A Last Mile Hazard Warning System for Disaster Risk Reduction in Sri Lankan Villages: Community Organization

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Abstract

The 2004 Indian Ocean tsunami was the largest natural disaster in recent memory in Sri Lanka and took more than 40,000 lives. In large part, due to the government's lack of organizational capacity, despite the fact that inquiries had been made to implement a warning system much earlier. In March 2007, LIRNE*asia*, with the resources and coverage of Sarvodaya and its Community Disaster Management Center (SCDMC), successfully completed a pilot study of a "Last Mile" Hazard Warning System in thirty-two (32)[1] Sarvodaya villages throughout Sri Lanka.

The aim of this project was to evaluate the suitability of five ICTs deployed in varied conditions in selected villages for their suitability in the last mile of a national disaster warning system for Sri Lanka and possibly to other developing countries. As regards organizational capacity, the pilot demonstrated that mobile and fixed phones performed best since they required little or no training while more higher end technologies such as AREA, VSAT and RAD were more complicated, requiring more training.

A hypothesis during the pilot phase purported that Sarvodaya level 4 villages would use and perform better with the ICTs than levels 1-3. Evidence found through the pilot demonstrates the congruity between highly organized communities and a better understanding and adoption of wireless technologies. This paper will address why community organization is significant to Sarvodaya and the HazInfo project within the context of disaster risk reduction, preliminary findings from the pilot supporting this argument, and policy recommendations for stakeholders.

[1] Thirty-two were selected for the project but only twenty-six (26) conducted the live-exercises and simulations due to lack of access on account of the existing conflict to the other six villages.

Introduction

In December 2005, LIRNE*asia*, an ICT (Information Communications Technology) policy and reform research organization, initiated a research project to evaluate the "last-mile" communication component of an all-hazards warning system for Sri Lanka.

The objective of the Last-Mile Hazard Warning System (HazInfo) project was to deploy and assess various alert and notification technologies[2] intended to reduce the vulnerability of local communities to natural and manmade hazards in rural and urban Sri Lanka. The project adopts an "all-hazards, all-media" approach designed around a set of five wireless communication technologies. The pilot project involved deployment, training, and field-testing of the technologies, in various combinations, across 32 tsunami-affected villages, using Common Alerting Protocol for data interchange with content provided in three languages (English, Sinhalese and Tamil).

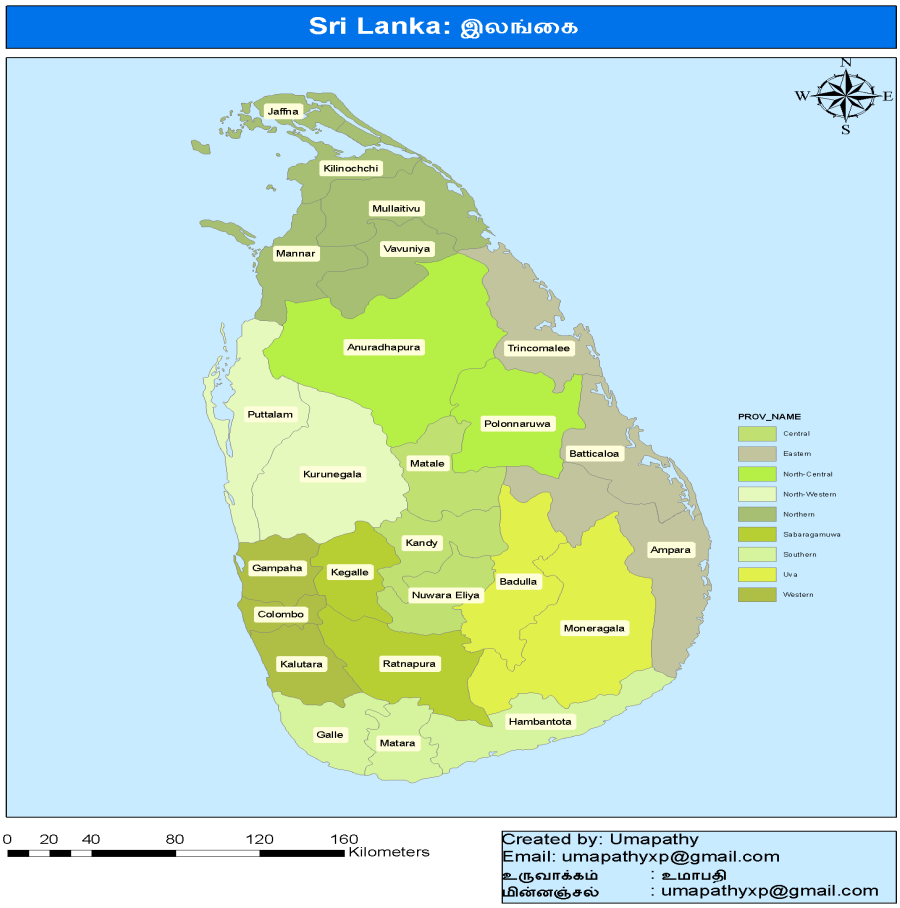

Figure 1: District and Provincial Map of Sri Lanka[3]

The assessment criteria are based upon the specific objectives of the HazInfo project, its research design, and system performance measuring process. The indicators for measuring the system design

[2] ICTs tested included: Dialog Early Warning Network Remote Alarm Device (DEWNS-RAD); Sinhala/Tamil SMS with alarm for Java compatible phones (mobile phones); Internet Emergency Public Alerting System (IPAS) with pop-up message; Disaster Warning Recovery and Response Addressable Satellite Radio (AREA); and, fixed phone.

[3] From http://upload.wikimedia.org/wikipedia/commons/5/53/Sri_Lanka_Districts.png.

and performance are:

- Reliability of the ICTs;
- Effectiveness of the ICTs;
- Effectiveness of the training regime;
- Level of organizational development;
- Gender specific response; and,
- Integration of ICTs into everyday life.

The results of the pilot found that levels of organizational development were significant for the adoption and implementation of wireless technologies. In the second phase, Sarvodaya, the NGO through which pilot communities were selected, plans to implement these warning technologies in 1000 villages. For Sarvodaya to do so, it will need to ensure that community organizational levels meet a certain standard (to be determined by findings and evidence presented in this paper), evidence from HazInfo and other experiences highlighting supporting organization and preliminary findings from the tests of the warning technologies in villages, and recommendations to stakeholders.

What is a community?
A community is a social group of organisms sharing an environment, normally with shared interests. In human communities, intent, belief, resources, preferences, needs, risks and a number of other conditions may be present and common, affecting the identity of the participants and their degree of cohesiveness.[1]

Sarvodaya Organizational Community
Thirty-two Sarvodaya communities participated in the HazInfo pilot project. Of these, 26 of the villages conducted simulations. All communities identified themselves by a number of the aforementioned characteristics and share an additional commonality as Sarvodaya communities. Sarvodaya is uniquely situated in the role of a national NGO with strong ties to over 15,000 villages in Sri Lanka. As part of its community-based disaster risk component, Sri Lanka's national Disaster Management Center aims to establish a sustained national program to build resilience and community level capacity for response and DRM in all hazard-prone communities in Sri Lanka.[4] Sarvodaya has a five-stage developmental process by which it defines the communities it serves. Levels 1-3 are basically less organized communities with few facilities and basic services. Levels 4 and 5 have a formal structure that enables coordination and direction of activities.[2]

The five evolutionary stages of a village

To fulfill its ambitions to develop human potential and to achieve widespread social effectiveness, the Sarvodaya Shramadana Movement is working with a participatory approach in nearly 15,000 villages on the island. The program is adjusted to the specific social, cultural, and religious conditions in each region. At the same time, all of the villages go through five stages of evolution or awakening.

. **Stage 1**: Inquiry from the village and organization of an introductory *shramadana* camp for the village, during which problems are analyzed together and needs identified.
. **Stage 2**: Establishment of various groups (children's, youngsters', mothers' and farmers' groups), construction of a child development center, and training of staff.
. **Stage 3**: Program for meeting the basic needs and setting up institutions (including the founding of the Sarvodaya Shramadana Society, which is responsible for the village's development initiatives);
. **Stage 4**: Measures to produce income and employment; establishment of complete self-reliance and self-financing;
. **Stage 5**: Support for other village communities.

The approach is designed in such a way that ten villages are always grouped around a pioneering village that has already reached the fifth stage. These villages cooperate, and the groups of ten are linked to one another in turn at the district and national levels, so as to be able to implement common projects such as a regional water supply. The aim is that the villages should be able to manage themselves as a community – to be organized, self-reliant, and able to act independently.

The box above describes the five evolutionary stages of a village within the Sarvodaya system. It should be noted that no village has yet attained Level 5 status.

Hazard Information Hub (HIH) Community
The HIH is the coordination center for the HazInfo project. It is designed to receive warnings sent to it from the National Disaster Management Center (NDMC) and disseminate alerts to Sarvodaya communities. During the HazInfo project, HIH personnel were trained to support the HazInfo simulations in the communities by sending alerts to each test village.

The Case for Community Organization and Disaster Risk Reduction
Over the past few years, there has been a growing realization that disaster risk reduction is most effective at the community level. After the 2004 tsunami, before government agencies and NGOs could react, communities were assisting each other in response and relief efforts. Rather than waiting for outside assistance, communities relied upon themselves in the initial period shortly after the tsunami impact. Community solidarity is an under-appreciated disaster protection measure. Local residents are the first and last responders to a disaster. Building their resilience is fundamental to ensure they are not reduced to disaster victims.[3] Solidarity is key to building a resilient community. Thereby, to build a resilient, prepared populace community organization and disaster risk reduction go hand-in-hand. Before a community can be mobilized for disaster mitigation, it must be organized. The HazInfo project lends credence to this step in community organizing for community development articulated by Lorna P. Victoria that in the organization of the group – the role and responsibility of each member vis-à-vis the community activities and tasks are identified and agreed upon. Skills improvement is provided to the community organization and they are encouraged to forge links with other institutions.[4] HazInfo provides skills improvement through the introduction of communication technologies; subsequently, empowered communities are more likely to seek links with other institutions.

The United Nations Development Programme (UNDP) defines disaster risk reduction as the systematic development and application of policies, strategies and practices to minimize vulnerabilities, hazards and the unfolding of disaster impacts throughout a society, within the broad context of sustainable development. Disaster risk reduction is aimed at tackling the fundamental elements of disaster risk: vulnerability, hazards (or shocks) and exposure. Reducing disaster risk is not just about additional investments – it is also about ensuring that development interventions are sound. For example, ensuring appropriate construction of critical infrastructure in highly vulnerable areas.[5] Sound development efforts are key to both community solidarity and disaster risk reduction. Risk reduction includes a variety of mitigation and preparedness techniques, which, in the long run, are designed to ensure sustainable development for the community of interest. Following the 2004 tsunami, Sarvodaya realized the importance of mitigation. In the wake of the disaster, communication was difficult and getting an accurate assessment of the devastation's extent was impossible. Land phone lines and even mobile phone connections were virtually non-existent in many parts of the country and the electricity supply had been cut off. Despite these challenges the Sarvodaya response was swift and systematic. As soon as the news of the disaster reached Sarvodaya headquarters in Moratuwa on 26 December around 10.30 a.m., a special Disaster Management Operations Centre was set up and began to receive reports from the Sarvodaya district offices in the affected areas. Staff members and volunteers from non-affected Sarvodaya Districts and Divisional Centers were sent to affected areas.[6]

In June 2005, the Sarvodaya Community Disaster Management Center (SCDMC) was inaugurated. The purpose of the center was to inculcate a culture of disaster management within the organizational structure. Sarvodaya recognized that its community development efforts could not function effectively without proper attention to disaster risk reduction. The HazInfo project fits into the SCDMC's framework for disaster risk reduction through its focus upon enabling Sarvodaya communities to receive alerts so that they may prepare for impending disaster in an organized manner.

Better identification of risk and occurrence of a hazard, coupled with monitoring the levels of vulnerability of a population through the establishment of effective early warning systems is also fundamental.[7] The HazInfo project, as a *community-based* hazard early warning system, is critical to

communities' resilience and sustainable development efforts. Through HazInfo project vulnerability assessments, the participating communities identified cyclone, tsunami, floods, landslides and lightning as the top five natural hazards communities have faced in the recent past. Considering that the communities in the pilot developed this list of hazards, it shows that a functioning level of community organization exists in all pilot communities.

Work to define institutional and legal mechanisms for disaster risk reduction in many developing countries, including the Maldives, Sri Lanka and Pakistan, has shown a clear trend towards empowering local governments. Local governments and communities are the first line of response in any emergency: disaster risk reduction can therefore be a strong incentive for decentralization. Local government also plays a crucial role in facilitating bottom-up planning and empowering local communities through knowledge transfer.[8] Zubair Murshed reiterates the point that communities are the first line or response by saying that organizational and social support networks are the most crucial coping mechanisms people rely on in times of crisis and emergency.[9] Tasks of community organization include preparing and sharing the emergency response plan with all community members, monitoring disaster threats, networking and coordinating with local government officials, issuing warnings (or alerts), managing community-wide evacuation, search and rescue operations besides planning and conducting relief delivery operations with aid agencies and implementing mitigation and rehabilitation activities. Further, Pardeep Sahni and Alka Dhameja contend that communities must be organized to ensure:

- Formation of committees at the village level and distribution of responsibilities.
- Involvement of the local committees in the warning system.
- Participation of the local committees in emergency relief aid, supply and delivery.
- Participation of disaster victims in the management of temporary shelters.
- Building up community awareness on hazards.[10]

Sarvodaya was able to react rapidly to the tsunami due to its structure being synonymous with that of the Sri Lankan government. The Road Map (DRM Framework for Sri Lanka) emphasizes the need for an early warning system and related components (such as upgrading the meteorological system, etc.) but does not acknowledge the participation of communities in this process. Oftentimes, official warning signals from the national level do not reach communities or if they do, they are late or are distrusted or not understood by the locals. Governments must also recognize the importance of community and its organization in developing not only early warning systems, but implementing disaster risk reduction measures. The Sri Lankan government can easily adopt both tacit knowledge and operational methodologies from Sarvodaya and lessons learned in the HazInfo pilot.

The Tsunami Recovery Impact Assessment and Monitoring System (TRIAMS) of ProVention Consortium has put together the following indicators that represent capacity for disaster management (DM).

DM1. Organization and coordination of emergency operations.

DM2. Emergency response planning and implementation of warning systems.

DM3. Endowment of equipments, tools and infrastructure.

DM4. Simulation, updating and test of inter-institutional response.

DM5. Community preparedness and training.

DM6. Rehabilitation and reconstruction planning.[11]

These indicators show that emergency response planning and implementation of warning systems are as important as community preparedness and training. To ensure preparedness and training in communities, they must attain a level of organization that enables community members to be receptive to preparedness and training, and knowledgeable about its importance. Within the HazInfo context, organization and coordination of emergency operations must be greatly enhanced at Sarvodaya. The pilot addressed each of the first five indicators to a large extent; the implementation phase should expand upon gaining more evidence to test the strength of these indicators within the

Sarvodaya and Sri Lankan context. Rehabilitation and reconstruction planning is a significant indicator in determining the scope of the pilot and steps it must take to proceed into implementation, primarily taking into consideration government action from the time of the tsunami until the present.

Communities in the Last Mile Hazard Warning System: Overview of Results

The overall aim of the HazInfo project was to set the stage for community-driven initiatives at the Last Mile of the Hazard Warning System. The matrix below shows the villages according to organizational level (vertical axis) and whether they were trained or untrained.

	With ERP Training				No ERP Training			
Sarvodaya Stage 1, 2, 3	VSAT Urawatha (Galle)	MoP Nidavur (Batticalo)	FxP Thirukadalar (Trincomalee)	AREA Moratuwella (Colombo)	MoP Meddhawatha (Matara)	MoP Thambiluvil (Kalmunai)	FxP Oluville (Kalmunai)	AREA Maggona (Kalutara)
	AREA + RAD Modarapallassa (Hambantota)	AREA + FxP Wathegama North (Matara)	AREA + MoP Palmunnai (Batticalo)	Control Village Abeyasinghepura (Ampara)	AREA + RAD Thondamanar (Jaffna)	AREA + FxP Karathivu (Kalmunai)	AREA + MoP Munnai (Jaffna)	Control Village Modara (Colombo)
Sarvodaya Stage 4	VSAT Modaragama (Hambantota)	MoP Diyalagoda (Kalutara)	FxP Periyakallar (Batticalo)	AREA Panama North (Ampara)	MoP Satur-kondagnya (Batticallo)	MoP Samodhagama (Hambantota)	FxP Indivinna (Galle)	AREA Brahamana-wattha (Galle)
	AREA + RAD Kalmunai II (Kalmunai)	AREA + FxP Samudragama (Trincomalee	AREA + MoP Valhengoda (Galle)	Control Village Mirissa South (Matara)	AREA + RAD Venamulla (Galle)	AREA + FxP Kottegoda (Matara)	AREA + MoP Thallala South (Matara)	Control Village Thalpitiya (Kalutara)

Figure 3: HazInfo Community Matrix

Of the 32 villages selected for the pilot, 16 were at Sarvodaya organizational level 4, whereas, the other 16 were at organizational levels 1-3. Eight of the levels 1-3 and 8 of the level 4 villages were selected to receive Emergency Response Plan (ERP) training. The other 16, comprised of 8 levels 1-3 and 8 level 4 villages, did not receive any training. Once all simulations were complete the remaining sixteen villages received training to avoid any discrimination accusations.

All Sarvodaya trained villages had started an “Emergency Disaster Management Committee”. In most cases this committee comprises members of the Sarvodaya Shanthi Sena Volunteers. They were the key resources in conducting Emergency Resource Plan (ERP) training and simulations in the communities. Tabletop exercises[5] revealed that all communities needed guidance and assistance to strengthen the resilience in their neighborhoods. The communities strongly requested that disaster management programs be continued and not allow them to end as many such activities do.

Simulations were first scheduled to be conducted over a 6-week period starting in November and finishing in December. This strategy failed because the Sarvodaya District Coordinators could note agree to the dates due to commitments to other project activities. Northeast District Coordinators were tied up with the Internally Displaced People (IDP) as a result of the Northeast conflict. A couple of the Communities and District Centers had organizational dysfunctional issues. The HIH did not have adequate capacity to assist in deficiencies in scheduling and executing simulations in the communities. Therefore, live exercises were conducted in only 26 of the 32 villages.

Galle, Ampara, Matara, Colombo, Trincomalee, Kalutara, and Kalmunai districts successfully

[5] In disaster planning, a type of test in which the disaster team role-play a disaster scenario prepared by a test moderator. The disaster plan is referred to for information during the test.

completed their Live-Exercises. However, as a result of the Northeast conflict, inadequate leadership, lack of resources, and language barriers prevented Batticaloa District from successfully completing training, deploying ICTs, and conducting Live-Exercise. All communities had an equal level of participation and enthusiasm implying that Sarvodaya villages in all stages responded equally to hazard warnings; i.e. all executed tsunami evacuation plans, which is the only emergency response plan the community was trained to execute. Despite the fact that of the thirty-two communities, only 16 were trained, the control communities had sufficient organizational structure to make an alliance with another community who had received an LM-HWS ICT. Although it was initially selected to participate in the research, Jaffna had to be removed from the beginning of the project because the civil war re-commenced and the main road (the A9) was closed. Consequently, ICT Guardians (ICT-G) and Emergency Response Plan Coordinators (ERP-C) could not go to Colombo to receive training nor could the HazInfo project team go to Jaffna to conduct trainings and simulations.

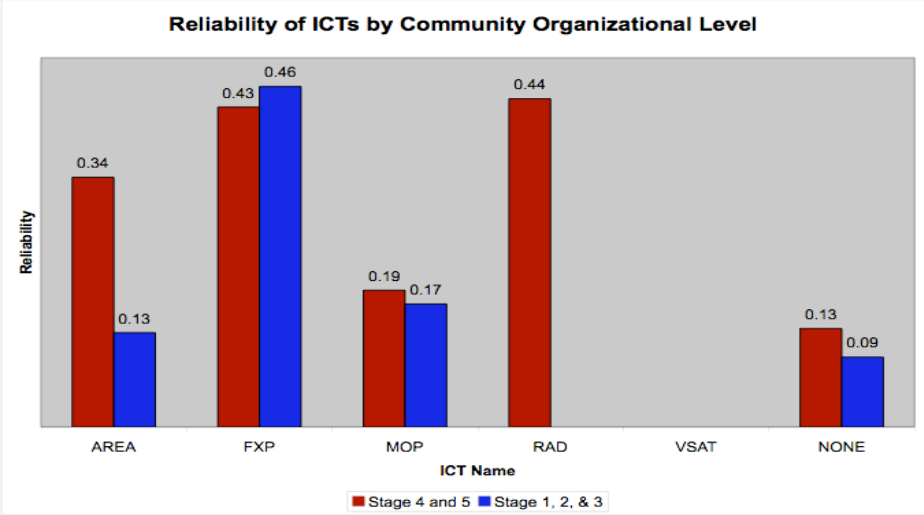

Figure 4: Reliability[6] of ICTs by Community Organization Level

Data in Figure 3 does not show a gap between the less-organized and organized communities for both fixed phone (FXP) and mobile phone (MOP). The reason could because these 2 ICTS exist in the Sri Lankan market; hence, the communities are exposed to this equipment. The AREA, which was introduced to the Communities through the project, shows a significant gap between the organized and less-organized Communities. It can be concluded that organized communities that have the formally established structure and capacity are capable of adopting new technologies compared to the less-organized communities. This argument could be further strengthened if results for RAD and VSAT, novel technologies to the communities, were available.

Community Organization: Recommendations for HazInfo Implementation

Given that the data in the HazInfo pilot phase supports the hypothesis that the more organized a community is the more likely it is to properly use the technologies for last mile warning, it is important that several policy guidelines be adopted to ensure the institutionalization of the Last Mile Hazard

[6] Calculation of reliability is dependent upon two main factors – *certainty* and *effectiveness. Certainty* is the operational state of the device (variable: R_c). *Efficiency* is the time taken to complete the transmission (variable: R_e). Therefore, *reliability* is $R = R_c \times R_e$

Warning System in target communities in Sri Lanka. Note that the findings are preliminary as the HazInfo pilot revealed several research shortcomings. Further research is required to ascertain the basic conclusions made herein.

The stakeholders in the HazInfo are the communities, Sarvodaya, partner affiliates (such as LIRNEasia and WorldSpace), the National Disaster Management Center of Sri Lanka. Each must adhere to certain policy guidelines in regards to implementation of HazInfo.

National Disaster Management Center, Sri Lanka

- Join all last-mile type early warning initiatives in the country.
- Capitalize upon signed MoUs with relevant community-based organizations (CBOs) to promote knowledge transfer and cross-pollination for an optimal early warning system.
- Develop a viable all-hazards early warning system that coordinates with the "last-mile".

Sarvodaya

- Increase capacity building in the Hazard Information Hub (HIH) by training personnel and obtaining necessary hardware and software for the HazInfo project.
- Seek a mutually beneficial partnership with the National Disaster Management Center through an MoU.
- Build capacity in disaster risk reduction throughout the organization and especially with communities where HazInfo will be implemented.
- Assist partners in maintaining and upgrading the HazInfo system through a feedback mechanism.
- Institute disaster public awareness in HazInfo communities and throughout the network of Sarvodaya communities.
- Update community organizational level requirements to include the adoption of HazInfo early warning system to become level 4 communities.
- Suggest ways in which HazInfo communities can use HazInfo technologies for daily use.

Partner Organizations

- Continue adapting technologies to fit capabilities and uses of target communities.
- Link with regional and international initiatives in last-mile hazard warning systems to obtain best practices with regard to communities and applicability to the Sri Lankan context.
- Include all-hazards evacuation plans.
- Assist Sarvodaya with training both HIH personnel and communities.
- Provide updated technical hardware and software suitable to communities, as necessary.

Conclusions

Findings from the HazInfo project are not all conclusive, but give an indication as to how the implementation of last-mile hazard warning systems should proceed. The data from the pilot phase supports the hypothesis that higher organized communities (level 4) are more capable of handling the higher end ICTs than those that are less organized. Use of basic technologies, like fixed phone or mobile phone, is essentially equal throughout all communities regardless of community organization.

Implementing the HazInfo project will require that the recommendations made in this paper are considered and serious time and effort invested in building both the communities themselves but also other relevant "communities of interest" such as Sarvodaya, its Hazard Information Hub, the Sarvodaya Community Disaster Management Center (SCDMC), partner organizations, and even the National Disaster Management Center.

The CPR*south* should take an interest in this research as it has implications for the implementation of the HazInfo pilot. Policy changes regarding community organization at both the field level to the government level must commence if community-based hazard warning systems are to be implemented and sustainable. Above all, implementation will require that more highly organized communities are targeted and less organized communities given more training and skill-building activities. Community organization is not only important for a last-mile warning system like HazInfo, but for effective disaster risk reduction.

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Appendix A: Description of Technologies used in HazInfo

Dialog Remote Alarm Devices (RADs)

RADs are stand-alone units that incorporate remotely activated alarms, flashing lights, a broadcast radio receiver to be turned off or on and SMS messages to be displayed, as well as self- test, message acknowledgement and hotline GSM call-back features.

GSM Java enabled SMS mobile phones (MPs)

MP receives text alerts in Sinhala, Tamil and English (Java Phone), activate a Java applet to sound an alarm, and hotline GSM callback features.

Disaster Warning Recovery and Response Addressable Satellite Radio for Emergency Alerts (AREA)

AREA is a WorldSpace satellite radio system that can issue address hazard information directly to those communities at risk. Global Positioning System (GPS) technology incorporated into the radio receiver set, along with the unique code assigned to every receiver, allows for hazard warnings to be issued to sets that are within a vulnerable area or just to radio sets with specific assigned codes.

Very Small Aperture C-Band Satellite Terminals (VSAT)

VSAT terminals have been installed in two communities and at the HIH. These facilities provide up to a 512 kbps Internet connection and enable testing of the Internet Public Alerting System (IPAS). An IPAS client application installed on a
computer enables pop-up messages to appear on a PC screen and an audio alert tone to be played on the computer's sound system.

CDMA Fixed Wireless Phones (FPs)

FP is a CDMA phones with built-in speakerphones to provide voice communication via the public switched telephone network.