belize, there are concerns that climate change will expand the regions of vulnerability and make these regions more sensitive to extreme events, and to damage to resources and ecosystems, settlements and infrastructure (NEMO, 2004). The impact of these factors are further compounded by poverty, the location of settlements in hazardous areas such as floodplains and coastal zones, environmental degradation, poor housing, and generally low levels of preparation for disaster (NEMO, 2004).

The effects of climate change are predicted to present a number of building challenges in the future including: windstorms, higher probability of flooding, increase demand for cooling, thermal discomfort in buildings, increased subsidence risk in subsidence-prone areas, water shortages and prolonged drought (Roberts, 2008). Climate change is a factor that in the future will thus intensify natural disasters.

Developed versus Less Developed Countries:

It is important to understand flood mitigation at an international level to compare and contrast solutions and options to aid in disaster.
management of the BRV. Floods are very expensive events around the world. Asia is struck by 70% of all floods in the world and the average annual cost of floods over the past decade is approximately $15 billion US (Hansson et al., 2005). Typhoons and floods account for more than 70% of the losses that stemmed from natural disasters in Taiwan (Hung, 2009). The literature suggests that roughly six thousand people die worldwide from flooding in 2000 resulting in flooding to become the dominant cause of flood loss of life from natural hazards in that specific year (Haynes et al., 2009). In Venezuela, the flood of December 1999 cost over 30,000 lives, destroyed 23,200 houses and damaged another 64,700 (Hansson et al., 2005).

Large areas of Bangladesh are flood-prone. Up to 60% of the country can be inundated in a flood disaster. Bangladesh experiences destruction of houses annually from development on flood zones. Ahmed (2005) states several reasons floods impact housing: depth, duration, uplift, and force. Secondary hazards from floods are normally high winds, storms, lightning, weak slopes and development on the ground. The flood of 1987-1988 in Bangladesh led to the start of the ‘Greater Dhaka Flood Protection Project’ as a measure to ensure flood-free life for about 10 million people (Chowdhury, 2003). Ahmed (2005) claims that, in Bangladesh, low-income households in flood prone areas receive little help from NGOs and the majority of homes built in flood plains are owner built without any proper material and building techniques targeted for flood areas.

Hansson et al. (2005) proposed a framework evaluation of flood management strategies. They state that disasters have the biggest impact in areas where the economy is weak. The authors express the importance that, in preparation for a disaster, there needs to be a common system to share information on losses from disastrous events, to efficiently use this information to mitigate damage to resources and to prepare better for disastrous effects on each community or country involved.

Participation of villages will be an important component of any housing policy for mitigating flood hazards. Policy makers, commentators, funding bodies and NGOs generally agree that the key for making low cost housing projects work lies in community participation (Davidson et al., 2007). Davidson et al. (2007, p. 101) summarize a variety of attitudes on the topic of housing projects for the poor in developing countries:

- construction codes and standards have to be met (as a result, housing is too expensive for though who most need it)
- projects have definite start and finish dates (yet informal low-cost housing is improved over decades or even generations)
- the poor are usually in a vulnerable social situation

Thus governments will have a larger role than merely adopting regulations. Villages will need to be involved in planning and development, and need assistance for improving flood safety.

**Construction Techniques in Floodplains**

One major approach for mitigating flood damage is to require construction techniques that can resist the ravages of flooding waters. Poorly constructed buildings are inevitably destroyed by floods, with great costs in property and sometimes lives. Anderson (2007, p. 207) stresses that

...it is widely recognized that it is cheaper in the long run (in the economic, social and political senses of the world) to prevent or mitigate disasters than to fund recovery.

Construction techniques are often specified in building codes. These codes can have provisions that apply to construction in flood prone lands. The general safety of buildings is covered in construction codes and structural systems (Dehring, 2006). In the United States, residential codes have been used for over one hundred years and the first model used was in 1905 published by the National Board of Pine Underwriters (Dehring, 2006).

According to the Belize National Hazard Mitigation Policy (2004) states the draft building bill [since enacted]:

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…was developed in recognition of the need to improve building standards and the construction of buildings especially of low-income houses, to resist severe weather events such as hurricanes... providing a review of building plans and the inspection of construction to be carried out by private building professionals and inspectors employed by authorities.

If people are going to build on floodplains, then the construction must be resistant to flood damage. Penning et al. (2006) claim that in the United Kingdom creation of a flood risk management policy shifts the attitude for defense from ‘living with floods’ and ‘making space for water’ and accepts that in the future floods will happen and they must be prepared to not be totally destroyed by them. In Florida coastal areas, the implementation of land use and building code requirements has created effective tools for mitigating damages, including state enforced elevation and construction requirements (Main et al., 1998).

A common theme within the literature is that globally people are accepting the “culture of preparedness” which is a shift from vulnerability to sustainability for their economy. Leatherman et al., (2008) argued that technological developments result in human safety: from automobile crash testing, shake tables for earthquakes and wind testing. Studies have proven that steel frames and brick buildings are less likely to collapse compared to other materials such as wood, and drywall that is waterproof will last longer in areas that experience annual floods (Kribich et al., 2005). There are some technologies for construction in flood prone areas can reduce flood damage.

Main et al. (1998) contend that it is the individual’s choice about where to live and how to protect their home and thus the responsibility to take precautions to reduce hazard risk should be placed upon the individual. California, Florida and the UK have acknowledged that people will continue to inhabit flood prone areas no matter what. Thus local jurisdictions must ensure structures will sustain future floods. The literature claims that, in general, mitigating harmful impacts can be achieved by reducing the harmful extent of the flood (Penning et al., 2006).

The literature supports that houses must be built stronger and more durable knowing that the built structures will and can survive a disaster with little damage (Leatherman et al., 2008). With mitigation in mind, the literature supports that use of elevation and stilts on homes as one of the most common flood mitigation practices. Investment in use of harder woods or concrete instead of softer wood ensures a more durable and longer lasting structure.

The U.S. Department of Housing and Urban Development Office of Policy Development and Research (2009) expressed options for flood and water damage mitigation and regulation:

Options for homes built in flood plains:
- Some residential construction will exist in a flood plain by choice or necessity
- Elevation designs will mitigate water damage if a flood were to take place

Elevated house construction:
- Traditional building in flood-prone areas are built on stilts
- Living spaces need remain high and dry as waters rise and fall to ensure health and safety for residents
- Structure of house cannot be vulnerable to flooding and must be able to sustain flowing water and debris
- If properly constructed the house will remain for years

Preferred building material attributes for flood-prone areas
- Non absorptive and materials that do not attain water
- Quick dry without creating long term damage
- Minimal building voids during construction
- Affordable in the market
- Non-moisture absorbent insulation
- Variety of housing types

Plycem is a construction material that has been proposed for new building construction in the Belize River Valley. Plycem fibre cement is an advanced construction material involving exclusive technology developed and patented by the Plycem Company; ‘Composed of cement, mineralized organic fibres and other non organic
additives’ (Plycem, 2006). The composition results in a light material that is easy to work with. It has the construction qualities of cement and the handling qualities of wood; not to mention it is ‘non combustible, termite resistant, moisture resistant, impact resistant and easy installation’ (Plycem, 2006). The company website claims it is only made in Central America which is good for Belize when it comes to transportation and access.

Although building codes and construction techniques can reduce flood damage, they should not be seen as the ‘safe’ solution. Floods are dangerous.

“Purely structural (physical) risk reduction initiatives, such as conventional and traditional engineering or planning which can easily create false security, are increasingly seen as the solution, few alternative strategies are being developed to replace them” (Wamsler, 2006, p. 151).

People will always fear floods because they have chosen to live on flood plains that would without control at any moment could destroy their livelihoods (Lyle, 2001).

**Floodplain Regulations**

Floodplain zoning is a non structural floodplain management measure aimed to reduce flood damage to a property (Hooper et al., 1996). Floods that severely affect both urban and rural developments are sometimes the result of mis-utilization the river rights in flood plains (Karmmouz et al., 2009). Hooper et al., (1996) claim that the first thing that must take place before any zoning is put forth is to identify the specific area or land type and apply limitations to the development on the floodplain depending on the basis of the likelihood and the severity of flooding.

Floodplain regulations are an important measure for reducing flood hazards to homes and other infrastructure. Floodplain regulations specify what types of land uses and buildings are allowed on floodplains, and how these buildings must be constructed. Zoning laws, regulatory techniques of improving materials and structures, prevention of development and building in flood prone areas, set back requirements and banning all construction on public areas of high risk location are common prevention strategies for building in flood prone areas (Main et al., 1998). However, the literature maintains that prevention, mitigation and preparedness measures are only measured in a developmental pre-disaster context (Wamsler, 2006).

The greatest historical flood in North America was the Mississippi flood of 1927 which was a direct result of the beginning of federal efforts in river management and engineering (Hudson et al., 2008). Revision of the National Flood Policy in the United States took place in 1994 with a focus towards limiting and reducing the amount of development inside the 100 year floodplain (Patterson et al., 2009). Roughly eight million homes in the United States are exposed to significant flood risk and represent considerable economic liabilities (Patterson et al., 2009). Flooding accounted for 90% of all natural disasters in the US, 900 deaths and 55 billion dollars in damage between the years 1992 and 2001 (Patterson et al., 2009). In the 2005, storm surges from Hurricanes Katrina and Rita caused major flooding of the US Gulf Coast and New Orleans. This resulted in a greater public awareness of fundamental linkages between flood management and geomorphology (Hudson et al., 2008).

Even though the US spends billions of dollars to decrease flood losses within the country a steady increase in flood losses is occurring directly driven by movement of people into flood prone areas (Patterson et al., 2009). The literature predicts that the trend will likely continue as the population grows and reduction of future floods impacts requires refocusing on the implementation of floodplain management and policies (Patterson et al., 2009). Restricting development on flood plains is an important tool for mitigating disastrous flood losses.

**Finance and Insurance**

Natural disasters create a major threat to property and life in developing countries (Hung, 2009). Financing is an important factor in mitigating flood hazards. Money is needed to reduce flood damage through relocation and better
construction. Money is also needed to restore housing and other structures after floods.

In developing countries, flood insurance can be created as a tool for flood risk sharing or reduction if it is well implemented and coupled with land use planning and other hazard mitigation measures (Hung, 2009). The purchase of flood insurance can reduce the uncertainty of recovery from future flood impacts by creating short term payments to ensure there will be money to reimburse people for future costs (Priest et al., 2005). Over the last decade, natural disasters have caused tremendous property losses around the world averaging $40 billion annually and reaching a staggering $100 billion in 1999 (Henstra et al., 2003).

In the United States at the Federal level, “The Federal Emergency Management Agency (FEMA) began the National Flood Insurance Program in 1969, in which participating counties adopt minimum elevation standards designed to reduce damage from storms and flood-prone areas” (Dehring, 2006). In the United States, the year 2008 claimed many lives and more property damage from floods than any other year on record (Kousky et al., 2009). Kousky (2009) stated that, the total cost of a flood event can actually be lowered by flood insurance because it reduces the amount of federal relief payments.

In Taiwan, the ministry of finance implemented a flood insurance program through the disaster prevention and protection act of 1999 (Hung, 2009). The act is expected to enable homeowners to confront future catastrophic disasters and encourage households to adopt relevant cost-effective measures to cope with flood loss (Hung, 2009) and in the long run benefit all parties involved. In the literature it is suggested that through past experiences with floods, the number of property contents insurance purchased and disposable income have positive correlations with the willingness to buy insurance (Hung, 2009) and social trust is the key predictor of whether or not a homeowner chooses to adopt risk-sharking measures or to buy insurance.

**Relocation**

One of the major options for mitigating disasters in disaster prone areas is to relocate homes and other valuable infrastructure to safer areas. For relocating housing, as Anderson states for addressing steep hill slope problems, the problems are,

- for the residents themselves; for governments in terms of potential relocation costs; for engineers in determining the precise nature of the hazard and risk, and for donor agencies (Anderson, 2007).

Relocation is a major and costly undertaking. However, in terms of floods, people’s attitudes have changed over time from a fear of an “act of God” to an overall understanding of the role human decisions play in determining vulnerability and the capacity to cope with the consequences of extreme events (Henstra et al., 2003). Henstra et al. (2003) define “adaptation” as measures taken in response to actual or expected changes in climate. Climate change is changing the nature of disasters – making them more frequent and severe in some areas. Relocation has to be considered for some areas in this context.

In discussion relocation as a mitigation strategy, it is important to understand the attitudes and interests of people in floodplains. Relocating after a natural disaster is a social issue and people usually do not want to leave their home. Chan (1995) examines the reasons why a significant proportion of Malaysians persist in inhabiting flood prone areas:

1. They do not know about the hazard and are therefore not unduly concerned.
2. They know about the hazard, but do not expect a flood.
3. They expect to suffer a loss, but not a serious one.
4. They expect to suffer a serious loss and therefore undertaken, or are planning to under take some action to reduce the loss.
5. They expect to bear loss but see this outcome as an acceptable cost of enjoying the location (environmental) benefits.
6. They had little or no choice where to live and have little or no choice but to stay.

Davidson et al. (2007, p 101) describe the challenges of housing relocation projects and argue that post disaster situations are similar to
challenges in many low cost housing projects in developing countries:

(a) “the scene is generally very chaotic and resources are in scarce supply, with simultaneous projects being launched by numerous local and international organizations for housing and infrastructure repairs, for livelihoods creations and for a range of other social programmes”

(b) “projects must be completed as quickly as possible to foster recovery and to satisfy donors who want to see results”

(c) “The post disaster period is generally seen as good opportunity to engage in activities that will increase the level of development and reduce vulnerability to future disasters, implying that projects must be implemented with sustainability in mind”

Thus a disaster situation is an opportunity for major changes that would reduce disaster risks like flood hazards. Such as examine areas of high ground for selective relocation or rebuilding.

A well-organized recovery effort could also have a positive effect on communities, if done with a participatory approach. Davidson, et al. (2007, p. 102) state that

Research shows that the beneficiaries of a housing project – depending on how organized – can, with proper, disinterested guidance, intervene at the levels of design decisions, materials selection and preparations construction: management and even financing.

They also state that participation has been found to play an important role in empowering beneficiaries or community members to become part of the general political process and to have a voice in decisions that shape the community” (p 102). If relocation decisions are warranted, these should be done with full participation of any residents affected. Overall the literature concludes it is difficult to move people away from their homes and new zoning implications should be put in place ensure no new construction should be allowed on floodplains.

**Conclusions**

Weritty (2006) states that sustainable flood management “provides the maximum possible social and economic resilience against flooding, by protecting and working with the environment, in a way which is fair and affordable both now and in the future”. Information about mitigating floods in the literature is vast with a common theme that the primary purpose of hazard mitigation is to ensure there are fewer victims of disaster. Globally, trends in both developed and non developed nations have adopted various mitigation methods to protect their people, and argue that at a community level they must be on board to make positive changes to mitigate disaster. Developed nations are obviously leaders in mitigation and can act as guides for poorer nations to adopt specific cost efficient methods to help the people. The literature also continually stresses the impact climate change will have on the future. Mitigation practices must be implemented soon to withstand the intense weather patterns predicted in the near future.

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Mitigating Livestock Losses from Floods
(by Susan Wells)

Susan Wells graduated in Geography from Vancouver Island University. Her continued interest is in building rural capacity and protecting agricultural productivity. She was a member of the geography group of the VIU Belize 2009 field project.

Summary
Emergency food distribution in a subsistence economy entails capacity building at the production level. From first response to long term planning, the community that provides a nation’s food is essential to the survival of the nation. Hence, farmers and livestock growers are the cornerstone of reconstruction after a flood disaster. In addition to frequent hurricanes (CARICOM/CARIForum2007), the Belize River Valley experiences repeated and significant flooding. How can the residents be best supported through prevention, mitigation, first response or into the reconstruction stage? In this review, I examine the Belizean farmer's reality with this in mind. Research online revealed a great deal of interest in this topic worldwide. Although the research in Belize is scant, the rest of the subtropical belt has a global pool of experience to look to. From Bangladesh to Indonesia, Brazil and Africa, the problems are similar. Climate change, increased upriver disturbances and lack of resources create difficulties for peasant farmers and their livestock.

Methodology
I used online scholarly search engines to narrow down the topic of interest. In this research, I focus on mitigation and reconstruction, with reconstruction and prevention being interconnected. In this search, terms such as ‘flood and livestock,’ ‘fodder trees,’ or ‘fodder and floods’ proved to be useful. ‘Tropical agriculture’ was a large topic but also produced some interesting sites. Through the use of on-line journals and publications available in and outside of Belize, the topic was narrowed to potential strategies.

This summary is a brief condensation of the articles of interest that I’ve found. Field research within Belize is limited, and there is opportunity to explore village economics at a micro level in order to more fully understand the cycle of disaster management there.

Importance of Livestock
Livestock is an essential source of social wealth and production for income as well as mere subsistence. During the frequent environmental disasters that Belize experiences, vulnerable animals are caught in floods, starved for feed, and preyed on by jaguars and other predators. As the flood waters recede, wet ground and spoiled feed add to the stresses placed on the animals. Disease and poor nutrition continue to take their toll (Santos SNC project 2008).

The families that rely on the livestock lose their wealth, food supply and income potential. Decaying carcasses foul waterways and increase the risk of further contamination. The local supply of fresh food is interrupted, often for the entire growing season. In a tropical country without long term food storage, this is a major concern. “Large scale disasters involving animals can modify the long-term stability of national economies, the environment and social structures” (Heath et al. 1999).

In order to assist Belizeans and to forward recommendations that may assist in the prevention and mitigation of further loss, I searched for similar situations worldwide, with the goal of presenting some possible strategies and adaptations for consideration. Among those considerations were examples of

- preventative land use strategies
- flood resistant fodder crops
- tree fodders grown as house hold crops
- flood tolerant animal species used for small farm production that are not currently common in the country
- mitigations that have been experimental in other parts of the world
Some Global Tropical Responses

Mitigation

Gregory et al. observe that food systems, including food availability (production, distribution and exchange), food access (affordability, allocation and preference) and food utilization (nutritional and societal values and safety), are all included in food security. These resources are therefore diminished when food systems are stressed. Stresses can include climatic, market and cultural factors. In Belize frequent hurricanes during seasonal cycles combine with riverine floods to create vast floodplains that impact the most arable lands in the Belize River Valley.

Climate change in Belize is predicted to affect the farming community in several ways. An increase in rain and wind during the wet season and increased heat and drought during the dry season is projected to reduce the volume of maize and sugar cane (Nedwell 1994). These growing conditions will also impact livestock grazing and feed available during floods.

Programs and policies that improve systems of food production, food distribution and economic access may all contribute to food systems adapted to cope with climate change, but in adopting such changes it will be important to ensure that they contribute to sustainability (Kendra 2006). Sustainability includes environmental impacts of the strategies, and long term solutions should be assessed within the concepts of climate factors, market changes and utilization.

Extensive studies in Bangladesh have proven to have strong parallels with the Belize environment. A sub-tropical climate, low lands, frequent floods and pervasive reliance on subsistence farming with livestock assets are similar. As well, poverty and lack of resources slow recovery in each country (Jabber, 1990; Choudhury, 2004).

In Bangladesh, flood losses were mitigated with earthen embankments, drainage channels and a number of town protection works during the 1960’s. These measures have provided a reasonable degree of protection to only half of the region’s flood-prone area. Several non-structural measures, such as flood forecasting and warning and flood-proofing programs, have also been taken. During high floods, many breaches do occur, causing inundation over vast areas for most of the monsoon months of June to September (Jabber 1990). More recent findings indicate that problems of drainage and back flooding can increase crop damage. Deterioration of the embankments and siltation can decrease drainage of the river mouths, also extending the duration of inundation (Choudhury, 2004, p. 256).

In addition to embankments, the use of identified high ground for livestock security is one strategy that is cost effective and engages the community in organizing and caring for the entire animal population (Kendra, 2006). Each community in the Belize River Valley has the potential to form a local response to flooding. The types of preparations identified by Sen and Chander (2003) include:

• A local emergency management committee should be formed involving local people.
• A safe shelter for farm animals and a disaster plan to protect property, facilities, and animals, should be planned, ahead of time, in conjunction with the local community. Potential places include fairgrounds, other farms, etc.
• Animals should be evacuated and taken to shelter as soon as there is news of an imminent disaster. Every animal must have some form of durable and visible identification, e.g. the animals should be branded or tagged.
• The community should have arrangements for appropriate transport, suitable for specific animals.
• A farm disaster kit should be prepared in advance so that supplies are readily available in the event of a disaster.

In a 1990 study by Jabber, effects of monsoon floods on livestock in terms of death, loss of livestock feeds, distress sales of livestock and their consequences for livestock owners in Bangladesh were assessed. He used data derived from a survey of 1,000 households in nine
districts conducted after the 1984 floods. The results show that there were very few animal deaths due to drowning during the floods but there were large number of deaths after the floods. This was due to disease and hunger caused by loss of animal feeds. In general, floods magnified the livestock related problems which were quite serious even under normal conditions.

In Belize, the aftermath of Tropical Depression16 was a repeat of the previous hurricane and flood damages reported. Animals drowned during transportation, were lost due to displacement, and starved in the weeks and months following their relocation (NEMO IDA 2008).

**Prevention**

If agriculture is to coexist with the natural environment, crop production practices must be able and sustainable. This often requires optimizing crop productivity while minimizing agricultural inputs. One example is nearby in the Florida Everglades. The largest wetland restoration project in history is underway in the Everglades to restore the natural ecosystem by increasing water flows to re-establish the natural hydrology. This area is also agriculturally unique because it is the only region in the continental United States where several species of subtropical and tropical fruit crops are commercially grown (Schaffer 1998). This is a form of agro-forestry that has applications in Belize. Large areas of protected forests meet free range livestock and slash and burn (milpa) farming on river floodplains. The arboreal growth has potential to survive floods and to provide fodder for livestock during and after floods. The futures of agro-forestry and silvopastoral approaches are identified in many publications. Livestock owners can plant, harvest and use tree fodder. Preferred fodder trees in neighboring Jamaica were identified as Bacedar (Guazuma ulmifolia), Breadnut (Brosimum alicastrum), Guango (Albizia saman) and Quickstick (Gliricidia sepium (Morrison 1996). Anecdotal information added some species of Mango (Mangifera indica) as well. Belize trees that are known as fodder by local farmers and some scholars include Ramon (Brosimum alicastrum), Mango (Mangifera indica), Guanacaste (Enterolobium cyclocarpum), Bay Cedar (Guazuma ulmifolia), and some of the Acacia family (Harris 2009).

Although some fodder trees are drought hardy, some, such as mango and willow, are flood tolerant (Schaffer 1998; Pitta 2003). Studies in West Africa during drought conditions revealed possible sheep feed in the form of willow trees. In one study, full access to willow fodder blocks proved beneficial in increasing ewe reproductive rate. However, it points out that both pasture and trees need to be managed as a tree/pasture system in order to produce herbage of higher nutritive value. Willows typically grow near wetlands. Initial searches for species native to Belize were unsuccessful. In nearby Cuba, the Carolina willow (Salix caroliniana) grows in river margins, marshes, ditches and in open wet forests.

In Bangladesh, silvopastoral management systems include fodder hedgerows, three strata forage systems, and living fences. Fodder hedgerows slow water flow, provide habitat, and define property lines. Three strata forage systems utilize ground, understory, and canopy growth levels to use all productive space throughout the growing and flood season. Additional suggestions were the production of indigenous fodder tree species, introducing improved tree fodder species, and planting improved pasture grasses concurrent with cash trees (Morrison 1996). These can be grown in rows, with fodder and crops alternating for seasonal harvests.

Small ruminants such as goats and sheep can be potentially fed within a family plot through the use of fodder shrubs. The establishment and management of fodder shrubs require much less effort, time, expertise and resources than that for herbaceous legumes and grasses. Fodder trees can be established in farm plots, along farm boundaries, and around household areas, with very little management, to produce forage for small ruminants. The multipurpose nature of most trees is an additional attraction for the small farmer as other benefits such as fruits, fuel wood, poles, shade, etc. may be obtained from fodder trees (Attah-Krah2009).

The major fruit crops in the Florida Everglades are Avocado (Persea americana Mill.), Mango (Mangifera indica L.), Tahiti Lime (Citrus-
Tahiti), and Carambola or Starfruit (*Averrhoa carambola* L.). There is also limited commercial production of several other fruit species, including Atemoya (*Annona squamosa* L.-*Annona cherimola*). Of these, mango has been used in some Caribbean communities as an emergency fodder for cattle (Morrison1996).

Belizean agribusiness produces sugar cane in the north. The FAO has identified and supported the use of sugar cane tops for fodder. Studies done in Mauritius and Vietnam found that the top 18 inches were preferred, that the milk production of the experimental animals was high, and that sugar cane can grow on sloping tropical foothills (Boodoo1988, Preston1995). Transporting the tops or by product of the cane industry to flooded areas for feed may be a local short term solution to flood forage.

Very promising research has been done on the *Moringa oleifera* tree. Native to the Himalaya’s, it is a potential source of protein, is grown easily by small holders, can be used to supplement a cut and carry feed system in the rainy season, and is an excellent dry and store feed in drought. Apart from being a potential animal feed, Moringa oleifera is also useful for alley cropping. It can be used as fuel, the fresh green pods are used as vegetables, and a pressed cake of the seed is used as a water purifier (Sarwatt,S.V., 2002, p. 246).

The FAO Corporate Document Repository also included a collection of publications that investigate tree as fodder in the tropics: (http://www.fao.org/docrep/003/t0632e/T0632E13.htm%23ch13&ei=5Do5SuWDFILgqgOPtv2oAQ&sig2=16iGfCwUJBVM_MZ8ntw0w&ct=b)

**Adaptation**

Improving the survival rate of small holder’s animals is an important opportunity to reduce the stresses that marginal farming practices face. Low market prices, loss of product and animals through disease or pests and predation take a toll in the best of times. Approximately 56% of Belize farmers are living in poverty (Marcotte, 2004). The cycle of loss and reconstruction during repeated disasters can be disheartening and prevent or reverse the progress of farm improvements that keep a producer competitive and in business. Subsistence farming does not provide a small holder with economic resilience; and therefore the loss of even a few animals has a great impact. Along with mitigation and prevention, adaptation can have a positive effect on the outcome of a disaster situation (Kendra, 2006).

One essential strategy is to build a resilient community base. “Resilience has been defined in a variety of ways …. Most definitions emphasize a capacity for successful adaptation in the face of disturbance, stress, or adversity” (Norris, Stevens et al. 2007). Encouraging community involvement allows residents to create a relevant plan and to apply manageable approaches to floods and disasters.

Increased income and improved opportunities to strengthen community capacity can be realized through the provision of more outlets for local sales, opportunities to pool resources, and long term local plans for a cooperative recovery. These suggestions all help to grow confidence, social capital and to speed response time to disaster recovery (Norris, 2007). Furthermore, Heath (1999) points out that

Disaster relief for the care of livestock should be recognized as a form of humanitarian assistance, given the benefits to be derived for public health and the socio-economic implications of successful intervention.

Along with crop choices, livestock itself comes in many breeds and some are more suitable to drought, and some are well worth investigating for suitability to wetlands.

The local cattle stock is descended from Spanish imports, crossed with North African Zebu for a hardy, durable but lean animal well suited to sparse forage. They do not tolerate wetland, become diseased and lose condition quickly. Belize’s Ministry of Agriculture Extension services are encouraging the import of hardy Brahma cattle to increase the quality of local herds. Through the rental of high quality bulls, local farmers can economically increase their production and profit margin. The potential income can be set aside as a hedge against loss.

In the Brazilian Amazon Basin, experimental herds of Water Buffalo have proven to be more economical and more productive than the local Criolla and Zebu mix breeds. Water Buffalo are native to wetlands of Africa and Asia, have been
domesticated for milk, meat, draft power and hides for many centuries. They forage underwater (up to 9 feet in depth) if their grasses are flooded, can withstand damp ground and produce more meat and milk than the local Criolla (Camaraoi, 2004). Water Buffalo also proved to be more aggressive towards predators and reduced losses due to panther attacks in Venezuelan herds. Whether raised as herds or incorporated into cattle herds, they are deterrents to predators. Two possible downsides to their use in Belize are (1) They can become feral if left unattended, and (2) a market for the meat and milk has not been established. There are twenty five buffalo listed as livestock in Belize on the Ministry of Agriculture’s website dated 04/05/09. This would be a species to explore.

Poultry is of great importance in village and subsistence nutrition. The large scale sale of eggs and chicken is a lucrative market currently dominated by private farms operated by Mennonite landowners. Backyard production however provides affordable protein for low income families. The loss of small flocks is a stress on both diet and income. During floods, chickens can fly into tree canopies, but suffer from lack of food and predation. Some waterfowl may be more resilient and survive with fewer flock reductions. Muscovy ducks (*Cairina moschata*), for example, are a South American wood duck that does not need water, can fly into trees but can swim and produce both eggs and meat. As an added benefit, they consume insects in large quantities. As natives to the Americas, it is not an invasive or introduced species (http://digital-library.unesco.org).

The problem of storage for fodder and transportation of animals to safe ground leads itself to experimentation. Rafts and floats have been of use in some countries. A presentation by Nedwell at the Fifth International Symposium on Ferro Cement suggested a simply constructed Ferro cement floatable box reinforced with local thatch or other fibres. This structure could also be closed up, made watertight and floated to another location. Livestock or fodder could be housed or relocated in this manner (Nedwell, 1994). Adaptations to shelters in Bangladesh also included bamboo mats that raised small animals off the floor of hutches, and coops on stilts (Ghani, nd).

Many long term solutions may also depend on land use policies. Norris and Kendra suggest community solutions to long term pressures from disasters. The stability of land ownership or government assurances that land is available for mitigation strategies is a key to community stability. Unequal distribution of income was an important factor in the overall picture of poverty and food security in Belize (FAO, 2007). The following are identified by the CARICOM/CARIFORUM Food Security Project in 2007 as important factors in food security:

- Natural disasters and seasonality
- Low productivity in small-scale agricultural enterprises
- Lack of drainage and irrigation
- Limited research/development on agriculture
- Outdated farming practices/equipment
- Inadequate packaging and grading/standards
- Limited Government land available for agriculture
- Inadequate access to credit, especially by small farmers; and
- Land tenure insecurity

These factors can be seen as suggestions for possible adaptations; each suggests a response that may in turn reduce the stress of disaster on small scale farmers in the Belize River Valley.

**Conclusion**

Literature available on the subject of tropical floods and livestock is widespread, as the problem is global. Belize has had some important studies done to determine the outcome of disaster and floods, but there are few detailed studies available on the Belize River Valley in particular. Many of the studies available globally are applicable to all aspects of flood disaster response and management. The use of tree fodder, species adapted to floods, village planning, strategies for recovery and government response to improve the village level capacity for resilience are all universally acknowledged as...
important parts of a management plan. While there are many suggestions that can be explored, there is also research needed in local solutions, strategies to empower farmers at the village level, and alternative approaches to relocation, care and subsequent return of the livestock affected.

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Floods and Farmer Livelihoods
(by Christina Ciolfi)

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Farmers often lose their livelihoods during and after a flood as a result of flood damage. Flooded lands can lead to crop loss; the ability for the farmer to replant can be limited if the supply of seeds and the condition of the soil is not sufficient. Many farmers living within the Belize River Valley (BRV) are subsistence farmers, meaning they grow and produce a lot of the food they need to survive. Floods affect the farmers’ ability to grow their own food. Floods inundate farmlands causing loss of crops and livestock. After the flood, the scarcity of good forage causes the loss of livestock. Farmers often do not have the money or saved seeds to replant after a flood takes their crop. Therefore alternatives need to be examined in order to ensure secure food sources are available, at all times, but most importantly during and after floods. Each community in the BRV is different and their reactions to floods and other disasters vary. Many farmers in the BRV who grow their own food also purchase key items from outside the community. This includes items that are difficult to grow but can be stored in large amounts, such as rice, flour, and lard.

Although each community is different they share common challenges when faced with floods. Farmers rely on the food that they produce not only to meet the needs of their families, but by selling the surplus or supplementing their income in order to eat and survive. Therefore, it becomes important to assess the extent to which farmer livelihoods are affected by floods, and how they can be strengthened in flood and non-flood times. This requires an analysis of what and how much farmers are growing for personal consumption, how much surplus they generate (if any), and the extent to which they are able to sell that surplus if generated. In short, how can farming be more profitable in order to create more stability during uncertain economic and/or environmental times?

Food security therefore becomes the most important topic to address.

If farmers had access to a variety of markets, their ability to make a living by farming would increase. Also if those markets were on high ground and easily accessible during floods issues such as transportation would not be as challenging. These are some issues that need to be addressed to reach a level where food security is stable. But in order to reach a level where those in the BRV are food secure they need to be supported.

Education becomes an essential component in addressing some of the challenges surrounding farming, and farmers’ livelihoods, and mitigation during floods. If farmers are growing their own food what could they add to their crops that would benefit them on a daily basis; but, more importantly what would ultimately help them survive during various natural disaster such as floods. Educating farmers on best practices, identifying markets, learning to work as a community and accessing funding sources are important in order to improve the profitability of farming and as a result the profits generated by farmers. Crop placement, crop rotation, and a central food distribution centre are some options that could help to address some of the issues facing farmers within the BRV.

Ultimately millions of people are highly exposed to climate change and their vulnerability to ever changing and unpredictable weather patterns is increasing. “The poorest are dependent on rainfed subsistence agriculture and need urgent and continuing humanitarian assistance to ease their plight. But they also need development pathways that help them escape from this trap” (Dobie et al. 2007/2008: 9). Farmer livelihoods and flood mitigation therefore become very important.
questions for organizations like NEMO and the Belize Government.

**Food Security**

Food security is an important international topic and as a result has been discussed and refined in the international community and at past World Food Summits since the 1970s. The latest definition, published in 2001, incorporates a number of different concepts such as the volume and stability of food supply and the ability of vulnerable populations to access those sources. The dynamics associated with that food supply include the effects of poverty and economic, natural, and social disasters, all significant factors that contribute to food insecurity. And of course, these include the effects that the lack of adequate food sources has on health. With all these factors in mind, a nation is considered to be food secure if “all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (Food and Agriculture Organization and the United Nations 2003:25).

According to a report produced by the Caribbean Food and Nutrition Institute in collaboration with the Food and Agriculture Organization (FAO) natural disasters, like floods, contribute to the overall food insecurity in Belize. Belize depends heavily on agriculture for income and employment. “It is estimated that at least 35 percent of GDP and 41 percent of total employment is directly dependent on agriculture, fisheries and forestry” (The Caribbean Food and Nutrition Institute 2007: 15). The national economic success of Belize is therefore connected to agriculture and is an important resource to promote, protect, and support. Food security is an important component when looking at farmer livelihoods. When farmers lose their agricultural production this directly impacts their food security and their livelihoods.

Vulnerability to food insecurity can happen at both a national and local level because these levels are interconnected. In fact, four factors have been identified as the principal sources of Belize’s vulnerability to food insecurity at the national level (and are incorporated within the definition of food security as listed above); exposure to natural disasters, economic vulnerability, fiscal vulnerabilities, and social vulnerabilities (Caribbean Food and Nutrition Institute 2007: 1).

In addition, local factors also affect individual food insecurity including poverty and therefore the lack of ability to purchase food (FAO and UN. 2007: 2). Belize is therefore facing some challenges in ensuring their country as a food secure nation. In summary, it becomes important to look at the national agriculture system and economic stability of Belize but it is also important to look at what is occurring at an individual and community level. The focus of the discussion below will predominately be on community-based agriculture systems which in turn affect the overall economic benefit of the country.

How do floods cause certain families or individuals to lose food security and who is most at risk? Even though someone might be food secure on a daily basis it is important to evaluate what risks are present that might cause them to be considered potentially food insecure in the event of a natural disaster. An interesting model was used in a report produced by the Food and Agriculture Organization (FAO), which outlines how food security can be negatively affected by a natural disaster. A distinction is made between food insecure people, potentially food insecure people, and food secure people (FAO and UN 2007: 7). This typology can be applied in the BRV to help assess whether residents there are at risk, and at what stage they become at risk. This approach is important for identifying the status of households and for implementing effective solutions. From working with residents in the BRV it became evident that people might be food secure on a daily basis but the threat of floods moves their status to potentially food insecure. Food insecurity directly relates to farmers’ livelihoods and food production. “Availability in this context refers to the physical existence of food, the source of which may be from own (domestic) production, commercial food imports, food aid, and domestic food stocks” (FAO and UN 2007: 23). Poor farmers have a harder time acquiring food in non-flood times and therefore are more prone to food insecurity during floods and other natural disasters.
Food aid is of course an important resource for farmers affected by floods. Aid organizations from all over the world come together and help Belize during and after floods. However, soon after the disaster is over the aid often ends. According to one resident in Belize, “you can’t wait around for help [...] you have to get up and fight for yourself and take what you can” (FAO and UN 2007: 54). Although aid organizations are vital for Belize in times of disaster, it becomes increasingly important to gather community data in order to ensure that the community is able to survive, and to assess what that community or individual needs and what they have access to.

Food security assessment is important in identifying intervention strategies. As noted by Helen (2001),

the type of intervention is influenced by the severity of food insecurity. This may be determined from two perspectives: first, by assessing whether people are able to meet their immediate food needs (the risks to lives); and second, the vulnerability and risks faced by different livelihood groups and their coping strategies (the risks to livelihoods) (Helen 2001: Abstract).

It is important to assess what Belizeans are eating and where they are getting it from, what and how much they are growing themselves, and where they are getting additional required food sources from. Not only is it important to judge food insecurities during and after the flood, but insuring farmers have secure food sources on a daily basis is an important analysis to consider when making recommendations.

**Re-Establishing Lost Crops**

Livelihoods, and the recovery of those livelihoods once lost, is an important issue in the BRV which is prone to floods and other natural disasters. Recovery of livelihoods often includes recovering lost crops but if those farmers choose crop types that withstand natural disasters the problem could be reduced. According to a report produced by ALNAP (Active Learning Network for Accountability and Performance in Humanitarian Action) and ProVention, certain agricultural practices could be beneficial to ensure livelihoods are maintained during floods.

“Methods for drying and preserving seed stocks can facilitate the continuation of farming. Promotion of flood-resistant crop varieties and cultivation practices and provision of seed stock can strengthen resilience” (ALNAP et al. 2008:7).

The protection of assets is essential in ensuring people can “recovery quickly but also reduces future vulnerability and poverty” (ALNAP et al. 2008:8). Floods can affect farmers crops in a negative way because the “cropping season might be over or agricultural support might not be available” (ALNAP et al. 2008:8). What farmers are growing, where they are growing it, and their ability to save seeds are all important aspects to address when discussing the options farmers have for remaining food secure during and after flooded lands have recovered. Irrigation and specific farming practices are also important to address.

Sections on each of these identified issues will be included: Crop Location and Placement, Crop Type/ Water Contamination, Crop Rotation, Irrigation Systems, and Seed Saving. But first it is important to define two very important terms, flood protection and flood proofing. Hugh Brammer has written many articles on land use, survey, and resources (Brammer (a), (b), (c), (d)). He explains two key terms that are important to address when looking a solutions: flood proofing and flood protection.

Flood proofing is a simple measure that is used and which can enable people to reduce the risk of loss to life, property or their means of subsistence by flooding or floods. “Farmers using crops, crop varieties, crop rotations and cultivation practices adapted to normal flooding characteristics and to the perceived risk of flood damage” (Brammer (d), 5).

Flood protection, on the other hand, is a term which includes large-scale and often expensive measures to prevent crop and property damage caused by floods or flooding. It can include the building of embankments alongside rivers to keep out unwanted river water; it may also include the provisions of either gravity or pump drainage to remove unwanted accumulations of rainwater from land behind the embankment (Brammer (d), 5).
Crop Location and Placement

Crop location is very important in flood prone areas. Many farmers living within the BRV lose their crops after severe floods and therefore the relocation of their crops needs to be addressed. Many organizations provide aid to those who lose crops; however, simply relocating these crops to different areas could help alleviate the amount of aid required in each community. Most communities in the BRV have some land on high ground. These areas could be utilized for group cultivation. Not only would the people involved meet the requirements for group grants (see section: Funding), the amount of people that lose their livelihoods due to floods would decrease and the overall financial success of the community would increase. An important report produced by the Damage and Needs Assessment (DANA) committee within the National Emergency Management Organization (NEMO) considers and outlines the effects Tropical Storm Arthur had on the agricultural sectors within Belize.

Total economic loss to the agriculture sector resulting from Tropical Storm Arthur is estimated at around $25 million. This includes direct loss to the farmer (damage assessment), which is estimated at around $11.7 million, and other losses to the country of Belize (DANA, 2008:10). Therefore individual farmers have been heavily impacted by floods.

Crop location could be an important first step in decreasing the negative affects floods have on farmer’s crops and therefore their livelihoods. In addition, a detailed land survey is important when assessing where high land might reside. Although land surveys are complex, making a differentiation between highland, medium highland, medium lowland, lowland, very lowland, and bottom land can be beneficial.

The farmers’ practice of cultivating fields on several soil and land types diversifies their cropping opportunities and spreads out their labour input. It can also provide security against crop losses due to natural disasters because not all their soils and land types may be equally affected by a flood, drought or other disaster. Similarly, different soils and land types may provide different cropping opportunities for rapid agricultural recovery following a disaster (Brammer (c): 10).

Although inundation land types are important to understand the relation of those crops based on this detailed information could be a realistic solution for farmers putting their crops on the appropriate plots.

Land consolidation is also an important strategy for mitigating flood risks. As explained in an article by Frank Frieseecke called “Flood Management: Flood Prevention by Land Consolidation in the Rhine Catchment Area.” Frieseecke explains how the benefits gained for land consolidation for agricultural productivity improvement can also be introduced to alleviate hardships caused by floods.

On the one hand, it can facilitate the creation of competitive agricultural production arrangements by enabling farmers to have farms with fewer parcels that are larger and better shaped, and to expand the size of their holdings. But, on the other hand, because of the growing importance of flood protection, land consolidation has become an increasingly important instrument in increasing water storage capacity, redeveloping flood plains and denaturalizing of rivers (Frieseecke 2005:2).

Therefore, land consolidation is a combination of agricultural special planning and land re-adjustment (Frieseecke 2005: 3). For example, Germany has a Land Consolidation Act, and Frieseecke finds it to “have the most far-reaching planning approach. [...] [Land] holdings can be re-arranged in view of improving the production and working conditions in agriculture and forestry as well as promoting the general use and development of land”(Frieseecke 2005: 4). Land can be economically improved by, for example, pairing oddly shaped parcels together to become a more optimal size, shape, or reside in a better location. Important farming amenities such as roads, waterways or water bodies, and other vital facilities were provided and other measures were taken to improve the overall economic condition of farming making the consolidation approach a “comprehensive” one. “Land consolidation represents a long-term solution to agrarian structure” (Frieseecke 2005: 4). A simplified model is also outlined in German Land Consolidation Act and includes such measures as,
“transport planning, communal land use planning, water management planning or planning concerning nature protection, flood protection and landscape” (Friesecke 2005: 4).

A land consolidation program would allow the government of Belize to re-arrange land so that everyone has access to land on high ground.

**Crop Type and Water Contamination**

Flood resistant crops could be very important in decreasing the number of people who lose economic stability. Many residents in the BRV report that water damage and soil contamination are the primary reasons they are losing their crops. In addition to the type of crop, it is important to address what time food is being planted and harvested as well as where the crop is located (see sections: Crop Location and Crop Rotation). Farmers in Bangladesh grow a number of different rice varieties in order to spread the risk associated with the rainy season and flooded lands. These crops have been developed over centuries and are capable of growing in different depths and are able to withstand various durations of flooding (Brammer 1990 (a):15). As climate change becomes more of a challenge, farmers will need to adapt and change their methods of farming in order to adapt to this change. “If the drylands become wetter, increased maize, rice and wheat cultivation is likely; if they become drier, millet production may rise, although its market potential is limited by low human consumption rates” (Dobie et al. 2007/2008: 7). Both climate change and consumption rates are therefore important to address when looking at potential successful crop types.

Integrated crop management has been a solution used in the past, however,

They should, as Philip Dobie, Barry Shapiro, Patrick Webb and Mark Winslow suggests, be explored with the combination of improved varieties.

Many residents in the Belize River Valley are growing fruit trees which are quite beneficial and profitable during floods. It has been noted that:

- high-value crops to dryland farming systems can boost incomes while diversifying the farm enterprise to reduce risk. The integration of tree, crop and livestock systems increases biodiversity while raising productivity through greater recycling of nutrients. Trees mediate wind and water erosion, and often tap groundwater resources through deep roots (Dobie et al. 2007/2008: 8).

In regards to unharvested crops, if crops are not harvested quickly after lands have flooded they could be lost due to decay. Also once these crops are harvested careful preparation must be practiced. Food needs to be cooked and cleaned properly before consumption (FAO: 8), therefore education surrounding what to do with crops after floods in important.

**Crop Rotation and Irrigation Systems**

Most farmers can grow food only during the rainy season because irrigation systems are expensive and generally not established (see team report section Irrigation). Although irrigation would be important to focus on, it is an expensive solution although not as expensive as some flood protection solutions. Farmers in Bangladesh, as mentioned above, are growing varieties of crops that survive and flourish in varying degrees of flooded lands; however farmers are also growing crops like potatoes and vegetables (Brammer, 1990 (a): 15), crops that do not survive after submerged by water. Vegetables like corn and potatoes are also popular crops in Belize (see team report section Agriculture Production) and these crops are being planted in the wet season. These crops, however; could be more successful if irrigation systems were established in order for farmers to plant them in the dry season. If crops were planted in the dry season farmers would not run the risk of losing them in the event that their lands become flooded. Irrigation systems are very expensive but, other agriculture support systems could also be established to build
farming practices to a level where expensive irrigation systems might be considered in the future.

Controlling what is grown on agriculture land and where agricultural land is located can greatly decrease the negative affects floods have on individuals. However a balance needs to be maintained. Floods can also benefit agricultural land. Therefore stopping flooding from entering lands or avoiding flood planes could negatively contribute to its overall fertility (Brammer (d): 7-9). In addition,

the provision of irrigation, where this is feasible, can reduce or eliminate the risk of drought and make timely sowing/planting possible. Flood protection (where feasible) is needed to reduce the risk of flood damage; in many areas, drainage (by gravity or by pumping) is needed in addition in order to remove the restriction which deep flooding places on wider cropping opportunities (Brammer, 1990 (a): 17).

Seed Saving

Zoe Goodman wrote a report called “Seeds of Hunger, Intellectual Property Rights on Seeds and the Human Rights Response.” In May 2009 she explained how ten years ago, in Thailand, farmers were involved in government sponsored workshops to educate them on how to improve their exports. Agri-business was involved in these workshops and supplied these farmers with the newest technology, “gifts of seeds, fertilizers, and pesticides, which farmers adopted with enthusiasm (Goodman 2009: 2).” Export markets require food and other supplies to fit very specific criteria. Seeds provided by agri-business fit that criteria, therefore farmers stopped saving seeds and fully adopted farming methods that were supposed to meet the export market demand (Goodman 2009:2). The end result for individuals and whole communities is often social and economic devastation.

But the question remains, why would farmers who have the ability to save their seeds purchase them? Farmers have the ability to cross breed their plants in order to isolate certain characteristics. This process enables the ongoing development of crops through the saving of seeds. Private companies combined this process with technology to create hybrid seeds. This allows farmers crops to produce uniform crops “well-situated to mechanized, industrial agriculture (Goodman 2009: 4).” In the past hybridization did not limit to farmers ability to save and sell the seeds produced from those crops, however, more recently new technologies are being explored by private agricultural businesses to limit the reproduction of the seeds they create. Some genetically modified seeds “produce sterile offspring or…propagate only if applied with certain chemicals (Goodman 2009: 4).” These businesses are also working hard to promote the legal means to control seeds through international property rights (IPRs). “IPRs grant the right-holder (a person or a company) a period of near monopoly control over the production, sale and use of an invention (Goodman 2009:5).” IPRs are very expensive to obtain and as a result these products become very expensive to purchase. Some critics say that IPRs on seeds lead to the loss of cultural and genetic diversity. Those same critics feel that farmers should have the right to:

save, use, exchange and sell farm-saved seed; to be recognized, rewarded and supported for their contribution to the global pool of genetic resources as well as the development of commercial varieties of plants; and to participate in decision making on the issues related to crop genetic resources (Goodman 2009: 9).

Farmers’ rights should be collective; they should not be exclusive. Communal rights should be explored and should build community and promote the sharing of information and this can be encouraged through seed saving, sharing, selling, and purchasing. Farmers should also be educated on issues surrounded seeds in order to ensure the blinders are lifted. “Many farmers have been seduced by commercial seed advertisements promises of greater yields (Goodman 2009: 11).” In India, for example, Monsanto and Mahyco, two international companies involved in IPRs and seeds, promised a variety of cotton (Bt-cotton) that would increase yields and decrease the use of pesticides. Farmers believed their promises. In the end, farmers increased their pesticide use and earned lower returns. Another challenge facing farmers is that these large companies decrease the supply of alternative options. They purchase all the smaller companies that sell cotton, for example,
and therefore farmers have limited choices, they are in a sense, forced to purchase these GM seeds.

Most importantly, “the world’s poorest inhabitant – small-scale farmers – would benefit most from research into local plant varieties and on-farm technologies, such as irrigation systems, that could dramatically increase agriculture productivity on marginal lands” (Goodman 2009: 12).

Families the BRV who grow their own food are saving seeds but the percentage of the population actually participating is low (see Agriculture and Farmer Livelihoods: Seed Saving and Storage). If farmers were saving seeds then they would not need to wait or pay for seeds to re-plant their lost crops and they would have a better standard of living and control over their success.

** Marketable Crops**

Farmers need to access markets and to do that they need to understand what markets are available. The Belize Field Team 2009 found that many people are purchasing food in Belize City. This could be a market that local farmers could access. If food was available locally and at a competitive market price then people would be more inclined to buy locally.

Farmers need urban areas as customers, and urban areas will trade their cash for the food they cannot grow themselves. The two sectors are mutually supportive. The increased income that can be earned from agricultural sales to growing urban markets motivates investments in more productive technologies such as small-scale supplementary irrigation, soil fertility improvement, terracing and other practices that buffer against weather fluctuations (Tiffen, 2002).

** Cooperatives and Farmers Markets**

Bangladesh and other countries have extensive experience with mitigating problems with floods. Many conclusive reports have been produced by international organizations like the Food and Agriculture Organization (FAO) and the United Nations Development Program (UNDP), and it is often suggested that countries should be concentrating their efforts on engaging “community involvement in planning and risk management” (UNDP 2003). Although countries like Bangladesh have successfully reduced the impact disasters have on their citizens their focus is still on emergency relief. Where their concentration should lie is on “steadily eliminating the risks and helping communities move from being vulnerable to resilient” (UNDP 2003). Prevention is being promoted here. Although case examples in Bangladesh shed light on food and food aid the most important lesson to highlight is prevention. While prevention maybe be a little harder to implement, it is the most effective form of intervention because you ideally eliminate all mitigable problems before the disaster strikes. Community engagement in prevention methods is important but it is also important for communities to work together throughout the disaster and the aftermath of a disaster. Examining some of the issues facing farmers on a daily basis could help mitigate problems resulting from flooded lands. One of those solutions could be farmers working together and establishing markets together.

One farmer in the BRV mentioned the hardships in selling food from his farm. He said that he had limited access to markets and often decides to travel to Belize City where he knew he could sell all his food all at once as opposed to stopping off at different locations and selling only a few items each stop. This valuable local knowledge highlights the need for farmers to have a central location to sell their crops.

Farmers markets or cooperatives could help in mitigating this issue. According to a government official in Belize, cooperatives have been established in the region in the past. Cooperatives have been initiated for growing, raising or producing a number of different food products including grain (which feeds both livestock and people), fish, cashews and cohune oil. These cooperatives reportedly faced a number of challenges, however, and have often failed. For some products, like cashews, there can only be one cooperative per area, so that if there is more than one started it may not be supported. Additionally, in the past personal interests reportedly got in the way of a true cooperative effort that would benefit the larger group of members. In summary many cooperatives have
have been initiated but they have not always worked out as planned. There is currently a plan for a cohune oil cooperative in Flowers Bank.

NiMble, a management consulting organization, is involved with “assisting and supporting organizations to understand their needs and sustain growth through improved processes and sound management practices” (NiMble 2005: 6). According to NiMble the co-operative model is the “best mechanism to address market and supply chain failures in agricultural commodities” (NiMble 2005: 1). The primary benefit of cooperatives is it allows those with similar interests to “pool their resources and thus take advantage of economy of scale” (NiMble 2005: 2). Specifically economies of scale has multi-level benefits ranging from production of inputs, communal warehousing facilities, negotiating transportation costs, and eliminating expensive intermediaries who might be involved in processing or marketing agricultural products (NiMble 2005: 2). All these factors make agriculture more profitable for those involved in the cooperative and therefore strengthen individual’s capacity to withstand losses. However other social benefits exist:

The other benefits are social in nature as experiences have shown that the cooperative model allow for employment of local youth. Creation of social cohesion, creation/up graduation of societal infrastructure. Cooperatives also enable their member to leverage finance at softer interest rates and attract international development agencies to even provide grants for societal infrastructure up gradation and investment in other livelihood opportunities (NiMble 2005: 3).

A farmers’ cooperative operates by farmers producing goods and bringing them to a cooperative which is set up and developed by farmers to control the agricultural inputs, processing, marketing, quality control, and warehousing. Cooperatives are aware of the market demands and produce products that meet those demands. All the profits made go back into the pockets of the producers but also back into the cooperative. In other words the continued education, awareness, employment, development and cohesion of the cooperative itself (NiMble 2005: 2).

Cooperatives are usually formed with a group of farmers with similar concerns and goals, who usually reside in the same geographical area. According to the World Food Program (WFP) farmers cooperatives have many challenges but these can be decreased by:

- smallholders need technical support and training to establish and manage an effective, truly representative farmer group;
- cooperatives require good leadership, management skills and institutional support;
- there are high initial costs to establish a farmer cooperative; ideally these costs are covered by a cooperative; ideally these costs are covered by donors or NGOs (WFP 49).

**Funding**

Funding sources are available within Belize and should be utilized when application requirements can be met. In the past the European Development Fund (EDF) has established aid sources to help Caribbean nations affected by natural disasters. For example after Hurricane Dean an amount of 3,000,000 Euros (almost 9 million BZD!) was available to help rebuild Belize and other nations. This rebuilding was focused on food sources and food security among other things (ECHO 2007). It is important to have access to funding sources during and after a disaster. However preparation before a disaster becomes continually more important. Although organizations like the EDF have provided funding in the past there is no guarantee that funding will be provided in the future. Therefore access to funding during non-disaster times is essential.

Today the EDF, in partnership with the Government of Belize and the European Union, has established a program called the Belize Rural Development Programme. The goal of the program is to “empower the rural poor and to invest with them to create wealth and to eliminate poverty” (BRDP). This program is designed to give funding to those that meet specific criteria, and once the application has been accepted the project is maintained and sustained by the individuals who benefit from it. Four different grants are available through this program including an individual microgrants, small group
grant, large grants, and priority village grants. Each grant has specific criteria that need to be met. In order to meet these criteria, help might be required. For example, for the micro-grant, individuals need to find someone who can mentor them and recommended them for this grant. That person needs to ensure that all requirements are met. In addition, the individual needs to prove they are unable to join a group because of lack of time or other reasons; meaning that the Belize Rural Development Fund encourages farmers to work together and if they are able to do so, they are eligible for further grants. Because of lack of education and familiarity with grant application process, it would be beneficial to have extension support for those individuals interested in applying. Extension officers could provide this service. Furthermore farmers should be encouraged to work together and be supported through the necessary steps of establishing and improving those groups (see section of Farmers Cooperatives).

A number of key studies are summarized in the ALNAP study and help highlight key lessons in other countries around the world that have experienced loss of livelihoods in the event of a flood. For example, in Kenya, a 1999 Oxfam study shows that

...cash schemes allowed households to avoid taking exploitative loans from money lenders and to clear their debts, to buy essential items and to invest in small-scale income generating activities. This provide[s] economic benefits for individual households and local businesses in addition to benefits for the whole community (ALNAP et al. 2008:8).

Bangladesh is a developing country that has suffered from many floods in its past. It is also home to the founder of the Grameen Bank (GB), Nobel Prize winner Professor Muhammad Yunus. GB is a bank for the poor and is based on the principles of

mutual trust, accountability, participation and creativity. [...] Credit is a cost effective weapon to fight poverty and it serves as a catalyst in the overall development of socio-economic conditions of the poor who have been kept outside the banking orbit on the ground that they are poor and hence not bankable (Grameen Bank: 2006).

Models such as the Grameen Bank can act as insurance systems for both the poor and the government because people are more independent. For this reason funding methods like the GB can help mitigate issues facing farmers experience during floods.

Education

Education is one of the key elements that will help alleviate many of the challenges listed. Without access to education farmers are not going to have the tools they need to success in today’s agricultural markets, they are going to know how to combat the uncertainties of climate change. They are not going to purchase crop types that will withstand floods and they will not see the benefits of working together with other farmers, farmers that can sometimes be seen as competition. Education comes in many forms, you can learn from your from your friends, family, community members, or government. However, the Ministry of Agriculture has an extension program that has been providing educational services to Belizeans in the past.

Extension (identifying Markets and Increasing Production and Sale)

Strengthening the performance of the National Extension Service is important to the Government of Belize.

On May 14, 2009, the Ministry of Agriculture and Fisheries held an all day National Stakeholders Consultation at the Belmopan Hotel. This was the exercise attended by more than 60 persons coming from various sectors including representatives of the public sector, farmers’ organizations, and private providers (Belize Business News 2009).

Three separate consultants were hired to assess the demand and supply side of the extension program. The consultants’ findings and recommendations were presented and later group brainstorm sessions were conducted and presented in hopes of ensuring all stakeholders were represented.

Some issues touched by the stakeholders were also recognized in an article by John Carr called “Necessary Concepts That Require Creativity and the Removal of Negative Constraints.” His article outlines some of the issues surrounding
marketing and exports, extension and training, genetics, financing and interest, and project results. Some of Carr’s recommendations are also similar to those found after the consultation was complete. Education, interagency collaboration, seed production analyses, creating a balance between local production and export production are also examples where stakeholders would like to see improvements. Although the National Stakeholders Consultation did not identify how improvements were going to be made, Carr suggests export production should be utilized in order to ensure over-production for a small population. He also argued that technology needs to be considered while ensuring that the cost of production does not increase to an unsustainable level. Finally, Carr and the stakeholders at the meeting feel that if the listed concerns and options are met, agriculture within Belize should be able to flourish (Carr 2009:19).

Belize was once a colony and the often negative results of colonialism can have a negative effect on the people of a country (Moberg 1990: 98-90). Agriculture production and poverty, especially with export crops, can cause farmers to have little control over their livelihood as they struggle to make enough to pay for the cost of production. Local production and local support need to be established and could empower farmers to establish local markets that could provide a sustainable income source. Such funding sources can be seen in the Funding section of this document.

According to Stigter, Ying, Dawei, Vega, Viet, Bakheit, and Abdullahi, there should be a “culture of disaster preparedness.” As they state; “We feel that the term ‘risk management’ should be abandoned for all but the richest farmers...Their key work in preparedness is not ‘management’ but ‘resilience’” (Stigter et al. 2007:171). A shift from management to resilience requires cooperation and communication from those that suffer from disasters. A bridge through education could benefit farmers. For example: “95% of farmers living in parts of China where most poor farmer live think that information could bring them great profits” (Stigter et al. 2007:175). These farmers especially believe in the need for education surrounding climate change and the effects it has on agriculture production: “Many believe that by obtaining technological information, including weather and climate related information, and market information they could carve out or enlarge their production scale and raise profits” (Stigter et al. 2007:175). Overall, this would increase their resilience to floods and other risks associated with disasters. A study done by the Ministry of Agriculture is China in conjunction with the Department of Market Information and the Center for Agriculture and Rural Research involved surveys similar to those done by the Ministry of Agriculture in Belize (Extension Workshop 2009). They both found that farmers are concerned with their ability to access practical technological information with “low investment and instant profits and information on market demands for agriculture products” (Stigter et al., 2007:175). Yet the information different farmers require depends, according to Ten Ying, to their varying income levels. He categorized four different levels of income and found that not only did all four treat the information provided differently but their satisfaction with that information varied as well (Stegter 2007:177).

A study done in India shows that when information on changing climate is provided farmers do make strategic decisions about adapting their crops, “what crop to plant and how much area to sow” (Stigter 2007: 184). Farmers in Belize could do the same if provided with relevant and accurate data with advanced notice. In order to ensure that predictions around weather were available in India these specific approaches were taken:

- provision of improved long range forecast of all India Seasonal rainfall before the beginning of the season (This provided time to the planners to adopt different strategies);
- close monitoring of the rainfall over different parts of the country on daily, weekly and monthly scales within the rainy season;
- delineation of different agro-climatological zones which helps in specific measures for agriculture planning on climatological basis;
- continued research efforts to enhance capabilities of forecasting monsoon rain on a local, regional and all India basis on different temporal scales (Stigther 2007:184).

This with a combination of ministry extension officers actively delivering the information to
farmers to implement the advisories help make the program successful.

**Conclusion**

Tools, training, seeds, fertilizers, and capital can help restore livelihoods in terms of agriculture. Belize is supporting farmers, which is important, but ultimately it is important for them to be self-sustainable to a level where they can replenish their own stocks in the event they lose their crops. In addition self-subsistence agriculture can be considered an income generating activity because it has the possibility of creating economic benefits for individuals, local business and the overall community. In order to have agricultural success, it is important to have multi-level intervention. Through the identification of markets, local and international support, and education farmers can gain the tools they need to be successful. All of these levels need to be addressed for success especially with the international economic connectedness that comes with globalization.

Prevention is an important strategy when it comes to planning for a disaster. It may take a few years to establish best practices that are unique to Belize. However, the combination of crop location on a high ground, at a central location could decrease the amount of food that needs to be supplied to a community. Farmers wouldn’t be losing all their food stocks due to floods and it would also promote cooperation and community involvement, which are all important aspects to securing funding and maintaining food security. If food was at a central location there would be one location, close by, where farmers or the community could sell their products making farming more profitable. Farmers markets are an effective model within other parts of Belize and the world. Each community is different but as farmers start to re-establish themselves after recent floods this could be explored. In the end, less food would have to be purchased from Belize City making the local community markets flourish. If the community does get cut-off due to flooded roads and bridges, there would be one central location that people are already used to, where they could pick up their aid if required making transportation of food aid more efficient and fair.

Education is probably the most important factor in the success of farming, no matter where the location. Extension officers could help farmers as individuals or as groups establish best practices for farming. They could explore systems that were flood resistant. Or they could save seeds so that if crops were lost and people decided to continue to grow on their own flood prone land, they wouldn’t have to wait for seeds to be delivered. Options can of course be suggested but ultimately it is important for farmers and extension officers to work together to discuss what the best options would be. Funding is available and should be accessed because money is essential to invest in a system that benefits not only Belize as a nation but the people within that nation at the local level.

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