SMART VILLAGES
New thinking for off-grid communities worldwide

Smart Villages and resilience to natural disasters

Workshop Report 18

SINGAPORE

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Smart Villages

We aim to provide policymakers, donors, and development agencies concerned with rural energy access with new insights on the real barriers to energy access in villages in developing countries—technological, financial and political—and how they can be overcome. We have chosen to focus on remote off-grid villages, where local solutions (home- or institution-based systems and mini-grids) are both more realistic and cheaper than national grid extension. Our concern is to ensure that energy access results in development and the creation of "smart villages" in which many of the benefits of life in modern societies are available to rural communities.

www.e4sv.org | info@e4sv.org | @e4SmartVillages

CMEDT – Smart Villages Initiative, c/o Trinity College, Cambridge, CB2 1TQ

The Asia Research Institute

The Asia Research Institute (ARI) was established as a university-level institute in July 2001 as one of the strategic initiatives of the National University of Singapore (NUS). The mission of the Institute is to provide a world-class focus and resource for research on the Asian region located at one of its communication hubs. ARI engages the humanities and social sciences broadly defined and especially interdisciplinary frontiers between and beyond disciplines. Through frequent provision of short-term research appointments it seeks to be a place of encounters between the region and the world. Within NUS it works particularly with the Faculties of Arts and Social Sciences Business Law and Design to support conferences lectures and graduate study at the highest level.

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Summary

This report summarises the findings of a workshop on Smart Villages and Resilience to Natural Disasters. Co-hosted by the Asia Research Institute, National University of Singapore, and the Smart Villages Initiative, the workshop brought together two communities of researchers and practitioners focusing on energy access and natural disasters to promote active discussion around key issues concerning smart villages and resilience to natural disasters. It also sought to draw out messages relevant to academic researchers and policymakers and make recommendations for future research questions.

Representatives from each of the two communities began by conceptualising "smart villages" and resilience to natural disasters. The need for further efforts to link the "smart villages" concept, particularly access to modern energy, with resilience to natural disasters was highlighted in addition to the nuanced nature of resilience.

The first panel session, consisting of frontline views of earthquakes, floods, and droughts, brought together experiences from Bangladesh, India, Nepal, and Asia as a whole. Key lessons learned included the need to actively include the community, for all stakeholders to work together, for processes to be embedded in governance systems, and for a long-term horizon approach to be adopted.

The second panel session focused on strengthening the resilience of rural communities. Using examples from Indonesia, Malaysia, and Thailand, three useful frameworks were presented for understanding resilience and the processes required to improve resilience among rural communities. A key message from this panel session was the need to see rural communities as equal partners in the resilience building process rather than simply as recipients of new knowledge.

The third panel session examined linkages between energy access and resilience. This session revealed the significant research gap concerning linkages between energy access and resilience and the need for the academic and practitioner community to undertake further work to better understand this relationship.

A final session on identifying policy messages and future research questions found that more explicit attention should be given by policymakers to the potential role of traditional knowledge in improving resilience. Further policy messages included the need to understand potential unintended impacts of interventions designed to improve the resilience of a community to a particular risk. Research questions suggested by participants included: energy, resilience and gender; the relationship between energy access/poverty and disaster resilience; and how energy access and technologies can improve resilience.

INTRODUCTION

A workshop on 'Smart Villages and Resilience to Natural Disasters' was held in Singapore on 5 May 2016. The workshop was co-hosted by the Smart Villages Initiative and the Asia Research Institute, National University of Singapore. It brought together 44 participants from two communities of researchers: those focusing on energy access, and those focusing on resilience to natural disasters.

The concept of "smart villages" is intended as a rural analogue to "smart cities", recognising that nearly 50% of the world's population and 70% of the world's poor live in rural areas, and that we should have a similarly ambitious vision of development. In smart villages, energy access, together with other key infrastructure, accelerates the development of education and healthcare services, provision of clean water and sanitation, availability of nutritious food, and the establishment of productive enterprises bringing new sources of income into the village. Underpinned by technological advances, such developments provide substantial improvements in well-being and life opportunities and a more equitable choice between remaining in rural communities and migrating to cities.

Being "smart" should increase the resilience of villages to natural disasters[1]. But does it, and if so, in what circumstances? The workshop therefore addressed the following questions:

1   How should we define resilience to natural disasters for rural communities?

2   What characteristics of a smart village could contribute to its resilience?

3   In developing the infrastructure of a smart village, particularly its energy services, how can we ensure that it supports the achievement of the desired level of resilience?

The workshop aimed to promote active discussion around key issues concerning smart villages and resilience to natural disasters in Asia as well as draw out messages relevant to academic researchers and to policymakers and make recommendations for future research questions.

Representatives speaking on behalf of the Smart Villages Initiative and the Asia Research Institute defined the "Smart Villages concept" and "resilience". This was followed by three expert panels focusing on: views from the frontline (earthquakes, floods and drought); strengthening the resilience of rural communities; and linking energy access with resilience. In addition, a short documentary on the 2004 Indian Ocean tsunami was screened. The workshop concluded with a session to identify policy messages and future research questions. The workshop agenda is included in this report as Annex 1.

Summaries of the presentations and discussions follow. Annex 2 of this report list the workshop speakers, moderators, and attendees. Copies of the presentations are available at www.e4sv.org.

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1 *The term 'natural disasters' is used to denote events, triggered by natural hazards, which have major deleterious impacts on people. Such natural hazards may be weather related (for example, cyclones/hurricanes, floods and droughts), or geophysical (for example, earthquakes, tsunamis, volcanic eruptions and landslides). It is recognised that the extent to which a disaster triggered by a natural hazard results in harmful effects to people depends not only on the scale of the natural event but also on the wide range of social, cultural and economic factors which constitute the affected population's circumstances.*

WORKSHOP PROCEEDINGS

The Smart Villages concept
John Holmes, University of Oxford and Smart Villages Initiative

John Holmes began the workshop with an explanation of the rationale behind the Smart Villages concept. Specifically, he showed the magnitude of the off-grid energy challenge by noting that more than one billion people do not have access to electricity and approximately three billion people continue to cook on unclean stoves, leading to around 4.3 million deaths per year. He continued by explaining the recognition of access to modern energy in the Sustainable Development Goals, the role that energy access plays as an enabler for most of the other Sustainable Development Goals, and how energy access can be seen as a catalyst for rural development.

An introduction to the smart villages concept was followed by an overview of the Smart Villages Initiative, which aims to provide policymakers, donors, and development agencies concerned with rural energy access with new insights on the real barriers to energy access in villages in developing countries—technological, financial, social and political—and how they can be overcome. This will be achieved through a three-year programme of workshops and follow-up engagement activities in six regions (East and West Africa, South and Southeast Asia, and Central and South America) that bring together the diverse set of players—scientists and engineers, entrepreneurs, villagers and civil society organisations, NGOs, financiers, policymakers, and regulators—who are actively involved in addressing the challenges of village energy for development.

John Holmes concluded with some initial reflections on how smart villages can embody enhanced resilience. Firstly, resilience at a general level is accumulated through progressing from a hand-to-mouth existence to a life that allows the accumulation of assets and savings that can support villagers in the immediate aftermath of a disaster and enable lives and communities to subsequently be re-built. Secondly, energy and information and communication technologies (ICT) can improve resilience through enabling training and education, and the sharing of information, and hence the creation of skills and knowledge in villages on developing resilient infrastructure. Thirdly, energy and ICT can facilitate communication links and provide the means for advance warnings of natural disasters as well as enabling more effective disaster relief efforts. Fourthly, energy and ICT can improve health facilities and provide lighting, which can help rural communities during post-disaster periods. Fifthly, social capital, environmental stewardship, and access to finance systems were highlighted as channels through which resilience can be improved in smart villages. Infrastructure was seen as being a critical channel to improve resilience but must be designed to withstand anticipated natural disasters.

Defining resilience in the context of natural disasters
Jonathan Rigg, National University of Singapore

Jonathan Rigg began his presentation with an exploration of the recent earthquake in Kathmandu, Nepal and asked how can we build resilience to events like this? He proceeded with an explanation of the main academic viewpoints on the nature of rural society. The first is the neo-populist view that sees 'traditional' villages as being inherently resilient through, for example, a social fabric that has evolved over time. When integrated into the mainstream, however, new vulnerabilities are introduced and traditional villages can become less resilient.

The second viewpoint explored was the neo-liberal view which sees the reason for poverty among traditional villages as their lack of integration into the mainstream, and that if traditional villages were integrated into the market economy they would begin to move out of poverty and become more resilient. The third and final viewpoint explored was the neo-Marxist viewpoint that points to unequal distribution and the exploitation of traditional villages by urban-biased structures as a key reason for a lack of resilience in traditional villages.

Jonathan Rigg continued by providing insights into four resilience tendencies: averaging, aggregation, smoothing, and valuing of resilience. Averaging is unhelpful as the devil is in the detail. Aggregation loses sight of the social units that make up societies: it is important to look inside the box. Smoothing out of resilience trends over history ignores the reality of life courses that are jagged and unequal.

Taken together, averaging, aggregation, and smoothing result in glossing over issues of resilience and losing much of the detail necessary to understand it. The economic valuation of non-market values was also highlighted as an area where the field of resilience scholars must move beyond simple economic tools in order to better understand the value of resilience.

The final points made in the presentation concerned policy-induced and market-induced vulnerability. Jonathan Rigg used examples from his fieldwork in Laos to show how policy can often undermine resilience. In the case of Laos, villagers were resettled, and this resulted in undermining their food security. Regarding market-induced vulnerability, the point was made that the terms-of-trade often shifts against agriculture, making rural communities more vulnerable and essentially forcing rural inhabitants to migrate to urban areas in search of a livelihood.

Jonathan Rigg, National University of Singapore

Panel 1 – Views from the frontline: Earthquakes, floods, and drought

Earthquakes
Gopi Krishna Basyal (NSET)

Gopi Krishna Basyal commenced the first panel of the workshop by exploring issues around earthquakes in Nepal from the perspective of the National Society for Earthquake Technology–Nepal (NSET). NSET is a technical NGO that plays a coordination and facilitation role between the government, academia and communities with the objective of managing earthquake risk in Nepal. He began by focusing on an old settlement in the traditional city area, Lalitpur-12. This is an area that faces high risks of earthquakes, fire, and epidemics and is an area where there have been significant efforts, mostly by women, to drive local level efforts to mitigate these risks.

To date, in Lalitpur-12, there have been a variety of focus group meetings with community front-liners, a workshop on "community level disaster risk management", the provision of fire response training focusing on housewives, and the undertaking of detailed risk profiling. Reflecting on these efforts, successful elements have emerged, including the fact that the community has further embraced their role on the frontline, the incorporation of marginalised groups in the process, the inclusion of traditional knowledge in resilience planning, and that the local government is now involved in an active manner. The main challenge remaining, however, is revitalising community-level volunteerism in a sustainable manner.

Gopi Krishna Basyal also provided an overview of NSET's current post-earthquake programme to "build back better" and make Nepal's villages more resilient to disasters. The goal of the programme is to ensure that reconstructed buildings are disaster-resilient with the result that rural communities in Nepal will be more resilient to disasters.

Reflecting on Lalitpur-12 and the "build back better" programme, Gopi Krishna Basyal concluded with several key learning points:

- Community resilience is only possible through community involvement

- Academics and practitioners should first listen to the community, and then the community will listen to the "experts"

- Addressing everyday (micro) disasters is an important entry point to building community resilience with a view to mitigating larger disasters

- Disaster risk reduction should be included in everyday social discourses

Drought, flooding, and smallholder farming
Albert Arunkumar, Kasam Agricultural Institute, India

Albert Arunkumar began by introducing the Kasam Agricultural Institute. Founded in 1919, the Institute is tasked with supporting smallholder farmers in Tamil Nadu, India. Smallholder farmers in Tamil Nadu face the threats of flood and drought, which have increased due to increased climatic variability in recent years. Regarding drought, Albert Arunkumar explained how the Kasam Agricultural Institute plays a role in ensuring that water conservation methods are promoted and practiced in activities such as rice cultivation. Other activities include the distribution of seeds for more drought-tolerant crops as well as the de-siltation of public ponds, canals, and reservoirs to help conserve water. Regarding flooding, the institute encourages smallholder farmers to grow deep water and lodging resistant varieties of paddy, to properly drain farm lands, and to delay the sowing of seeds depending on weather forecasts. Following the tsunami in 2004, indigenous knowledge played a key role in

restoration of land that had been inundated by seawater.

Albert Arunkumar proceeded to explore what changes are required at the policy level to improve the resilience of smallholder farmers in Tamil Nadu to drought and flooding. These include: the need for more substantial public sector investment in smallholder farming by the Indian government; the formation of a farmers' federation or association to consolidate and express farmer viewpoints; the need to support smallholder farmers to ensure that a poor harvest season does not spiral into significant household debt; and the promotion of more sustainable agricultural practices that also incorporate traditional knowledge where appropriate.

Flood resilience in Bangladesh
Mousumi Pervin, Practical Action, Bangladesh

Mousumi Pervin began by sharing how floods are now occurring at a higher frequency in Bangladesh due to increased climate variability, resulting in increasing damage to rural communities. This is a result of high volumes of floodwater entering the country from upstream areas and the unstable nature of its major rivers. To provide further context, Mousumi Pervin gave an overview of the policy framework for flood mitigation, which has shifted from a relief-oriented approach to a comprehensive approach that prioritises the reduction of risk. As a result, efforts in Bangladesh focus on both flood adaptation and mitigation. Disasters are no longer seen as extreme events created entirely by natural forces but as manifestations of unresolved problems of development.

Regarding flood adaptation, current approaches include constructing homes on raised earth mounds, constructing roads to act as embankments, temporary migration from flood-prone areas to non-flood prone areas, and adaptive

agricultural methods (e.g., switching to more flood resistant crops and encouraging "floating gardens"). Mitigation measures can be disaggregated into both structural and non-structural interventions. Among the structural measures in Bangladesh are the construction of embankments alongside rivers, regulators to control the flow of drainage water, disaster shelters and raising roads and railways. Non-structural measures include flood forecasting and warning systems, protocols during times of disaster management, volunteerism, and awareness raising.

Mousumi Pervin concluded by providing an overview of the contributions of Practical Action in Bangladesh. These include: flood-proofing measures such as helping poor families to raise homestead floor levels; disseminating early warning to communities (digital and manual boards have been set up in hubs in villages); alternative livelihood support; skills training; and helping adjust cropping patterns.

Views from the frontline: drought
Alan Ziegler, National University of Singapore

Alan Ziegler began by showing participants the importance of understanding the different categories of drought: meteorological, agricultural, hydrological, socio-economic, and disaster. This was followed by an overview of several of the most devastating droughts recorded: the Indian Famine (1769); the Great Chinese Drought (1876-1879); the Chinese Famine (1959-1961) and the African Famine (1981-1984). He also offered some first-hand observations from his research sites in Northern Thailand.

The need for drought to be looked at from a long-term perspective was illustrated through the use of satellite data. In particular, imagery from the one-month and 24-month standardised precipitation indices were compared

showing that a short-term viewpoint hid the true scale of drought and its challenges to resilience. This was followed by an examination of El Niño and La Niña trends and the finding that there has been very little done to prepare for drought.

He then addressed the paradox of multi-purpose dams. Designed to meet the twin objectives of maximising storage for irrigation use in the dry season and keeping enough dead storage available for flood prevention in the wet season, Alan Ziegler noted that they are not achieving either of these purposes adequately. Instead, there simply is not enough water being saved during the rainy season to improve resilience to drought. Another problem is the over pumping of groundwater resulting in the lowering of the water table.

He concluded by noting the relationship between disease and drought. In particular, viruses, protozoa and bacteria are known to pollute water resources when rainfall is insufficient thus adding a further channel through which drought affects the resilience of rural communities.

Discussion
Moderator: Michael Douglass,
National University of Singapore

Reflecting on the four presentations, Michael Douglass observed that solutions to improve resilience are so partial that efforts keep falling far behind what is needed. This led to the first question of the session that focused on how to scale-up responses to go beyond project dependency and build-in capacity for resilience at the community level. To this question, Mousumi Pervin responded with the need to tackle resilience issues with sustainable business models. Gopi Krishna Basyal highlighted the need to work with government institutions and to ensure that communities continue to be engaged in

order to scale-up effectively and build sustainable efforts. Reflecting on the experience following the 2004 tsunami, Alfred Arunkumar indicated that government should be involved in NGO-led projects from the start otherwise they may be unwilling to pick up projects when NGOs wish to hand them over. Small-scale farmers need to be empowered. Participants then highlighted the need to embed initiatives on resilience into broader systems of governance and to engage in cross-regional learning.

The second question asked focused on the role of scientific analysis in policy. Participants observed that if scientific analysis does not support the views of a wider group of people, it is ignored. If it supports the views of a wider group of people, it is accepted. This led to discussion on how to better incorporate scientific analysis into policy and a recognition of the sheer complexity underlying scientific analysis, with both natural and human systems interacting.

Considering the value of self-organisation, Alfred Arunkumar indicated that local self-help groups have proved to be effective in Tamil Nadu. In Nepal, some ethnic groups have strong social organisation and others do not. Migration can undermine the social coherence of rural communities. In Bangladesh, there may be tensions in urban communities but people tend to help each other in rural communities.

Panel 2 – Strengthening the resilience of rural communities

Resilience to natural disasters of rural communities
Estuning Mei, Gadjah Mada University, Indonesia

Taking a lead from a 2013 OECD report, Estuning Mei defined resilience as "the ability of individuals, communities and states and their institutions to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term changes and uncertainty". This was followed by an introduction to the diverse range of risks faced by Indonesian villages: drought, forest fires, volcanic eruptions, typhoons, tidal waves, tsunamis, earthquakes, flash floods, flooding, and landslides.

To better understand the issue, Estuning Mei employed the disaster cycle of Schramm, et al. (1991), which breaks down a natural disaster into three main phases: pre-disaster; syn-disaster; and post-disaster. Improving the resilience of rural communities therefore involves interventions at each of these phases. Put simply, this means figuring out "how to prepare" during the pre-disaster phase; "how to cope" during the syn-disaster phase; and "how to recover" in the post-disaster phase. Being "smart" means integrating multiple information and communication technology solutions to manage a region's assets.

Using her research and practical experience in the Indonesian context, Estuning Mei highlighted the importance of a regional inventory during the pre-disaster period to map resources (elements at risks) but also capacity and vulnerability. A further important consideration is the development of protocols and mechanisms to share this information with rural communities to empower people with information for disaster preparedness.

During the disaster, it is crucial that information flows ensure that the emergency response is optimal. This involves warning systems and the establishment of help lines, and requires a partnership between government and civil society. In the 2010 Merapi Eruption, use of information and communication technology led to effective volunteer coordination, crowdfunding, and logistics/aid distribution.

In the post-disaster period, it is important to provide information on effective rehabilitation strategies that incorporate learnings from the shock to improve future resilience. Governments need to be informed about local problems.

There are five key factors in being smart in order to strengthen village resilience: human resources, partnerships, resources, infrastructure, and institutions. Villagers need to be smart with enhanced knowledge and skills, for example in emergency management. Inter and intra village partnerships are needed, for example the "sister village" concept in which villagers can move to the sister village in case of emergency. Available local resources need to be used to fulfil community needs. Infrastructure needs to be maintained, not just constructed. And institutions should provide for the involvement of important stakeholders such as society, government, scientific, and academic institutions, etc.

Exploring community flood resilience in Bang Rakam, Thailand
Shorna Allred, Cornell University

Shorna Allred began by defining vulnerability along its social and biophysical dimensions. Social vulnerability concerns the structural factors that make communities susceptible to damage from external factors. It is influenced by factors such as poverty and inequality, marginalisation, food entitlements, access to insurance and housing quality. Biophysical

vulnerability is the amount of damage caused to a system by a hazard and is a function of the frequency and severity of a given type of hazard.

Vulnerability of whom to what? is the key question in understanding vulnerability and resilience. Resilience was then conceptualised as increasing adaptive capacity and a community resilience model introduced. The model sees community resilience as dependent on:

- Adaptive capacities: institutional memory, innovative learning, connectedness, and assets

- Resource robustness: resource quality, redundancy, diversity and assets

- Social capital: attachment to place, sense of community, formal and informal ties, perceived and actual social support, organisational linkages and cooperation

- Community competence: community action, problem solving and reflection, flexibility and creativity, collective efficacy, empowerment, and political partnerships

- Economic development: diversity of resources and equity of distribution of resources

Shorna Allred's presentation proceeded to focus on three main research questions: (1) how is flood knowledge transferred in the community?; (2) what aspects of the community contribute to resilience?; (3) how has flood knowledge changed over time? Research was undertaken in Bang Rakam, Thailand in the aftermath of the 2011 floods using narrative interviews with villagers and sub-district officers.

The main findings from her research were:

- Knowledge about flooding is transferred primarily through observation.

- Villagers would like to be informed about the volume and velocity of the water.

- Community members often needed to change the crops they planted to adapt to longer flooding periods.

- Community solidarity during the flood and reliance on other village members is important.

- Some believe that reliance on government has contributed to a decrease in local flood knowledge.

Concerns were expressed that children moving out of the villages for work results in their losing their local wisdom and attachment to nature. Moreover, in the past, villagers were more interdependent; their increasing reliance on the government means that they now help each other less.

Ngerabit eLamai: Experiences of working "with community"
Tariq Zaman, Universiti Malaysia Sarawak

Tariq Zaman shared the experiences of the Institute of Social Informatics, University Malaysia Sarawak in working with very remote communities. To date, the institute has 29 project sites and has undertaken projects in collaboration with remote communities to the value of USD$3 million. Tariq Zaman focused his presentation on the indigenous community of Long Lamai, a semi-nomadic Penan village consisting of 113 households and with limited access to electricity and mobile phone coverage.

Workshop participants

Reflecting on the work undertaken with the community to undertake sustainable tourism and e-commerce activities and to document and preserve indigenous knowledge, Tariq Zaman highlighted the need to see rural communities as equal partners in the resilience building process rather than as recipients of new knowledge. This involves respecting community governance structures, taking the time to understand community protocols, being willing to learn from traditional knowledge, and working "with the community" rather than "for the community" or "on the community."

Lastly, Tariq Zaman shared a socio-technical system of resilience. The system, which is a work-in-progress, unwraps community governance structures and maps them to resilience challenges and opportunities to build resilience in the face of each challenge.

Discussion
Moderator: Michelle Miller, National University of Singapore

The discussion focused on the recognition that there are hundreds of thousands of communities that require help in improving their resilience to natural disasters. In order to reach these communities, it is clear that some form of generalisation is required, however what generalisations are possible? In response to this question Shorna Allred stressed that, despite recognising the unique contextual situation of each rural community, there are lessons to be learned. Focusing on her own research, which relied mostly on qualitative data, she stated that although qualitative data is not generalisable, it is still transferable within context and can provide lessons to be learned for other rural communities.

Jonathan Rigg highlighted the need to step back and ask bigger political economy questions to draw out generalisable lessons from individual case study approaches. Estuning Mei found that

one of the most effective means of disseminating general lessons was from having villagers learn from other villagers through study-tours of other villages. The sister village approach enables collaborations to be established on particular issues; for example, children can spend time studying in the school in the sister village.

Documentary screening:
"Ichiro and the wave"
Isaac Kerlow, Nanyang Technological University

This short film, produced as part of a longer project referenced as "Tsunami of new dreams" illustrates and emphasises local community resilience in terms of both old dreams shattered by natural disaster as well as the possibility of new dreams arising from such an event. It also illustrates one of the challenges of communicating natural disasters and community action and engagement through audio-visual means: since the events are largely unanticipated, they are rarely filmed. This film employs an innovative combination of survivor interviews with striking hand-drawn graphics of the disaster scenarios to illustrate the point. It is currently in the final stages of production and release, and will eventually be linked from the Smart Villages website.

Panel 3 - Linking energy access with resilience

Linking energy access with resilience
Dipendra Bhattarai, Practical Action, Nepal

Dipendra Bhattaria began with a personal recollection of the 25 April 2015 earthquake in Nepal. By and large, people were unprepared for such an event, unaware of the action they should take, and despite public discussion of the possibly of an earthquake, it was largely unexpected. In the immediate aftermath, services that the urban population had thought they would be able to rely on, such as mobile telecommunications, proved to be unusable as the ground-based infrastructure that powered the system was knocked out by the disaster. In this situation, lacking electricity, water and communications, even the urban population were helpless, and unable to receive public information on disaster response relayed through conventional channels. This brought home to the urban population the important role that energy plays in disaster response and recovery, and the degree to which they were reliant on fixed but vulnerable urban services infrastructure.

In the context of this experience, Dipendra Bhattaria commented on the difficulty of defining resilience. The framework on dimensions of resilience set out by Brooks in a study for DFID—including adaptive capacity, social safety nets, access to services, institutional and governance and assets, amongst others—demonstrates the complexity of the situation, and a simplistic energy access mind set, equating energy just with lighting and cooking, missed the true complexity and reach of energy services in this context.

There is a need to consider the question of for whom the energy is intended, and for what it is to be used. At the level of the home, for example, improved cooking technology can improve lives and use less fuel, and a solar lantern can allow children to study more and increase domestic security. In a productive energy use situation, mobile telecommunications can empower entrepreneurs with up-to-date market information, cooling technology can reduce post-harvest loss and electrical devices can allow for local value addition, such as milling. And for community benefit, energy can facilitate access to clean water, improved public health provision, and improved community organisation, engagement, and record-keeping.

A simple linkage between energy access and resilience to disasters is a tricky one to define

and to demonstrate. Furthermore, there are fundamental differences between day-to-day resilience and community resilience to catastrophic natural disasters. The experience of residents of Kathmandu being without electricity and communications for up to 20 days after the 25 April earthquake struck demonstrates that the very infrastructure that provides superior day-to-day services and resilience for urban populations compared with rural populations can prove to be a disadvantage when natural disasters occur. These disasters have a disproportionate effect on large-scale infrastructure on which urban development depends. A decentralised village infrastructure, by contrast, might prove to be much more robust to a similar shock (although the experience of the 25 April event did demonstrate that in the face of a "direct hit", a decentralised approach offered no protection in the case of immediate proximity to the epicentre of the earthquake).

Dipendra Bhattarai felt there was a particular research gap in generating evidence of the linkage between energy systems and disaster resilience and that it was important for the disaster mitigation and adaptation communities to be cognisant of the critical role that energy access plays in the facilitation of pre- and post-disaster communications, ICT, healthcare, and reconstruction.

Linking energy access with resilience
Wendy Guerra, International Consultant

Wendy Guerra began her presentation with a definition of resilience from the UN Food and Agriculture Organisation (FAO), which includes capacity "to prevent disasters and crisis, as well as buffering them, and recovering from them, on time in an efficient and sustainable way". She emphasised the importance of the link with climate change, and the interconnectedness of resilience, disaster risk management, and anthropogenic climate change

considerations, in particular the capacity of the latter to exacerbate the effects of natural disasters or in fact to contribute to their causality.

Highlighting the complexity of the universe of energy risks between different energy sources (both traditional and alternative), risks of energy generation both from construction and generation, and potential natural disaster risks associated with different types of energy generation, Wendy Guerra emphasised the importance of applying traditional energy risk assessment, management, and mitigation strategies to non-traditional rural forms of energy generation. She also drew attention to the possibility of further risks introduced into a community from energy access initiatives. Reliance on solar power brings new risks to a community when net insolation falls (from weather or volcanic eruptions, for example), and reliance on micro-hydro means drought has consequences not just in local agriculture but also in local energy supply.

These overall risks, and new risks introduced into a community, should be considered when planning new energy access initiatives, as well as in studies of the links between community energy provision and disaster resilience. Policies, regulations and methodologies for disaster risk management and adapting to climate change should be developed and implemented for infrastructure projects in smart villages. Strategies of resilience should be developed for smart villages including actions to reduce disaster risk—risk awareness, prevention, mitigation and recovery—and to maintain basic functions and structures during emergencies.

Discussion
Moderator: Terry van Gevelt, University of Cambridge and Smart Villages Initiative

Questions were raised about the economic feasibility of off-grid energy options, with concerns centring on their high cost compared to urban, grid-based power. Dipendra Bhattarai responded that there were questions as to how economic viability was perceived. The degree of remoteness changes the economics of supply of energy through increased cost, whether through grid extension, long supply chains of diesel fuel for example, or newer off-grid energy technologies, and often this makes off-grid supply competitive or even more economical in the long term as compared to other sources. He also felt that it was important to factor in the socioeconomic development benefits of energy supply, so that even if the electrical supply itself was not fully viable, the associated benefits and impact it brought to a community could compensate for that. Wendy Guerra also raised the notion of access to energy as a basic right as well as an enabler of other technologies as an additional consideration.

In discussion of whether there was cross-subsidisation of rural energy solutions, Dipendra Bhattarai noted that in Nepal, where the government has been promoting decentralised approaches for over three decades, the position has shifted gradually from subsidies of up to 30% of costs of micro-hydro projects to the current position where the government is considering whether subsidies should be eliminated and the private sector should take over on a fully commercial basis.

Terry van Gevelt pointed out that from a political economy standpoint, before the 1970s, governments around the world stressed the public good and social justice aspects of electrification (whether rural or urban). It is only more recently that the private good elements have been stressed, and there has been a shift in thinking to a more economically self-sustaining system, with infrastructure loans more difficult to come by on non-commercial terms. John Holmes pointed out that with modern technological developments (progress in efficiency of solar panels, for example) costs of provision are also falling.

Gopi Krishna Basyal also reminded the participants of the very real benefits to a rural community of energy access. An electric pump might, for example, save two hours of a person's time each day in fetching water. That time benefit has a value to the local population that may outweigh the higher unit cost of the energy to power the pump.

Identifying policy messages and future research questions
Moderator: John Holmes, University of Oxford and Smart Villages Initiative

An initial question raised was: why do we need villages (and in particular why do we need them from a resilience point of view, as opposed to encouraging urban resettlement)? There were several aspects raised in response. Firstly, diversity tends to support greater resilience. Diverse populations and community structures are likely to provide superior resilience to a nation or a region. Additionally, there are services (such as agriculture) that depend on a rural population. From a more pragmatic perspective, some participants felt that an appropriate re-casting of the question should be "given that there are villages, what can they contribute to overall resilience (and our understanding of it) and what can we do to make them more resilient?"

Villages, and their community structures and social systems, make for particularly valuable features of resilience. Many of the case studies presented at the workshop focused on the organising and response powers of rural

community social structures. The continued existence of villages over many centuries demonstrates a degree of inherent resilience and adaptability, from which we can learn. Participants felt that indigenous approaches to development and traditional knowledge could hold particular insights into resilience that could easily be lost in an urban context. From this point of view, some participants felt there was value in giving social aspects of community resilience primacy over technological aspects, and encouraging further research into this.

Jonathan Rigg, in the context of a discussion on the complexity of the notion of "smartness", emphasised that resilience is not a one-dimensional property, from less to more, of communities. The complexity of resilience, especially in the context of rural communities and the complex notion of their "smartness" is one whose elements and dimensions could profitably be researched further.

Michelle Miller discussed the changing role of the village in Southeast Asia, and the "romanticisation of the Kampung". Villages no longer necessarily mean just agriculture and agrarianism. A reverse flow from urban centres to "gentrified" villages has been changing the countryside in recent decades as people move back, bringing wealth and technological resources with them.

In the context of resilience, the importance of retaining traditional methods and approaches when investing in new solutions to contingency management was emphasised, lest their loss actually increase community vulnerability. John Holmes felt this was analogous to the observed phenomenon in rural energy access of technology "stacking" where new technologies (improved cookstoves, for example) tend to be added alongside the older technologies

(kerosene stoves, for example) rather than completely displacing them.

A critical question remained: who needs to be resilient to what? Experience in urban development has shown that improving vulnerability to one particular risk can increase vulnerability to another. A further important question is who decides. Community participation is crucial.

An observation was made that the distinction between urban and rural populations is not always clear cut. In Banda Aceh in Indonesia, for example, small coastal fishing communities exist alongside more developed, urbanised communities just inland. These communities have a flow of populations between them, and the experience of the 2004 Boxing Day Tsunami demonstrated that neither community was aware of the early warning indicators, or emergency response to take. Therefore, information and preparedness training is required for all communities.

An interesting observation was that in many of the disaster case studies, little explicit mention was made of energy, although many technologies that are critically dependant on energy (communications, ICT, healthcare, etc.) were referenced. It would be useful if, in future, the energy dimension of disaster response and mitigation could be explicitly referenced and investigated.

Key additional research questions to address include: energy, resilience and gender, and whether there was a double burden; the relationship between energy access, poverty and disaster resilience, in particular the extent to which any causal connection can be said to exist; how energy access and technologies can improve resilience and efficiency in disaster-affected agricultural communities; and the link with psychological trauma and response to disaster.

Workshop Participants

Conclusion

This workshop, "Smart Villages and resilience to natural disasters", brought together 44 participants from two communities of researchers: those focusing on energy access and those focusing on resilience to natural disasters. Together, participants exchanged learnings and examined the synergies between the two research areas through the vehicle of "smart villages". This workshop and its associated learnings are envisioned to serve as the first platform in a series of cross-cutting activities exploring the linkages between energy access and resilience and making "smart villages" more resilient.

ANNEX 1: WORKSHOP PROGRAMME

Monday, 25 January 2016

0945   **Registration**

1000   **The Smart Villages Concept**

John Holmes (University of Oxford and Smart Villages Initiative)

1015   **Defining Resilience in the Context of Natural Disasters**

Jonathan Rigg (National University of Singapore)

1030   **Panel 1 – Views from the Frontline: Earthquakes, Floods and Drought**

Moderator: Michael Douglass (National University of Singapore)

Gopi Krishna Basyal (National Society for Earthquake Technology, Nepal)

Alfred Arunkumar (Kasam Agricultural Institute, India)

Mousumi Pervin (Practical Action, Bangladesh)

Alan Ziegler (National University of Singapore)

1200   **Lunch**

1300   **Panel 2 – Strengthening the Resilience of Rural Communities**

Moderator: Michelle Miller (National University of Singapore)

Estuning Mei (Gadjah Mada University, Indonesia)

Shorna Allred (Cornell University)

Tariq Zaman (Universiti Malaysia Sarawak)

1430   **Break**

1500   **Documentary Screening: "Ichiro and the Wave"**

Moderator: Isaac Kerlow (Nanyang Technological University)

1530   **Panel 3 - Linking Energy Access with Resilience**

Moderator: Terry van Gevelt (University of Cambridge and Smart Villages Initiative)

Dipendra Bhattarai (Practical Action, Nepal)

Wendy Guerra (International Consultant)

1700   **Break**

1710   **Identifying Policy Messages and Future Research Questions**

Moderator: John Holmes (University of Oxford and Smart Villages Initiative)

1740   **Closing Remarks**

Bernie Jones (Smart Villages Initiative)

Jonathan Rigg (National University of Singapore)

ANNEX 2: WORKSHOP PARTICIPANTS

Name	Organisation

Workshop Speakers and Moderators

Name	Organisation
Shorna Allred	Cornell University, USA
Alfred Arunkumar	Kasam Agricultural Institute, India
Gopi Krishna Basyal	Nepal Society for Earthquake Technology, Nepal
Dipendra Bhattarai	Practical Action Nepal
Michael Douglass	National University of Singapore
Terry van Gevelt	University of Cambridge and Smart Villages Initiative
Wendy Guerra	Independent Consultant
John Holmes	University of Oxford and Smart Villages Initiative
Bernie Jones	Smart Villages Initiative
Isaac Kerlow	Nanyang Technological University, Singapore
Estuning Mei	Gadjah Mada University, Indonesia
Michelle Miller	National University of Singapore
Mousumi Pervin	Practical Action Bangladesh
Jonathan Rigg	National University of Singapore
Tariq Zaman	Universiti Malaysia Sarawak
Alan Ziegler	National University of Singapore

Workshop Participants

Name	Organisation
Cao Kai	National University of Singapore
Lucia Youngran Choi	Ramboll Studio Dreiseitl
Simone Chung	National University of Singapore
William Chong	National University of Singapore
Chung Lili	Exactly Foundation
Shubhagato Dasgupta	Centre for Policy Research
Satya Dash	Sambalpur University, India
A.J. Heng	Independent Scholar
Jonathan How	Relief Singapore
Shuchi Jhalani	National University of Singapore
Ku Ka Leung	National University of Singapore
Leo Teng Yong	SINGLAND Auto Air-Cons Centre

Karunanithi Letchumanan	Humanitarian Assistance Network for Disaster
Lincoln Lewis	Future Cities Laboratory
Carellynn Lim	National University of Singapore
Celine Lim	Independent
Kevin Phun	IGIT Consulting
Arjan Primalani	TG Pgr GRC
Shivani Ratra	National University of Singapore
C.K. Ren	Independent
David Sadoway	Nanyany Technological University
Timothy Soh	Independent Scholar
Carol Soon	National University of Singapore
Martin Stavenhagen	National University of Singapore
Tng Ying Hui	National University of Singapore
Robert James Wasson	National University of Singapore
Mark Wong	Independent
Hong Yu	National University of Singapore

SMART VILLAGES
New thinking for off-grid communities worldwide