CASE STUDY
Category: ICTs, Climate Change and Disaster Management

Climate Change, Innovation & ICTs Project

Centre for Development Informatics (CDI), University of Manchester, UK
With the support of the International Development Research Centre (IDRC)

Role of ICTs in Early Warning of Climate-Related Disasters: A Sri Lankan Case Study

Author: Kanchana Wickramasinghe

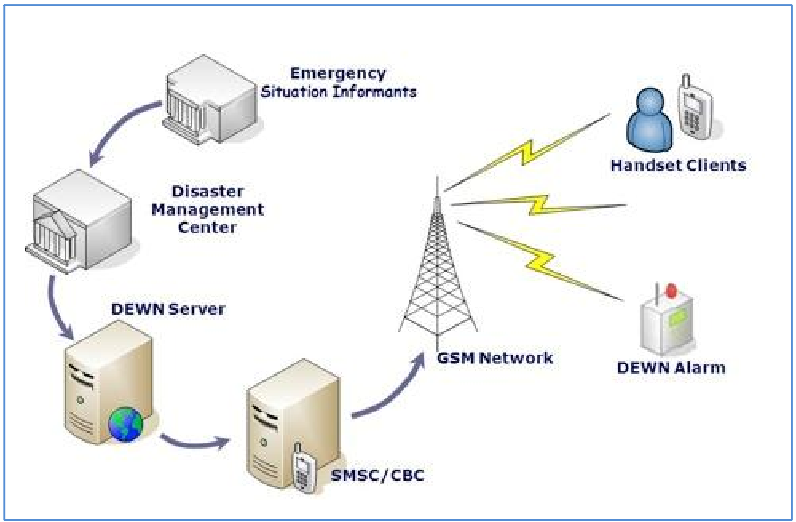
Initiative Overview

Climate change is now increasing – and will further increase in future – both the frequency and intensity of natural disasters in Sri Lanka including cyclones, floods and landslides (MoE 2010). While a number of strategies are necessary to address growth in climate-related natural disasters, an effective early warning system can play a crucial role in lessening the probable negative impacts. More generally, the need for such a system was highlighted following the huge devastation caused by the 2004 tsunami. After four years of research, development and piloting activities, the Disaster Early Warning Network (DEWN) was launched in Sri Lanka on 30th January 2009. It aims to provide timely, reliable and cost-effective mass-scale disaster early warnings. DEWN represents a multipartite effort and a case for public-private partnerships in delivering ICT-based early warnings.

Application Description

The DEWN server is located in Sri Lanka's Disaster Management Centre (DMC), the responsible agency on the island for all disaster management issues. The DMC receives early warning information from recognised technical agencies. Accordingly, information regarding floods, landslides, earthquakes and tsunamis is provided by the Irrigation Department, National Building Research Organisation, Geological Survey and Mines Bureau, and Meteorological Department, respectively. The DMC holds the responsibility for verifying the emergency situation and then issuing alerts. Emergency personnel are alerted first in the case of a potential disaster and public alerts are issued after the threat is further verified (DMC 2009).

Figure 1: Overview of the DEWN System



Source: Wijesinghe et al (2008)

DEWN's alerts are multi-modal; that is, making use of multiple technologies to disseminate information to the last mile. As shown in Figure 1, the end devices are normal cellular phones and alarm devices which were specially developed for this initiative. DEWN can generate mass, personnel-directed or location-based alerts to the end devices using the two commonly-available mobile communication technologies: cell broadcast (CB) and short message service (SMS)[1] (Wijesinghe et al 2008).

[1] CB is point-to-multi-point / broadcast technology by which messages are broadcast to all handsets which are 'listening' to the appropriate CB channel. CB can reach millions of handsets in a matter of seconds if they are listening. In contrast, SMS is point-to-point, where messages are individually sent to a known number, one after another. CB remains entirely functional even in the case of network congestion where SMS services are impossible to use (O2M 2010).

Figure 2: An Alarm Device Placed in a Hospital

SMS-based alerts are sent to the contacts, mainly emergency personnel (currently numbering around 1,500 people). Since SMS is not immune to possible network congestion that may occur during disasters, it is not used for mass-alerting. Instead CB, which is immune to network congestion, is used to send mass alerts. The content of the message follows the internationally accepted Common Alerting Protocol (CAP). Customised messages are trilingual (English, Sinhala, Tamil) and can follow a number of formats including alert, order for evacuation and 'no threat'[1]. They can be sent to individual or groups or to the general public in identified areas.

In addition, alerts can be sent to the specialised DEWN alarm devices which are designed to be kept in the public places such as police stations, religious/community centres, markets, hospitals etc. (see Figure 2). The alarm device can be triggered either by SMS or CB and includes a number of functionalities which are essential in emergency communications. These include an audible alarm, visual light alert, callback facility to a hotline number, backup battery, remotely and locally tunable FM receiver, and the ability to be used as a portable radio in day-to-day life. Its design thus provides a functionality before, during and after a disaster even in situations where there are power disruptions and the requirements for population movement (*ibid*). The device has been successfully tested, though further study and improvements are ongoing so that the device is not yet operational at national level.

Formal Drivers

DEWN was specifically initiated in response to absence of an effective, last-mile warning system for Sri Lanka, following the tsunami devastation in 2004. However, it was also designed to address climate-related disasters – cyclones, floods, landslides – since it was expected that climate change would aggravate all of these in terms of intensity and frequency over coming years (Parry et al 2007, Solomon et al 2007). In all cases, the most important missing link in disaster management was seen to be the difficulty of getting early warning information out to key emergency personnel and to the general public. This element of the information system is seen as the one most able to minimise the negative impacts of climate-related (and other) disasters.

Objectives/Purpose for ICT Usage

The traditional ways of disseminating disaster early warnings in Sri Lanka have been through radio and television, military forces and early warning towers. However, during a disaster situation, there are important limitations – mass media channels are not always switched on, and other channels have limited reach. In designing DEWN, then, the intention was – via the combination of cell phones (many of which are constantly switched on) and alarm devices – to enable early warning information to reach the last mile more effectively but also at relatively low cost.

[2] 'No threat' messages are used to inform people that the danger from the disaster is over.

Stakeholders

The DEWN initiative is a multi-agency collaboration which includes the government's Disaster Management Centre, Dialog Telekom Ltd. (a private mobile telecommunication operator), Microimage (Pvt) Ltd. (a private software development company), and the University of Moratuwa (UOM). The mobile operator initiated research and development activities in collaboration with the university in the Dialog-UOM Mobile Communication Research Laboratory. All funding and some technical assistance for this was provided by the company. Most software development activities were undertaken the software development company. Like Dialog Telekom, Microimage got involved in the initiative on non-commercial grounds. The ultimate stakeholders are the emergency personnel and general public who will benefit from the warnings, though cell broadcast alert messages to individual phones are only available to those who are Dialog Telekom subscribers.

Impact: Cost and Benefits

The costs of the DEWN initiative are very hard to estimate since they have been undertaken as an integral part of the activities of all the stakeholders, without separate and explicit costing. One of the few costs that is known is that of the alarm devices, with initial versions costing around US$190 each to produce. At the time of writing, DEWN had not been used in an actual disaster incident. However, the benefits can be expected to much higher than the costs. The main benefit of any early warning system is the saving of human life. It is hard to provide monetary estimates for this and such estimates as exist vary considerably. However, using figures from Hong Kong and adjusting for differences in GDP per capita gives a very rough estimate of US$150,000 per life saved in Sri Lanka (Siebert & Wei 1998). There will also be benefits in terms of any movable goods and assets that might be saved from disaster due to the early warning, with estimates of a 1:7 ratio between overall costs and benefits of investment in disaster early warning systems and other preventive measures (DT 2010). There are also some more quantitative benefits, from greater feelings of security within communities that can access the warnings, to reputational and other benefits for the mobile operator.

Evaluation: Failure or Success

DEWN is expected to be a successful example of an early-warning system suitable for addressing the growing threat of climate change-related natural disasters. However, since no such major disaster has befallen Sri Lanka since DEWN's implementation, no full evaluation can be given; only the assessment of pilot and trial exercises which have shown the value of mobile telecommunications in this area of climate change adaptation.

Given the innovativeness of DEWN, it received a number of pre-implementation awards including a National Best Quality Software Award and National Award for Science and Technology in Sri Lanka in 2006, a Vodafone 'World Around Us' Workshop Award in Cairo in 2006, and Commendation at the GSM Global Awards in 2007. The alarm device has also been patented.

Enablers/Critical Success Factors

- **Public-private partnership** has an important part of the success of this project. The public sector must be involved since the DMC is the responsible agency for early warning, and it provides the sole legitimate node that can draw on other public agencies for the early warning information. However, it lacks many key resources – money, knowledge, skills, and a nationwide mobile infrastructure. It was all of these that the private partners – Dialog Telekom especially – could provide.

- **Building on existing technologies** has been central to the project. Rather than try to set up a new, separate information system to deal with climate change / disasters, DEWN was built on the existing mobile network in Sri Lanka. This has brought many advantages. It has reduced costs. It has ensured long-term viability since the mobile network and its phones exist irrespective of the DEWN project. It has ensured strong penetration of the warnings given that mobile subscription rates have been growing by nearly 50% per year during the first decade of the 21st century, with 82 subscriptions per 100 citizens by 2011 according to data from the Sri Lankan Telecommunications Regulatory Commission. (More specifically Dialog is the market leader with a 39% share amounting to more than 7 million customers, and coverage of 75% of the island's land area and 95% of its population.) The high penetration rate and high market share for Dialog and the fact that many people have their mobiles on at any given time day or night (unlike radio and TV) mean that virtually all communities are likely to receive at least one warning, and most will receive many.

- **Integrating climate change into broader applications** helps. This was not a system designed specifically for climate change. Instead, it integrates the dangers of climate change – its exacerbation of natural disasters – into a more generic information system. Indeed, DEWN is broader also than just an early warning system since it can also be used to contradict erroneous messages about disasters, and to disseminate information on post-disaster operations.

- **Specific disaster-relevant design components** have been included. So – unlike some other early warning systems – DEWN includes an audible alarm warning. By being trilingual, it also minimises language barriers that would occur if, for example, warnings were only sent out in English or in Sinhala.

Constraints/Challenges

The **technology** has been a challenge in three ways. First, the ***cost*** of the alarm devices was initially quite high for a developing country context like Sri Lanka – more than US$400 – limiting its diffusion. Ongoing development work has reduced this cost by more than half, but the money for this – as compared to using the existing mobile network – has to be found from somewhere. In addition, there have been problems with some phones in use in the Sri Lankan market, which do not adhere to ***international standards***. As a result, it has been very difficult to get CB messages delivered to these phones. Technology has also proven a challenge to ***network interconnection***. At present, only Dialog subscribers receive the alert messages. Discussions have been held with other mobile operators to enable cross-network connectivity but this will only be possible with the necessary technology and infrastructure (and political will) to enable this interconnection.

Not yet a proven issue in Sri Lanka, but there are reports that mass alerts in certain other contexts have generated **panic and chaos** among the recipients at times of disaster (Jayasinghe et al 2006).

Recommendations/Lessons Learned

The following lessons were learned from this case study:

1) **Public-private partnerships can play a valuable role in ICT-enabled climate-related disaster management**. The situation with DEWN is not untypical where early warning systems are needed due to climate change and other causes: the public sector has legitimacy, institutional capital and reach; the private sector has technology, innovative capacity and other resources. Each provides what the other lacks and – if collaboration is well thought-through – each can be motivated to successfully work together.

2) **Mobile technology can be used now with limited additional investment**. Although, as seen, technology remains a challenge for early warning systems, those challenges would be far greater if projects required investments in new infrastructures and required users to make use of new, unfamiliar technologies. Mobile now provide a ready, increasingly-ubiquitous, increasingly-familiar technology in developing countries around which to base not just early warning systems but other ICTs and climate change applications.

3) **Multi-operator collaboration is necessary for fuller coverage**. Already, DEWN likely reaches into virtually every community in Sri Lanka. However, to ensure the fullest-possible coverage and to avoid concerns about economic or other gains being sought by one operator, it would be sensible for mobile-based, climate change-related ICT applications to be based around a multi-operator collaboration; something on which government partners could insist.

4) **Technology must be complemented by other actions**. Just rolling out technology is not sufficient for early warning systems. Instead, there must be awareness raising (via mass media and / or via phone) among the general public; there must be specific training for those using specialist devices like the alarm; and all this must be part of much wider training of emergency personnel for both early warning and disaster intervention response.

5) **Build climate change into existing disaster applications, don't built stand alone applications**. DEWN does not give any separate consideration to climate change – it focuses on effects and is thus "cause-blind". It thus addresses the effects that climate change may exacerbate but within a general-purpose application. Consideration of climate change thus comes at initial planning stages for early warning applications, to ensure that the type of disasters climate change may exacerbate are incorporated into the overall system design.

Data Sources & Further Information

The case study is based on published materials plus key informant interviews with the DMC, mobile telecommunication operator (Dialog), software development company (Microimage) and the mobile telecommunication research laboratory, who are the stakeholders of DEWN which, in turn, is seen as an integral component of the climate change response process in Sri Lanka.

Author: Kanchana Wickramasinghe
Institute of Policy Studies of Sri Lanka
100/20, Independence Avenue,Colombo 07
Sri Lanka

For further information:
E-mail: kanchana@ips.lk

References

DMC (2009) *Newsletter, Second Quarter*, Disaster Management Centre, Colombo.

DT (2009) *Innovation for Inclusion*, Dialog Telekom, Colombo
http://202.69.200.131/en/responsibility/dewn/dewn.html

DT (2010) *Disaster and Emergency Warning Network*, Dialog Telekom, Colombo
http://www.dialog.lk/about/responsibility/outreach-cr/dewn/

Jayasinghe, G., F. Fahmy, N. Gajaweera and D. Dias (2006) A GSM Alarm Device for Disaster Early Warning, paper presented at the *First International Conference on Industrial and Information Systems*, 8-11 Aug, Peradeniya, Sri Lanka

MoE (2010) *National Climate Change Adaptation Strategy for Sri Lanka: 2011 to 2016*, Ministry of Environment, Colombo

O2M (2010) *Cell Broadcast System*, one2many, Deventer, Netherlands
www.one2many.eu/content/bestanden/faq-cbs-pws-o2m-v1.2.pdf

Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds) (2007) *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK

Siebert, W.S. and X. Wei (1998) Wage compensation for job risks, *Asian Economic Journal*, 12 (2), 171-181

Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.) (2007) *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK

Wijesinghe, L., P. Siriwardena, S. Shanmugarajah, S. Wijeratne, R. Wijesinghe, M. de Soyza, H. Purasinghe and D. Dias (2008) DEWN II: A Trilingual Disaster And Emergency Warning Network, paper presented at the *International Information Technology Conference*, 28-29 Oct, Colombo

EDITORS:

Richard Heeks
Angelica Valeria Ospina

Photo Credits: DT (2009)

The **Climate Change, Innovation and ICTs** Project is an initiative led by the Centre for Development Informatics (CDI) of the University of Manchester, UK, with funding support from Canada's International Development Research Centre (IDRC).
Further information about the project and related resources can be found at: http://www.niccd.org