SMART VILLAGES
New thinking for off-grid communities worldwide

Smart Villages in Nepal: Kathmandu Workshop Report

Workshop Report 5

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Smart Villages

We aim to provide policy makers, 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 are have chosen to focusing 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.

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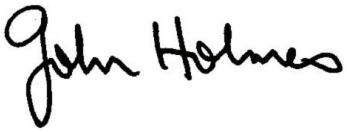
Foreword

Nepal was selected as the country where the Smart Villages Initiative would commence its programme of engagement activities in the South Asia region due to Nepal's major investment in off-grid hydroelectric energy systems over many years and its experience of associated initiatives to stimulate rural productive enterprises. The workshop, bringing together key people in Nepal concerned with off-grid village energy provision, did not disappoint and generated valuable insights into the challenges of establishing energy access for rural communities and how those challenges may be met. We are grateful to our local partner, Practical Action Consulting South Asia, and in particular to the staff of the Nepal office for all their work in setting up and running the workshop.

The workshop was held just two weeks before the major earthquake which brought so much devastation and hardship to the country. The thoughts and sympathies of the Smart Villages project team go out to the people of Nepal. Our hope is that in the reconstruction that will follow in coming years many of the aspirations of the Smart Villages Initiative can be realised.

Dr Bernie Jones
Project Co-Leader



Dr John Holmes
Project Co-Leader

Summary

The Smart Villages Initiative, working with its local partner Practical Action Consulting South Asia, held a workshop in Kathmandu, Nepal on 10th April 2015. The aim of the workshop was to learn lessons from Nepal's experience of micro/mini-hydroelectric schemes for off-grid rural communities and associated initiatives to stimulate productive enterprises which could be shared with other stakeholders in the South Asia region.

Workshop participants were informed about the work of the Alternative Energy Promotion Centre (AEPC), under the Ministry of Environment, Science and Technology, which plays a central role in coordinating the deployment of government and international donor funding for off-grid electrification schemes in Nepal. As well as providing subsidies and support to off-grid energy, it promotes the establishment of productive enterprises in rural communities enabled by energy access.

Key challenges for off-grid energy systems in Nepal include upscaling of implementation, upgrading the quality of electricity supplies, establishing financially viable business models, access to finance, and the need for a more integrated approach to planning incorporating both on-grid and off-grid systems. The challenging terrain and remoteness of communities exacerbate problems of transport costs, operation and maintenance, and monitoring and evaluation.

However, there are opportunities arising, for example, from the return of Nepalese people who have worked overseas bringing relevant skills and money for local investment, and from the potential to connect village-level enterprises to national and international markets provided that the required infrastructure is developed alongside energy services. Progress has been made in establishing productive enterprises in rural communities which now address a wider range of products and services than the traditional agriculture-based activities.

Looking to the future, improved access to finance and markets need to be established for rural communities, and the project development period needs to be shortened by reducing bureaucracy. Additional schemes should be put in place to develop business and technical skills at the local level, and more effective management arrangements need to be established for off-grid energy schemes bringing together community ownership and private enterprise in hybrid management models. Initiatives should build on local cultures and lifestyles, rather than working against them.

A key aim must be to move beyond energy access schemes oriented just to lighting, and focus on a more ambitious approach that fully supports the establishment of local enterprises and new income generating opportunities which are essential to achieving the sustainability of off-grid energy schemes and to realise smart villages.

Introduction

The Smart Villages Initiative commenced its engagement programme in South Asia with a workshop held in Kathmandu, Nepal on 10th April 2015. The workshop focused on Nepal's substantial experience of off-grid rural energy systems, in particular micro/mini-hydro schemes, and of initiatives to stimulate productive enterprises enabled by the availability of sustainable electricity supplies. The workshop met its aim to identify key lessons learned that can be fed into the Smart Village Initiative's ongoing programme in South Asia and in other regions.

A cross-section of active players in the Nepalese off-grid energy scene participated in the workshop resulting in lively and insightful discussions. This report summarises key points arising in the presentations and discussions. Copies of the presentations are available on the Smart Villages website. A background paper was prepared by Practical Action in advance of the workshop summarising key features of the energy situation in Nepal. This too is available from the website .

Annexes 1 to 3 of the report provide the workshop agenda, list of participants, and biographies of presenters.

Sessions

Opening Speech

Mr Achyut Luitel, Regional Director, Practical Action South Asia Regional Office

Achyut Luitel opened the workshop by noting that there are a great many inspirational stories from all over the world. Practical Action is involved with a large range of projects including micro-hydro projects which form a significant part of their work in Nepal. A recent workshop with AEPC (Alternative Energy Promotion Centre: www.aepc.gov.np) is indicative of the Practical Action approach, asking the villagers to come up with their ideas on livelihood systems development. He recognised that energy projects that are just for lighting in the evening may not be sustained, and there is a need for energy provision sufficient for other applications including education and health services. The concept of smart villages brings these ideas together.

The overarching concept of Practical Action is of 'Technology Justice'. This incorporates advances that the private sector is making, not just for the elites but also for the poorest people. The thinking behind smart villages aligns well with technology justice. There is a need to recognise, though, that use of resources at the rate of urban communities is not in itself sustainable as we would need two extra planets to support that level of consumption. Mr Luitel reported on a recent summit with the Nepal Academy of Sciences on the injustices of energy access and use, and noted that this was stimulating ideas of how to change the way they work and prompting consideration of how projects can be smarter.

He finished by reiterating that Practical Action are happy to be partnering with the Smart Villages Initiative which can help guide smart investment decisions in the context of technology justice. The collaboration presents an

opportunity to challenge ideas and learn from each other in the sector. He encouraged all attendees to participate and continue the discussion about these important issues.

The Smart Village Concept

Dr John Holmes, Co-Leader of the Smart Villages Initiative

John Holmes introduced the Smart Villages Initiative, initially pointing out that over 1 billion people still do not have electricity, 3 billion still use dirty, inefficient and harmful cook stoves, and the health implications of this are that 4 million people die prematurely each year. A key objective of the UN's Sustainable Energy for All (SE4All) initiative is universal access to modern energy services by 2030. The Smart Villages Initiative aims to contribute to achieving this objective by providing an insightful 'view from the frontline' of the challenges of village energy provision for development and how they can be overcome.

With 47% of the global population and 70% of the world's poor living in rural villages, the Smart Villages Initiative gives a focus to these villages and providing residents with a more balanced choice between an improved quality of life in the countryside and urban migration for perceived opportunities in cities. Key features of smart villages include: substantially improved education and health services; modern information and communication technologies (ICT) providing connectivity which enables participation in governance processes; fostering entrepreneurship in the provision and productive use of energy; and, consequently building more resilient communities that are better able to respond to shocks. Through this, the intention is to shift the balance of opportunities between cities and villages allowing people to choose to stay in the countryside rather than migrate to cities.

The Smart Villages Initiative is focusing on local solutions such as mini-/micro-grids and solar home systems (SHS), and the barriers that need to be overcome to deliver them. The desired outcome is more effective interventions based on real-life experience. Dr Holmes explained that the project team is based mainly in the Universities of Cambridge and Oxford in the UK, working in collaboration with the

Mr Achyut Luitel, Practical Action

national science academies and their networks, and with Practical Action and The Energy and Resources Institute of India (TERI), two organisations with recognised experience of village energy projects for development.

The initiative is funded for three years by two charitable foundations – the Cambridge Malaysian Education and Development Trust (CMEDT) and the Templeton World Charity Foundation (TWCF) – and began in October 2014. Preparatory work over the preceding three years produced a number of reports that are now available on the Smart Villages website (www.e4sv.org), and included an initial 'Forward Look' workshop held in Cambridge in January 2014. Dr Holmes noted that a series of further 'Forward Look' workshops on a number of different issues will be held over the coming two years in Oxford and Cambridge.

The core components of the project are 12 month engagement programmes in six regions (East and West Africa, South and Southeast Asia, South and Central America), featuring regional and country-focused workshops, and always working with local partners. In addition, there will be a series of capacity building events. One, engaging community elders will be held in Tanzania in June 2015 and others will follow. Another, an entrepreneurship competition in East Africa, has recently been launched. Other outputs of the project include a book of essays and a pocket guide summarising key points for non-specialists.

In addition to the ongoing dissemination of findings through the regional engagement programmes, the overall findings of the project will be disseminated through a pair of final workshops, one in Brussels targeting EU policy makers and the other, probably in Addis Ababa, addressing international bodies such as the UN and World Bank.

A key aspect that is emerging so far is the need to involve the private sector to leverage current annual investments of around $10bn to reach the $50bn annually that will be needed to meet energy access targets. There is a need for integrated approaches tackled at the village level. Through this, people can be catalysed to move beyond the first rung of the energy ladder.

Dr John Holmes, Co-Leader of the Smart Villages Initiative

Dr Holmes concluded with a summary of the main findings of the two previous international workshops held in Arusha, Tanzania and Kuching, Malaysia.

In the ensuing plenary discussion, John Holmes responded to a question about the added value of the Smart Villages Initiative by indicating that its key aim is to bring up to date insights from practitioners in the frontline of rural energy access for development to the attention of policy makers and development agencies who can be rather remote from the practical realities on the ground. Collaboration with the science academies and local partners will lend their credibility and authority to the messages, helping to secure their impact.

Workshop participants pointed to the many successful cases of mini-grids in Nepal, mainly using micro-hydro systems. Newer technologies such as solar and wind have so far been less successful. The key issue is the cost of the energy, and powering houses with solar is often too expensive, especially when people are used to getting things for free. That has become the attitude so villagers are not willing to pay more even if they can afford it. As evidence of this, for commercial activities such as milling, many businesses still use diesel even though it is expensive and its supply is erratic.

A concern was expressed that it has proved difficult to stimulate entrepreneurship in villages in Nepal. However, NACEUN (National Association of Community Electricity Users Nepal: www.naceun.org.np/) has connected 300,000 rural households and developed productive uses for this energy. In order to facilitate energy access people need to invest but policy changes are needed to make this happen. As well as targeting domestic users, initiatives must first support the development of enterprises. There is a need to link energy issues with income issues and this needs a cross-sector approach.

The Smart Villages Initiative was encouraged to look into the detail of the challenges of access and productive enterprise at the village level. A concern was expressed that achieving smart villages in Nepal, so as to really change the situation for villagers, will be difficult.

Keynote speech: Community-based Rural Electrification in Nepal – Status, Prospect and Challenges

Mr Madhusudhan Adhikari, AEPC/NRREP

The Alternative Energy Promotion Centre (AEPC) is the primary body in the Government of Nepal Ministry of Science, Technology and Environment (www.aepc.gov.np) supporting rural electrification. This is generally undertaken through multiple-donor supported projects as public-private partnerships. AEPC manages the demand side and the private sector is responsible for the supply side. The philosophy of AEPC is to be demand-driven serving the people. Things are not given for free, and are only provided in response to a formal request from a community.

Rural energy access initiatives are focused through the National Rural and Renewable Energy Programme (NRREP) the development aim of which is to improve the living standards of rural women and men, increase employment of women and men as well as productivity, reduce dependency on traditional energy and attain sustainable development through integrating alternative energy with the socio-economic activities of women and men in rural communities.

Drawing on the 2011 national census, Madhusudhan Adhikari reported that in Nepal, there is 74% electricity access with 94% coverage in urban areas and 70% in rural areas. For cooking in Nepal the census shows that 64% of energy used nationally for this purpose is from fuelwood: 73% in rural areas

Mr Madhusudhan Adhikari, National Renewable and Rural Energy Project/AEPC

but only 26% in urban areas. Kerosene, LPG and biogas amount to only 13% of cooking needs overall.

Mr Adhikari highlighted the very large hydro-power potential in Nepal at around 84,000MW capacity. Of this around 800MW is installed. The grid is predominantly in the Terai of the South and is less accessible in the High Mountain regions of the North. There are good opportunities to exploit the hydro-power potential in the High Mountains and Mid-Hills regions, making distribution to every part of the country possible.

The off-grid trend is very steep, using solar home systems and micro-hydro, and supported by AEPC. 1 million households, approximately 15% of the population, have been connected to modern electricity supply through off-grid schemes. The number of micro-hydro projects continues to grow rapidly: installed capacity is currently around 36 MW and there is potential to do substantially more. AEPC was established in 1996 and has contributed to around 28 MW of that installed capacity. There is a good distribution of generating plants across the country to support areas, particularly in the Mid-Hills and High Mountain regions, which do not yet have effective grid connections.

Targets for AEPC/ NRREP for 2012-17 include to install 25 MW of mini- and micro-hydro power (serving 150,000 households); 4,000 improved water mills; 600,000 solar home systems; 475,000 improved cook-stoves (with a Government of Nepal declaration to provide clean cooking solutions to all by 2017); and 130,000 household biogas systems. Through this access to modern energy services the aim is to establish 1,300 new small and medium size enterprises and consequently to increase employment by 19,000 people.

Subsidies provide the major link between the public and private sectors in the public-private partnership implementation model. The public sector, responsible for the demand side, actuates awareness and capacity building, provides technical and financial assistance where needed, helps with planning, coordination and networking, and ensures quality assurance, monitoring and evaluation of the projects. The private sector delivers the supply and is able to mobilise

manufacturing and supply of parts, sales and installation of the components, deliver after sales services, repair and maintenance, and conduct internal quality control and monitoring. Subsidies facilitate the standards and guidelines, and the qualification, grading and evaluation of the schemes.

All this benefits the end users but Mr Adhikari recognised that the bureaucracy may be becoming long-winded and appears to be causing bottlenecks, killing productivity and demotivating the fast-moving private sector. There is a need to design out the delays from the system and demonstrate what is being done but in a less paper-based way.

There are significant challenges for community-based renewable energy including questions about the definition of electrification: for example, whether we are referring to replacing wick/kerosene lamps, whether electricity is only for evening lighting or for other productive uses, and whether we are considering the availability or amount of electricity. There is also a need to consider the sustainability and economic benefits of investment and this includes the role of government and awareness of local capacity. If we go for a low level of electrification as the basis of access, then the government is off the hook when there is a lightbulb in a household. When considering improvement in livelihood do we look at comparing beneficiaries against themselves, cities or the capital, or to global figures?

A pre-requisite to improvement of livelihoods is to provide technical solutions for improved living standards. The cash flow in Nepal at present is not bad (particularly from remittances) so people have money to invest. People are already buying products and technologies such as phones, Coca-Cola and PV technologies, but if these products are imported from China then every item bought is money leaving Nepal. Mr Adhikari advocated that people need help in making better decisions about their purchases. In thinking about smart villages, we should question the definition of smartness. It is not about providing access to modern light, but it is about the sustainability of technical solutions and increasing the living standards of all people.

Challenges of community based renewable energy include:

- Upscaling of implementation and upgrading of quality: not many systems currently installed will last their promised 25 years.
- Establishing financially viable business models.
- A need for more integrated planning and inter-connection of off- and on-grid systems.
- Remoteness and difficult geography result in high transportation costs.
- Operation and maintenance of plant consequently need to be carried out at the local level but there is a lack of local expertise.

Great reliance is placed on evaluation, but evaluation approaches are not closely linked to reality on the ground in Nepal. Monitoring of performance is difficult and relies on information from suppliers which can be inaccurate.

Barriers to upscaling include high initial up-front costs of technology for end-users and sub-optimal financing mechanisms: grants and subsidies if available have long approval processes, there is a lack of access to credit, and transaction costs are high. It takes a long time for a community to arrange funding and costs can be very high. Compounding this, the community has low bargaining power in the bidding process and the process of procurement is not well defined. Negotiation

Prof Dr Jiba Raj Pokharel, Vice Chancellor, Nepal Academy of Science and Technology

Prem Sagar Subedi, National Advisor for NRREP/AEPC

between rural community members and urban providers is asymmetric and works against rural households, often leaving them with high costs and poor quality products.

Looking to the future, there is a need to shorten the project development period with subsidy approval and financial closure happening much faster. Promotion of credit facilities in rural areas requires financial institutions to expand their reach and cut or share the overhead costs more favourably, perhaps through subsidised interest rates on credit. Markets need to encourage mobilisation of urban developers into rural areas (via favourable feed-in tariffs) and the government needs to encourage equitable investment by cross-subsidy from urban to rural areas. There is currently a greater provision of funds to urban rather than rural projects and it is important to remedy this imbalance.

There is an opportunity to start up production of renewable energy equipment in Nepal, rather than continuing to purchase materials from China and India. Overall, there needs to be a strong policy to promote rural energy-based enterprises involving more comprehensive capacity building for local people in the operation and maintenance of systems. It is important to recognise, however, where expertise and economies of scale mean that a product is better produced in one place than another. For example, it is recognised that Bhaktapur (urban) paper is better than Baglu (rural) products so it is not possible for the latter to compete, even where there is new production, so there is a need to encourage entrepreneurship in other product/service areas.

Welcoming Address

Prof Dr Jiba Raj Pokharel, Vice Chancellor, Nepal Academy of Science and Technology

Jiba Raj Pokharel talked about the prominence and importance of villages in Nepal and expressed his support for the smart villages concept. Only around a third of the population lives in urban areas. However, villagers contribute just one third of the national GDP and their development is a priority, though they are already smart. Prof Pokharel then talked about the UK examples of Sir Ebenezer Howard's 'garden cities' of the late 19th Century and the attempts to use the concepts in Calcutta and

Delhi, India. The aim of the movement was to gain the best of both the rural and urban environments.

He then turned to more contemporary examples noting that all cities are now designed to be 'green'. Suggesting that the importance of 'smart cities' is accepted, he referred to Norman Foster's design for Mazdar City in the United Arab Emirates which aims to be entirely solar powered, but is currently at a cost of US$32billion and rising. Cities must be designed to address the local environment.

There has been less concern with the villages in Nepal and the statistics as presented by the Nepal Living Standards surveys are worrying, showing that facilities in villages are poor. While overall literacy in Nepal is 70%, in villages it is only 45% and for girls it is an "embarrassing" 25%. Health indicators are also lower in the villages with access to a doctor for only around 20% of the population. Inadequate food provision is a major problem with the majority of villagers reporting a lack of sufficient food. Modern technologies are typically not accessible in rural communities.

Practical Action is seen as a notable NGO, built on Schumacher's "Small is Beautiful" principle, and the Nepal Academy of Science and Technology (www.nast.gov.np) has established links with Practical Action to consider why technology is not available to all people in Nepal. Prof Pokharel stressed that the identity of the place, the genus loci, must be protected. He referred to Prince Charles' Poundbury village in the UK and suggested that we need to understand and use the culture and lifestyle of the village to ensure the success of smart villages.

Prof Pokharel noted that Nepal is a "mini supermarket of disasters" with seasons of floods, fires, earthquakes and storms. Disaster risk reduction is therefore of great importance. He finished by saying that the burden of day-to-day activities on village women needs to be addressed.

Keynote Speech: Productive Use of Energy for Sustainability Mini-Grids

Mr Prem Sagar Subedi, National Advisor for NRREP/AEPC

Prem Sagar Subedi is the National Advisor for the National Rural and Renewable Energy Programme (NRREP) of the Nepal Government's Alternative Energy Promotion Centre (AEPC). They offer technical support, a central renewable energy fund and advice on productive uses of energy in order to contribute to an increase in income generation and employment potential for micro, small and medium sized enterprises (MSMEs) in rural areas, especially for men and women in disadvantaged groups.

Productive uses of energy need to be supported by deployment of sustainable renewable energy technologies leading to economic growth and sustainable development. There is evidence that this can have a significant positive effect: there has been a 20% increase in the income of MSMEs in renewable energy catchment areas. The Productive Energy Use Component of AEPC has established 2,800 new MSMEs and upgraded 1,300 existing ones, resulting in 15,300 households being supported to date through income generating activities.

Support is offered through business development and financial assistance. Technical assistance is given to identifying what is available in terms of markets and capacity in the area through business opportunity assessment, followed by facilitation of business plan development and business registration. Networking with business development service providers and provision of entrepreneurship training courses for people with ideas is useful for sorting out those who feel able to progress

to the next step and are keen to develop their ideas after an initial feasibility investigation. Training is offered on business orientation, enterprise creation, business management, and skill development. Market linkages are facilitated. There is regular follow-up and monitoring for those moving to the next level.

Financial support is available to the really poor to develop income generating activities through individual enterprises, with a maximum grant of Rs100,000 (around 1000 USD) or not exceeding 30% of total equipment and hardware cost. Community-based enterprises can receive up to Rs300,000 (around 3000 USD) or not exceeding 50% of the total. An additional Rs10,000 (100 USD) is available for single women, disadvantaged groups, the very poor, disaster and conflict victims, and endangered communities. New income generating activities can benefit from grants up to 75% of total investment not exceeding Rs10,000 (100 USD). The support cycle for MSMEs covers four phases: preparatory; appraisal; implementation; and monitoring, evaluation and review. Financial support if allocated is given as 90% upfront with 10% retained until the implementation phase. This support scheme has encouraged local people to invest substantial amounts in activities.

A range of MSMEs have developed focussed on local consumption, import substitution, and exports to regional, national and international markets. A key aspect is services to local people who are demanding modern services. They are no longer just looking to agricultural processes such as milling (which previously accounted for 85% of MSMEs), and are catering to diverse demands such as computer and mobile phone services, photocopying, and services such as beauty parlours.

There is a need to focus on other services that are complementary to energy production, and to recognise the difficulties of remote areas. Services provided by MSMEs can be categorised into seven groups: dairy (3%) and related services; agro-based (5%) coffee, masala, and tea; forest based (8%) such as furniture and paper and oils production; ICT (11%); manufacturing (11%) including bakeries, grills, blocks, tile making etc.; personal services (25%) including beauty parlours, tailoring, photocopying, money transfer, and printing; and more traditional milling services (37%) including hulling, grinding and expelling.

Mr Subedi asked whether micro-hydro projects are able to make villages smarter and talked about the sustainability of projects in terms of tariff payments. Using the example of the Khamarikhola micro-hydro project (53kW) in Surkhet he showed that there has been a rapid increase in revenue collection from last year to this, allowing better provision of income and services through better salaries for workers. Once enterprises start to earn more they are sustained for longer. He also covered the case of Annapurna Lokta paper and handicrafts which are cheaper to manufacture in the location where the raw resources are and consequently generate local employment.

Other successful examples enabled by energy access are: the Computer Training Center in Baglung providing education through ICT; an FM radio station in Kharbang powering communication; a poultry farm in Sindhuli, and other projects elsewhere providing health services, and agriculture through lift irrigation. The case of drinking water provision in Ghandruk, Kaski demonstrates value addition for the local community and protection of their environment: by producing clean water and banning small water bottles in this Annapurna region villagers were able to profit by selling drinking water refills to trekkers.

The challenges faced include the lack of a sufficient business orientation of micro-hydro project management committees and users

as their initial orientation was just to provide basic lighting. Also, poor reliability of power supply from micro-hydro projects may cause problems for businesses which are therefore reluctant to use this as their main source. Mr Subedi gave an example of a scheme where the owners were not aware of the implications of a loss of power on entrepreneurial activity. In this case, a canal breakdown led to a loss of power causing fatal interruptions to lighting for chicks which proved serious for a small poultry start-up.

After-sales services for equipment installed can be poor and this problem is compounded by transportation and experts' costs. Up-scaling needs to also consider production and improved quality and access to appropriate finance. The scale of businesses is also an issue: for example, new drying technologies for cardamom can give improved quality but the scale of businesses is too small for this to be profitable. Lastly, access to finance is a major challenge. Large investors are unwilling even to assess rural businesses given the high transaction costs involved, particularly those associated with transportation to remote communities.

The aim of AEPC is to overcome these challenges and there are many opportunities arising from energy access. Firstly, local resources are ample in Nepal and labour is relatively cheap in the locations of plentiful natural resources. Returnees from foreign employment are good assets with money and ideas. They make good entrepreneurs seeking to generate more profit from projects. There is potential to bring Nepali products to national and international markets using quality enhancements, improved branding and market linkages. Social investors from cities may be encouraged to invest in rural enterprises, sharing money, ideas and connections for better sustainability. Developing rural industrial clusters and industrial estates can help share benefits and is more attractive to investors than many small individual and unconnected businesses.

The way forward is a paradigm shift from mini-grids for basic lighting services to mini-grids for earning money and creating investment opportunities. Micro-hydro projects should be promoted as enterprises progressing from community management (which is good in the construction phase), through cooperative management (which is better for operation and maintenance and sustainability of the projects) and finally to private management where the community manages the scheme as a private property. Ultimately, rural electricity is delivered by a utility managing multiple micro-hydro projects for the direct benefit and profit of the community who owns it.

Concluding with some comments about willingness to pay Mr Subedi reflected that people will pay for mobile phones but are currently unwilling to pay for electricity that they have received after inputting labour to construct the system. This mentality needs to be changed to ensure the long-term sustainability of the systems and secure the economic benefits from access to modern energy services.

Interactions between Productive Use of Energy and Access to Markets – the essence of market mapping

Mr Trishakti Rana, Practical Action Consulting

Trishakti Rana launched the afternoon session of the workshop with a presentation on applying a value-chain approach to understand the interactions between productive use of energy and access to markets. He began by defining productive use of energy as "agricultural, commercial and industrial activities involving energy services as a direct input to the production of goods or provision of services." Energy projects with productive use components are more likely to achieve economic sustainability and lead to rural economic development. This is because

enterprises that generate profit through electricity use produce a more even demand profile and have a higher ability to pay for energy services than private households who use electricity for purely consumptive purposes. Profits generated from enterprises using electricity improve incomes and create a multiplier effect through the local economy.

There are several key enabling factors to facilitate the productive use of energy and achieve sustainability and rural development outcomes. These include: access to credit, complementary infrastructure, and appropriate knowledge and skills. A crucial point is that rural enterprises require access to external markets to sell their goods and services. If there is no access to external markets, demand in rural areas is unable to absorb additional production and instead of economic growth, the rural community will just experience redistribution of income and assets.

Shifting to the Nepalese context, Mr Rana recapped that in order for a hydro micro/mini-grid system to be economically sustainable, demand from users must be sufficient to cover costs. This requires the productive use of electricity throughout the day. In Nepal, the majority of hydro micro/mini-grid systems are not operating sustainably due to weak cash-flow performance. This in turn, is largely due to rural enterprises having low productivity and efficiency and not making optimal use of electricity.

Practical Action Nepal is using its in-house Participatory Market Systems Development (PMSD) approach to achieve the economic sustainability of off-grid electricity supply projects through the establishment of productive rural enterprises making use of electricity services. PMSD takes a value chain-based approach to help identify where there are missing nodes and connections in an existing market chain, and to identify where there are barriers. The PMSD is applied both to the development of sustainable micro/mini-grid markets and to rural enterprise development, and helps understand and design appropriate interventions.

Discussion Session: Transforming Rural Electricity Access Provision in Nepal

Facilitators: Mr Dipendra Bhattarai and Ms Mary Willcox, Practical Action Consulting

On the back of Mr Trishakti Rana's presentation, workshop participants engaged in a discussion session designed to operationalise the PMSD approach to Nepal. Lively debate among participants led to the discussion of a number of topics, including: financing; regulations, licenses and resource rights; ownership structures; private sector investment; and a brief overview of an exemplary case study.

Financing micro/mini-hydro projects

Participants highlighted the financing of micro/mini-hydro projects as a key barrier. Currently, the typical micro/mini-hydro development receives around 32% (up to a maximum of 50%) of its initial capital financing in subsidies facilitated through AEPC. With subsidies being such a key part of capital financing, participants stressed the need to ensure a streamlined application process for developers while establishing that subsidies were used most effectively, and that an optimal balance between subsidy and credit is achieved.

Currently, developers need to raise an average of 68% of initial capital cost. A proportion of this, usually up to 15%, can be raised from communities themselves. However, the remaining capital cost needs to be raised through the Nepalese financial system. Although some commercial banks have recently expressed an intent to lend to the "deprived" rural sector, it is difficult for a district bank to approve a loan for a development in a remote village for two main reasons:

Mr Trishakti Rana, Practical Action Consulting Nepal

the distance taken for the bank to visit and assess the site; and collateral requirements. Currently, many projects see individuals using personal assets as collateral to secure loans – a situation unanimously considered by participants as unnecessarily risky and undesirable.

Project financing was mentioned as a means to achieve the necessary capital requirement. However, it was pointed out that in rural areas, assets that are created are worth significantly less in sales value than in construction value. Escrow financing was mentioned enthusiastically by participants as an alternative financial product. An important point was made that escrows tend to operate in well-developed financial markets and may be unsuitable to non-monetised rural households. This led to discussion about improving the financial capacity of rural households and designing a quasi-escrow instrument. A final point was made that it is currently very difficult to prove to banks that micro/mini-hydro projects are bankable. Participants recognised that the Central Rural Energy Fund is intended to deal with these problems; however, it is still at a very early stage of evaluating the financial landscape.

Regulations, licenses and resource rights

The discussion turned to the extent to which regulations, licenses and resource rights act as a barrier to the micro/mini-grid market. At the beginning of the discussion, participants expressed the view that regulations, licenses and resource rights tend to operate well in Nepal. Further discussion, however, identified several issues. In general, participants stated that regulations and licenses tend to be affordable and simple. There is, however, an issue in obtaining licenses over the resource rights in areas captured by large-scale hydro projects that bypass villages and provide electricity to cities. Licenses are generally obtainable but only by expending significant effort to negotiate bureaucracy. Similar bureaucratic barriers hamper obtaining licenses from the Forest Department to install distribution lines.

The two most important issues to come out of this discussion were: the lack of regulation concerning operation and maintenance for micro/mini-hydro projects and the lack of arrangements for the future grid-connection of smaller systems.

Ms Mary Willcox, Practical Action Consulting

Ownership structures

The break-out session moved to a conversation on ownership structures. Drawing on Nepal's vast experience of community-based ownership of micro/mini-grid projects, participants brought up some recurrent issues inherent to a community-based ownership structure. Firstly, community-based ownership structures tend to be 'loose': financiers are uncomfortable with this making it difficult to obtain loans for the initial capital outlay. Secondly, community-based ownership structures tend to suffer from coordination failure: "everyone owns it and no-one owns it." Consequently, maintenance of the system may be neglected leading to system failure.

A further major issue with the community-based ownership system is the difficulty in collecting tariff payments from households. As villagers tend to contribute their labour during the installation of the micro/mini-hydro system, many villagers refuse to pay, or do not understand why they have to pay, a monthly tariff. This inability to collect revenue negatively impacts the sustainability of the system.

A move to a private ownership structure was advanced by some participants as a potential solution. A point was made that while private models may solve some problems, they will introduce others such as the reluctance of the private sector to engage with rural communities. This resulted in an interesting call for the design of a hybrid private-community model where the system is community-owned but management of the system is subcontracted by the community to the private sector.

Private sector investment

Moving on from ownership structures, participants addressed the question of what is required to attract private sector investment to the micro/mini-hydro space. The point was made that all stakeholders need to recognise that the private sector maximises profit. This means that stakeholders need to ensure that the private sector is able to undertake profit-oriented business.

Another key point was made that the remoteness of many villages is unattractive to the private sector. To illustrate this point, participants mentioned that to achieve an 18% return with a 60% initial capital subsidy, the private sector would typically require a 50% load factor. For a remote village, however, a 70% load factor would be required in order to be profitable. This suggests that the government and other stakeholders need to play a role in ensuring that electricity is used productively to realise 50-70% load factors. A further point made was that different business models are required for micro/mini-grids that are connected to the grid and for systems that are expected to remain off-grid.

A consensus was reached that the government can play a key role in facilitating private sector investment without stepping into the delivery space.

Case study

A case study was discussed by participants as an exemplar. Supported initially by the NGO Winrock International, civil engineer and entrepreneur Bir Bahadur Ghale obtained a loan for the construction of a 50kW micro-hydro system in Gorkha. Rural enterprises that made productive use of electricity developed and through coordination of loads through the day (for example, baking late at night and operating mills during the day) a load factor of 75% was achieved. This led to increased revenue, and profits were reinvested to increase the capacity of the system to 100kW. There are further plans currently to again increase the system's capacity significantly. Key points made by participants regarding the success of the case were: the clustering of households in the Gorkha region, the homogeneity of the community, and the use of in-kind tariffs.

Closing Comments

Dr John Holmes, Smart Villages Initiative
Ms Mary Willcox, Practical Action Consulting

John Holmes and Mary Willcox closed the workshop by summarising some of the main findings from the day. A key point is the importance of productive uses of energy: in Nepal, without a load factor of 50-70%, hydro mini-grids are generally not able to operate sustainably. Also, it is necessary to move beyond the "feel-good" factor of community-based models of ownership and operation to a rigorous evaluation of their feasibility in achieving sustainability, and the need to explore hybrid community-private sector business models.

Dr Holmes communicated to participants how the Nepal workshop will feed into the Smart Villages Initiative's on-going engagement activities in South Asia and how lessons from this workshop will be communicated both within the region and internationally. Ms Willcox added to this by stressing how Nepal is a good example to share with other countries, as micro/mini-hydro activities undertaken in Nepal are one step ahead of much of the rest of the world. Consequently, Nepal has shed light on helpful lessons for other developing countries while also showcasing remaining issues to be overcome. The Smart Villages Initiative and Practical Action Consulting will seek to share this knowledge between regions, and ensure that the Nepalese experience helps informs approaches in other countries in Asia, Africa and the Americas.

Annex 1: Workshop Programme

Friday, 10 April

0930 **Opening Speech**

Mr Achyut Luitel, Regional Director, Practical Action South Asia Regional Office

0950 **The Smart Village Concept**

Dr John Holmes, Co-leader of Smart Villages Initiative

Plenary Discussion to refine/adapt/augment concept to circumstances in Nepal

1030 **Coffee Break**

1100 **Keynote Speech: Community-based Rural Electrification in Nepal: Status, Prospect and Challenges**

Mr Madhusudhan Adhikari, National Advisor AEPC/NRREP

1130 **Welcoming Address**

Prof Dr Jiba Raj Pokharel, Vice Chancellor, Nepal Academy of Science and Technology

1150 **Keynote Speech: Productive Use of Energy for Sustainability Mini Grids**

Mr Prem Sagar Subedi, National Advisor for National Rural and Renewable Energy Program of Nepal Government's Alternative Energy Promotion Centre

1230 **Lunch**

1330 **Interactions between Productive Use of Energy and Access to Markets: the essence of market mapping**

Mr Trishakti Rana, Practical Action Consulting Nepal

1400 **Discussion Session: Transforming Rural Electricity Access Provision in Nepal**

Facilitators: Mr Dipendra Bhattarai and Ms Mary Willcox, Practical Action Consulting

1620 **Closing Comments**

Dr John Holmes, Smart Villages Initiative
Ms Mary Willcox, Practical Action Consulting

Annex 2: Workshop participants

Person	Organisation
Achyut Luitel	Practical Action
Aditi Rana	Practical Action Consulting Nepal
Anuj Dhoj Joshi	Practical Action Consulting Nepal
Bibek Shrestha	Alternative Energy Promotion Centre/National Rural & Renewable Energy Programme
Binod Shrestha	Winrock International
Dilli Ghimere	The National Association of Community Electricity Users – Nepal
Dipendra Bhattarai	Practical Action Consulting Nepal
Heather Cruickshank	Smart Villages Initiative
Jiba Raj Pokharel	Nepal Academy of Science and Technology
John Holmes	Smart Villages Initiative
Krishna Prasad Devkota	Nepal Micro Hydropower Development Association
Lynette Korir	SNV Netherlands Development Organisation
Madhusudhan Adhikari	Alternative Energy Promotion Centre/National Rural & Renewable Energy Programme
Mary Willcox	Practical Action Consulting UK
Narayan Chaulagain	German Federal Enterprise for International Cooperation (GIZ)
Nischal Shrestha	Krishna Grill
Pashupati Khatri	Winrock International
Pradip Neupane	Hydro Energy Concern Pvt. Ltd
Pragyan Pradhan	Danphe Energy
Prem Bahadur Thapa	Practical Action
Prem Sagar Subedi	Alternative Energy Promotion Centre/National Rural & Renewable Energy Programme
Purna N Ranjitkar	Nepal Micro Hydropower Development Association
Rakshya Shah	Practical Action Consulting Nepal
Rojen Shrestha	Nepal Micro Hydropower Development Association
Rubina Shakya	Practical Action
Shailaja Fennel	Smart Villages Initiative
Terry van Gevelt	Smart Villages Initiative
Thomas J Mathew	
Tilak Limbu	Alternative Energy Promotion Centre/National Rural & Renewable Energy Programme/ The Renewable Energy Resources Laboratory
Trishakti Rana	Practical Action Consulting Nepal
Vijaya Singh	UNDP Nepal
Vishwa Amatya	Practical Action

Annex 3: Speaker Biographies

Mr Achyut Luitel

Achyut Luitel is the Regional Director of Practical Action in South Asia. He trained as a Civil Engineer and has over two decades of experience in the development sector, including the World Bank, the Asian Development Bank and Helvetas. During this time he has gained practical knowledge in many different kinds of rural infrastructure programmes. He was part of the core team involved in the design of DFID's transport and livelihood programme (Rural Access Programme) between 2000 and 2001, leading this team until early 2006 when he joined Practical Action as the Country Director, Nepal in March 2006.

Dr John Holmes

John Holmes is Co-leader of the Smart Villages Initiative and a Senior Research Fellow at the University of Oxford where his research is concerned with making better links between science and policy making. His previous career spanned the assessment and development of clean coal technologies, responsibility for the science and the engineering of the UK's radioactive waste disposal programme, and being head of the science programme of the Environment Agency, the UK's main environmental regulator. He has a first degree in natural sciences from Cambridge University, a PhD in engineering from Imperial College, London and an MBA from Henley Management College.

Prof Dr Jiba Raj Pokharel

Jiba Raj Pokharel is Vice Chancellor of the Nepal Academy of Science and Technology (NAST). He gained his PhD on Architecture Conservation from the University of York in the UK in 1994. As a Professor of Urban Planning and Natural Disaster Risk Management, Prof Dr Pokharel has been sharing his knowledge in the Institute of Engineering (IOE), Tribhuvan University, Pulchowk Campus and had also served as Dean of IOE.

Mr Prem Sagar Subedi

Prem Sagar Subedi is National Advisor for the National Rural and Renewable Energy Programme (NRREP) of the Nepal Government's Alternative Energy Promotion Center (AEPC). He has over 14 years of experience and expertise in various fields including livelihoods promotion through productive use of energy, biogas projects, renewable energy financing, and developing carbon projects and microfinance. Currently he provides advisory support to the Productive Energy Use component of NRREP. Before joining AEPC, he worked for Winrock International for 4 years in Pakistan and provided technical advisory support for various projects. While working at Winrock Nepal, he coordinated a 3 year USAID funded project on capacity building of micro finance institutions for financing biogas plants and other renewable energy technologies, and a 2 year Ford Foundation funded project on promotion of biogas plants through community forest users groups.

Mr Trishakti Rana:

Trishakti Rana has a Master's degree in Business Administration (MBA) from University of Nottingham and a Bachelor's degree in Commerce (B.Com) from the University of Pune. He joined Practical Action Consulting in 2014. Prior to his master's degree, he gained over 5 years of work experience working in the private sector, and following the completion of his degree he was involved in writing reports and conducting primary research for various development organisations within the country. Currently he is engaged in understanding and implementing the Participatory Market System Development approach in various projects, while also understanding and strengthening the various value-chains and supply chains.

Mr Madhusudhan Adhikari

Madhusudhan Adhikari is a national advisor at the National Renewable and Rural Energy Project/AEPC. He has more than 22 years of experience in managing energy projects and programmes, of which 18 years have been in the capacity of senior manager. He has a first degree in Mechanical Engineering from Punjab Engineering College, an MBA from Maastricht School of Management and an MPhil on Finance Management from the School of Management of Kathmandu University.

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SMART VILLAGES

New thinking for off-grid communities worldwide

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