



SMART VILLAGES

New thinking for off-grid communities worldwide

East African Community Leaders' Dialogue Workshop Report



Workshop Report 7

TERRAT, TANZANIA

August 2015

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Biomass, Pico-lighting Systems,
Entrepreneurship

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 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.

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SUMMARY

Amidst the stunning background of Terrat, a Masaai village in remote Northern Tanzania, members of the Smart Villages team spent the weekend of 22-23 August, 2015 engaged in an extremely productive dialogue event with representatives of village level energy initiatives from Ethiopia, Kenya, Tanzania, Malawi and Uganda. The event was organised at a time when final discussions were taking place on the Sustainable Development Goals (SDGs), their accompanying targets, and indicators to measure progress. It brought to the fore the voices and views of village leaders and rural change makers on the impacts of energy provision, a feature that is often missing at international fora.

Participants included local champions, community leaders, academics and representatives of small private companies at the forefront of bringing technological, social and institutional change to effect tangible sustainable developmental impact throughout their communities in East Africa. The passionate nature in which individual and communal experiences of the impact of energy provision were discussed, and the atmosphere of mutual respect in which a lively debate evolved, are testament to the presence of dynamic visionary leaders and collective spirit throughout the region. Through their communities, leaders had adopted innovative modes of collective action essential to achieving their own local sustainable development goals. These experiences and the exchanges between participants are the foundations upon which transformational development change can be built.

The Smart Villages team in Terrat listened carefully to participants' experiences, views, successes and failures. The goal of this process is to ensure that these voices are heard and their stories of bravery, ingenuity,

persistence and passion told and retold. The over-riding message participants left the team with was the importance of sustained ongoing engagement with local communities. As such, this workshop should be the beginning of such a listening process, not a one-off exercise.

Key messages emanating from the participants of the workshop included:

The Concept for a Smart Village

Participants across the board shared the goal of making human life better in their communities, however, there was a strong consensus that development priorities at global and national forums did not necessarily reflect those of villages. For community leaders, the potential to achieve local development priorities is strongly affected by access to modern energy. These priorities include: improved female and child health; income and employment generation opportunities especially for youth and women through skill development and training; improved educational outcomes and standards; access to water resources; and increasing participation in agricultural value chains.

In the opinion of participants, a Smart Village is a context specific concept that should reflect the demands and objectives of the people residing in rural areas. It can be neither universal nor predesigned without local problem diagnosis, prioritisation and sustainable solution design.

Whilst this still allows for certain ingredients of a Smart Village to be identified, these should in no way be viewed as a 'checklist' guaranteeing universal success if all boxes are ticked. Policy makers must find a model to fit rather than fit villages to a model - a reversion from 'best practice' to 'best fit'.

Institutional

- Developing sustainable business models for off-grid energy provision requires long term engagement.
- Mechanisms that support revenue sharing arrangements between distributors and rural entrepreneurs, supply chain development, technical support and training, incentivising market mechanisms for payments, and the ability to exclude free riders, are likely to have a positive impact on local communities.
- In larger projects such as mini-grids, financial sustainability may be facilitated by engaging with local anchor customers like agricultural processing units.

Social

- Empowerment of youth, as well as women, through utilisation of technological innovations in off-grid energy provision emerged as an important theme. Both these groups understand the specific development needs and priorities of local communities better than external actors but are frequently constrained by capacity and social barriers.
- Local sustainable development is a collective action problem. It requires not only visionary leadership but community ownership and continued engagement. Information transfer via social relationships based on trust and demonstration effects have a positive impact on adoption of new technologies.

Technical

- Participants emphasised that access to electricity is a means to an end and the mere provision of electricity is not in itself sufficient to enable achievement of sustainable development outcomes.
- Any technical goods and services provided need to be of high quality and reliable, with long warranties and a sustainable maintenance plan.
- There are significant social, cultural, institutional and economic hurdles to adoption of new technologies. Overcoming these barriers requires concerted and sustained efforts from internal and external stakeholders.
- Apart from electricity, other forms of rural energy provision like improved cookstoves have substantial environmental and health impacts, especially on women and children. These sections of rural society are often the most marginalised which hinders the adoption of these solutions, despite their benefits.

1. INTRODUCTION

The Smart Villages Initiative held a two-day dialogue event for East African village leaders and others actively involved in village-level energy provision in Terrat Village, North Tanzania on 22-23 August 2015. The aim of the event was to share village-level experiences of off-grid energy provision across East Africa. It was the first of a 'Masterclass' series of events to be held in each of the six regions in which the Smart Villages Initiative will operate. Participants included a wide cross-section of actors involved in village-level energy initiatives

across the region including village leaders, community elders, change makers, academics and off-grid rural energy providers.

This report provides a detailed summary of the key points that arose from the presentations, discussions and deliberations. Copies of presentations are available on the Smart Villages website (www.e4sv.org). Annexes 1 and 2 of the report provide the agenda of the dialogue event and a list of the participants.

2. WORKSHOP SESSIONS

Day 1

Welcome Address

Martin Kariongi, IOPA

The workshop commenced with a welcome speech by, Martin Kariongi, the Founder and Executive Director of the Institute for Orkonerei Pastoralists Advancement (IOPA). As an illustration of the spirit of local co-operation and community involvement that was to underlie all of the day's presentations, Martin explained how IOPA was the umbrella institution for a portfolio of social enterprises and provided a co-ordination role to ensure the provision of public goods for the collective benefit of the community.

Foremost amongst these goods is a 380 kW mini-grid which is supplying power to 224 households and small businesses across Terrat. Using biodiesel, electricity is generated at a power house located close to the village. Biodiesel is manufactured from *Jatropha* seeds at the plant which is then used as the primary fuel to generate electricity. Biofuel-based electricity generation is soon to be augmented by a biogas plant at the same site.

Youth from the village are entirely responsible for the operation, maintenance and management of the plant. Based on a commercial business model, households and commercial enterprises pay for the electricity at rates indexed to those charged by the national grid. The cost is slightly higher than that charged by the state electricity distribution monopoly.

In a semi-arid area with low rainfall, electricity generation has facilitated greater water availability and its effective use. This has been possible partly through rainwater capture, however, more importantly electricity has made possible the installation and operation of pumps which have the capacity to pump 400,000 litres of water per day from a depth of 136 meters. Water is supplied from the pumping stations to 8 points across the local area where members of the Maasai community can collect it. They have to pay for the water according to their usage with a rate of TzS 100 per litre used¹. Martin Kariongi emphasised that the key to the sustainability of these projects is that their ongoing maintenance

¹ 1 US\$ is equal to TzS 2200 and TzS 100 translates into 5 cents

and financing is in the hands of the local community.

The benefits that access to energy has brought to the village and the surrounding communities are both tangible and intangible, individual and communal, monetary and non-monetary. A major impact has been improved educational outcomes. Access to electricity has meant that a higher proportion of children are now able to attend school. There has also been an improvement in results as children are able to study for a longer period of time each day.

Access to electricity has also improved access to the outside world and has opened new avenues for the productive use of electricity. An entrepreneur in the village has setup an Internet café and a computer training and repair institute. Other new ICT-related small businesses include facilities for recharging mobile phones. In 2002, to improve access to information in the surrounding rural areas IOPA established a community radio station in Terrat. The station can broadcast within

a radius of 100 km and has an estimated audience of almost 2 million people.

From an economic development and employment generation perspective, the provision of water and electricity has been beneficial for local people, especially women. It has enabled the establishment of a dairy business which manufactures a number of different products including a national prize winning cheese from cows' milk. The plant is managed and operated by women from Terrat village. The women have been trained in the Netherlands and despite speaking no Dutch or English have been successfully operating the plant. The dairy processing plant has also increased the income of women in the community as it allows for an outlet for surplus milk production. The value-added dairy products are sold in community-owned outlets in the urban centres of Arusha and Dar-es-Salam.

Other examples of access to electricity catalysing local entrepreneurship also came to the fore in the opening session. A small-scale welding and metal workshop has been



Martin Kariongi, Founder and Executive Director of the Institute for Orkonerei Pastoralists Advancement

operating successfully in the village and is providing valuable services to local people. A woodworking and carpentry shop has also started operating in the village, providing employment and skill development opportunities to villagers, especially youth.

Martin Kariongi finished his welcome address by reiterating the importance of electricity as a driver of progress and change. Access to electricity contributes to local development and economic empowerment of rural communities as it enables access to many new sectors which in the past remained inaccessible to villagers.

The Smart Villages Concept

Shailaja Fennell, Smart Villages Initiative

In her opening address, Shailaja Fennell, representing the Smart Villages Initiative, highlighted how access to energy is critical for rural development. The importance of ensuring access to modern energy has been accepted at the global level and has been added as one of the Sustainable Development Goals (SDGs) by the United Nations. She

emphasised the importance of complementing global initiatives like the SDGs with village-level initiatives that are aimed at understanding energy requirements by interacting with local communities and their leaders.

Talking about the Smart Villages Initiative, she told the participants that the project aims to highlight the challenges of village-level energy provision for development and to identify solutions for overcoming these challenges. The Initiative brings together researchers from different disciplines based at the Universities of Cambridge and Oxford, and the current phase will last for three years with 12 month engagements across six regions i.e. East and West Africa, South and Southeast Asia, and South and Central America. These engagements comprise regional and country-focused workshops, and include working with local partners to help ensure that the Initiative builds on local knowledge and expertise.

As part of the regional engagement in East Africa, this dialogue event in Terrat, Tanzania is the first to focus on sharing of experiences between villages across East Africa. It therefore



Dr Shailaja Fennell, Smart Villages Initiative

provides an ideal chance to learn from the diverse experiences of the group and as a capacity building exercise.

She further elaborated that the aim of the Terrat event was to understand enablers and constraints facing initiatives that are aimed at rural energy provision to catalyse development. Learning about how these initiatives started, the factors that supported their development, how social networks were formed, how knowledge and technology were acquired, the financing mechanisms, and some of the major constraints that the leaders and change makers faced in the implementation of these initiatives can provide valuable lessons for future programmes aimed at rural energy provision.

The role of entrepreneurship in availing Pico-Solar Lighting Systems (PLS)

Edwin Kinyatti, Green Energy Africa

Edwin Kinyatti is the founder and CEO of local social enterprise, Green Energy Africa Limited which was established in 2010 but started a project targeting women's groups in South Kenya in Kajiado County in September 2014, with financing from the Embassy of Sweden. Kajiado is home to the nomadic pastoralist Maasai community. Green Energy Africa works through community organisations in Kajiado and Makueni counties, and set up the 'Women and Entrepreneurship in Renewable Energy Project' (WEREP) through which it trains local women's groups and provides pico-solar lighting systems, panels and other renewable energy equipment to rural households. WEREP works in three main areas:

- addressing the information gap on utilisation of renewable energy resources;
- improving access to alternative clean energy solutions for local communities; and

- lobbying the government for legislative and policy measures to address issues of sustainability in the use of natural resources.

Ten women and youth groups were provided with seed capital to set up solar business enterprises. In the first phase of the project, approximately 1,000 households benefited from the solar equipment.

Edwin Kinyatti emphasized that the foundation for the initial success in introducing PLS and other devices to the Maasai community in Kajiado lay in concerted efforts to mobilise the community and to inform them. Engaging women and young people facilitates the cultural and normative shift necessary to enable continued use of solar products. The Maasai of Kajiado have for a long time used "koromboi" which are smoky kerosene lamps to light their households. Introducing the pico-solar lighting systems has enabled households to save KES 250 (\$2.50)¹ per week on kerosene costs. A basic pico-solar system is the more cost effective option at KES 2,500 (\$25), and can provide light for 8-36 hours when fully charged. Furthermore, the sustainability of product use is guaranteed through provision of warranties, which deal with the challenge of access to spare parts.

Edwin Kinyatti explained that this access to power has encouraged the Maasai to use smart phones, which require more frequent charging. One of the main challenges remains building awareness of the benefits of pico-solar lighting systems and instilling good business practices particularly among the youth.

Edwin Kinyatti is also working on biogas alternatives and finds that the missing link to

¹ US\$ 1 is equal to KES 100 (Kenyan Shilling)

increasing uptake is the packaging of biogas in cylinders, similar to what you would find with liquefied petroleum gas (LPG). He is currently working on developing this mode of packaging, which is to be launched in the next few months.

Pico-solar Lighting Systems (PLS): Women leadership and entrepreneurship

Jackline Naiputa

Jackline Naiputa is a local Maasai leader heading up the Osopuko-Edonyinap women's group, which is part of the WEREP project initiated by Green Energy Africa. With little formal schooling and coming from a strongly patriarchal community, she has nevertheless grown into an influential, independent and well-respected entrepreneur in her own right. In April 2015 she set up a shop to sell pico-solar systems and has since scaled up to sell her goods in three villages – Magadi, Shompole and Oldonyo-Onyokie - and makes an income of approximately US \$60 per week.

The success of her business is in part due to her ability and willingness to scale-up her

business beyond the home village to neighbouring localities. Solar lighting systems have helped the community ward off attacks by wild animals on their livestock, which is their primary source of income, and reduced losses. They have also enabled children to study at night, and improved the birthing process for mothers which otherwise had to be done using “koromboi”, which was expensive and did not provide adequate light. For the community, the access to improved lighting has helped alleviate some of the most important problems and has had a transformative impact on the standard of living and their livelihoods.

The role of cookstoves in Kenyan village level initiatives

Emily Bunyasi and Mary Kibui

Emily Bunyasi is part of a women's group in Sipala Village, Bungoma County in Western Kenya which rears livestock, including goats and chickens, for sale. Improved cookstoves that were energy efficient were introduced into the village by the German International Development Agency, GIZ through chief's meetings in 2007 to replace the much less efficient traditional three stone fireplace. The



Edward Kinyatti and Jackline Naiputa, WEREP

Kenyan Ministry of Agriculture was involved in mobilising and sensitising the community on cookstoves technology. Emily was one of the nineteen (nine women and ten men) village leaders identified for training on how to make the Jiko Kisasa (modern stove) and Rocket Stoves.

Of the nineteen trained, only two remained active as manufacturers of improved cookstoves. The high drop-out rate is due to the poor profit margins in the industry which dissuade people from entering and continuing in the field. The low number of people involved in manufacturing improved cookstoves has also affected local uptake of the stoves. Over time however, an active network of cookstove technicians and manufacturers has developed in the region. Materials like bricks and clay obtained from ant hills, are locally available and cheap. The cost of stoves also has to be kept low in view of the low purchasing power of consumers in rural areas.

The Jiko Kisasa, which also has a portable model, has a liner and conserves 40% more energy than the three stones option. The improved efficiency has a positive impact on the environment as it uses substantially lower quantities of fuel as compared to the traditional cookstove. It also reduces the time spent by households in looking for fuel. The Rocket Stove is more popular because it has a high temperature combustion chamber which allows for complete combustion and ensures yet higher levels of energy efficiency. This is important because it further reduces usage of firewood and therefore reduces deforestation. Unlike the Jiko Kisasa, the Rocket Stove does not produce smoke.

Emily Bunyasi highlighted some advantages of the improved cookstoves, which include better maternal health. As women are marginalised in society, it is difficult for male members of the

household to understand the positive impact of improved cookstoves and realise the negative impact of the traditional cookstove. Even though she has built more than 5,000 improved stoves, and trained women in their use, in the Bungoma, Uasin Gishu, Nandi and Eldoret areas there is opposition from male members of households. Sensitising them requires constant education, use of demonstration kits, and awareness programmes. She noted that there is much easier uptake on lighting than on adoption of cookstoves: this is largely due to lack of awareness and the gendered nature of the product.

Mary Kibui who is based in Rwathia village, Kangema in Murang'a County in the highlands of Central Kenya, is a member of the Kenya National Farmers' Federation (KENAFF) which is a farmers' lobby in tea, coffee and dairy farming areas. GIZ made use of the pre-existing mobilisation of farmers around KENAFF to identify women leaders who they trained to build improved cookstoves. Only three women stayed on as cookstoves manufacturers/technicians, but they have trained more people in subsequent years. To raise awareness and increase the uptake of the Jiko Kisasa and Rocket Stoves, Mary also facilitated the setup of demonstration kits in each of five tea factories. The improved efficiency can be gauged from the observation that wood equivalent to a fully grown tree used to be consumed by a household on average in a month for cooking using a traditional cookstove but with improved stoves the same quantity of wood lasts for almost 3 months.

Agriterra, an agricultural investment company, also identified her for training to setup biogas kits in off-grid areas. Initiatives promoting biogas for cooking and improved cookstoves are vital in managing the impact of constant land-subdivision in these densely populated areas. They are also vital to deal with problems of environmental degradation, deforestation and depleting water levels in the highlands.

Between 2007 and 2010, Mary has overseen the construction of 3,500 biogas kits in Murang'a. Furthermore, ISAK works with four 'People Living with HIV/AIDS' (PLWHA) groups, constructing stoves in their houses and training them on how to commercialise the stoves.

She explained that a serious challenge that local community leaders face is where private companies fail to acknowledge the efforts of local leaders and instead benefit themselves. She gave the example of a factory manager at Kanyinyaini who appropriated the data from the 4,000 households for which she had built cookstoves, and won international Fairtrade awards for the factory with no recognition of her efforts. This exploitative dynamic is often overlooked, but in the long run breeds mistrust and jeopardises the local uptake of renewable energy technologies.

Group Discussion on Village Experiences in Energy Service Provision

The discussion session started by looking at some of the challenges to commercialising biogas technology on a larger scale. Livinus Manyanga, the Executive Director of Kakute Projects Company, opened the discussion by explaining that he has been working with the Dutch NGO SNV on commercialisation options for biogas technology. Mary Kibui explained that to overcome this problem in her village, people now combine human, poultry and pig waste as feedstock for biogas. The group then explored the possibility of building hubs for the collection of feedstock from abattoirs, as a business alternative for those areas that do not have dairy farming.

The discussion also focussed on comparing the cost efficiency of biogas and LPG. Edwin Kinyatti explained that in Nairobi, 6 Kgs of LPG ranges from KES 1200 (\$12) to KES 1400 (\$14). One of the ongoing projects at Green Energy Limited is a packaging option that

will provide biogas in 6 kg cylinders at a cost of KES 500 (\$5). While, there was agreement among the participants that LPG is generally cheaper than charcoal, not everyone can afford gas stoves. The other challenge to uptake is the abundance of "free" firewood which is used for making charcoal. This often makes charcoal seem like the cheaper option for villagers. However, in urban areas like Nairobi, a sack of charcoal is the pricier option, at KES 2000 (\$20).

Keynote speech: Opportunities and Challenges of Village-Level Programmes

Blessings Chinsinga, University of Malawi

Despite some success in poverty reduction, there are a number of development challenges facing African countries observed Blessings Chinsinga in his keynote address to participants. These challenges are especially acute in rural areas where life remains a persistent struggle for the majority of those living there. A majority of the Millennium Development Goals remain unmet in many countries across Africa, especially in rural areas. In the African context, unified macro-level theories of development have failed to improve people's lives.

In order to meet the development challenges facing rural areas, village-level development interventions are required that allow for more local context and variable pathways to achieving prosperity, and which reflect the development priorities of local communities. Doing so entails a more organic and flexible approach to development in a "move away from 'best practice' to 'best fit'" keeping in view local nuances and differences. Village-level development programmes can also provide opportunities for capacity building in communities and to learn about technological developments. Such initiatives can drive skill creation by expanding the opportunities available to local communities. They can also serve as ideal platforms

for the development of a local leadership which is capable of dealing with collective action problems and can engage with external stakeholders.

Drawing on research undertaken in Malawi on the implementation of village-level programmes like the Millennium Villages Project, Blessings Chinsinga observed that a number of the development challenges facing rural areas seem to be primarily socio-political, rather than economic. Elaborating further, he observed that local development initiatives, especially those that are successful, are more likely to be hijacked by politicians and other external stakeholders like NGOs. In many such instances the local community which has played the most important role in the success of initiatives is reduced to the status of meagre spectators. To deal with the external challenges, it is extremely important to cultivate and develop avenues to train local leaders who can sustain and scale-up development programmes. He emphasised the need for local communities to protect their own intellectual property and be helped to engage more productively with national and global institutions.

Blessings Chinsinga's presentation was followed by a lively discussion and the participants deliberated on some of the major issues related to rural development and village-level initiatives highlighted in the keynote address. Talking about the risks of political interference by external stakeholders and efforts to mitigate them, participants stressed the importance of fostering avenues for collective and shared leadership within villages to ensure that the community continues to be a stakeholder in the development process. Participants also discussed the lack of support given to frontline energy providers, especially women involved in improved cookstoves dissemination programmes. As micro/small entrepreneurs with limited resources, the hard work and effort put-in by them towards improving the

environment and human health is usually not appreciated within communities and the local leadership.

While acknowledging the need to develop and foster local leadership, the youth need to be involved in village level development programmes. One of the challenges to local development initiatives in rural areas is the rapid increase in rural-urban migration of the youth because of a lack of opportunities.

Barefoot Grannies Initiative in Rwanda **Colette Umurunga, RUGO**

Rwanda has a population of more than 12 million people and is a landlocked country in East Africa. Agriculture, mainly small-scale subsistence farming is the mainstay of the economy and a vast majority of the labour force is engaged in this activity. Energy consumption in the country is dominated by biomass which accounts for 85% of primary energy use with electricity accounting for a paltry 4% of use and petroleum making up the rest.

Colette Umurunga from the NGO Rwanda UK Goodwill Organisation (RUGO) in her keynote address laid the background of the Barefoot Solar project in Rwanda. The village of Karambi located in Bugesera District in the country's Eastern province was chosen as the site for the pilot project by RUGO with the support of the Rwanda Women's Network.

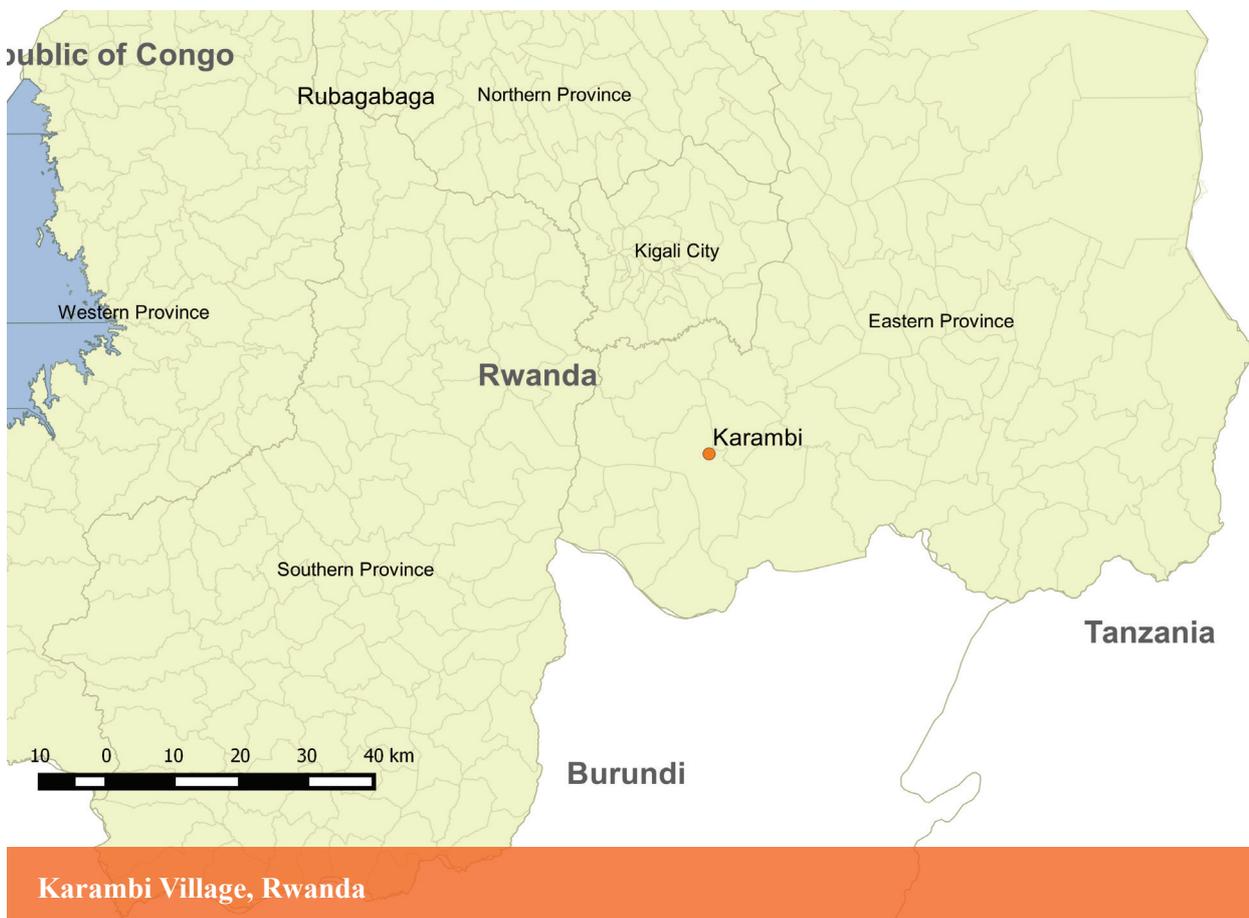
Located at an hour's drive from Kigali, the village has 110 households and almost half of the households are women led. The genocide in Rwanda had a particularly devastating impact on the population which remains poor and marginalised. In the absence of electricity, a few of the households used kerosene based lamps for lighting needs, however, it was both expensive and had a negative impact on health. There was an urgent need in the village to improve access to modern forms of energy. As it was highly

unlikely that the village would be connected to the national grid in the near future, the way forward was to use off-grid solutions to meet the needs of the community.

Instead of simply raising funds and installing solar home systems (SHS) in the village, RUGO started working with Barefoot College in India to ensure that the local community developed the requisite skills to install and maintain the systems within the village. Based on requirements of the Barefoot College, women over 45 had to be selected by the community to go to India and receive training. The emphasis on women raised contention in the village, however, effective communication with the community ensured that four women were selected from the village by the community. To hedge against migration by skilled workers to urban areas, the Barefoot College model trains only women who fit certain pre-set criteria. The four women were

sent to India for training for 6 months with financial support from the Indian government in 2011. As part of the project, a workshop has also been built in the village for the grannies to store equipment and for them to undertake maintenance work.

Equipment for the project has been sourced by RUGO through fund raising. The equipment was ordered based on a detailed survey across all households in the village and was provided free of cost. The business model as it has evolved means that maintenance and ongoing costs are to be paid by the community to the grannies using resources previously spent on buying paraffin for the kerosene lamps. Equipment supplied to households comprises solar panels, two fixed lights in the house, a portable solar lantern that can be taken in the fields and a mobile phone charger. The model is being replicated in two more villages by RUGO.



The Barefoot Granny experience of off-grid energy provision

Odette Mukarumongi and Dative Mukanabana

Odette Mukarumongi and Dative Mukanabana, grandmothers from the village, were nominated by the community to be among the first batch of women to receive training in India. They talked about the importance of having a facilitative environment allowing women to participate in such productive activities. They credited the Rwandan government with creating an environment where women are not as marginalised anymore. With no prior training and limited education, the women were trained in solar engineering over six months at the Barefoot College in India. As the women spoke no English at all, it was quite a challenge as they had to learn about putting the system together and connecting the panels to batteries. They did so by assigning numbers to the various components. Each number was associated with a component's English name which they translated into Kinyarwanda, their local language.

The women returned to Rwanda in October 2011 and began installing the systems. As it took longer than anticipated for the construction of their workshop, they installed the solar home systems at two homes as a pilot project. By November 2013, the grannies had installed SHS throughout the village. In the context of rural Rwanda, this was a huge cultural change as women wearing trousers and climbing on rooftops to install the panels was completely unheard of. The SHS were installed for free throughout the village as they were donated by RUGO, but the villagers paid the women a token amount for their labour costs. Over time, there have been some ongoing maintenance issues in the systems and the women have been able to deal with them within the village in their purpose built workshop. This has ensured the continued sustainability of the systems.

Talking about some of the benefits of the project, the ladies stated that there have been significant environmental and health benefits with the move away from kerosene lamps. Kerosene lamps provided limited light and had to be carried from place to place for illumination, however, with solar lighting this is no longer a problem. The health of children has improved substantially and they don't suffer from breathing ailments from breathing in the exhaust from the lamps.

Access to solar energy has also increased the length of the working day for people in the village and has meant that children can study for a longer period of time without breaks. This has improved their performance in school. Women can also work longer hours, and there is improved protection against ants and other insects biting them during the night. Most importantly, the initiative has helped women improve their social standing and to contribute to the betterment of the community. To expand the network further, the women also expressed their willingness to train women in other countries across Africa.

The presentations were followed by a discussion session. In response to a question about the challenges they faced, the grannies opined that language differences were difficult to deal with initially, however, over time with the support of the instructors at Barefoot College they managed to become experts in setting-up and maintaining the equipment. One of the key reasons for the success of the initiative in their opinion was the high level of trust that they had with the community which allowed them to work with households. Participants also talked about the cost of the system and the technical parameters of the solar lanterns. Differences in the performance of products sourced across different parts of East Africa also came under discussion during the session. During the period that the SHS have been working in Karimba, Odette Mukarumongi and Dative Mukanabana told participants that there hasn't been any major issues, however, now that some of those systems have been



Odette Mukarumongi, Grace Mwemere and Dative Mukanabana

working for an extended period of time there are a few parts that need replacement. In terms of the regional nuances, cultural differences in East Africa make the replication of this initiative in other countries, like Uganda difficult. There is a negative connotation associated with women climbing onto rooftops to install solar panels.

Medical Services and Improving Skills for Renewable Energy

Joab Wanjala and Livinus Manyanga

Located in western Kilimanjaro, Longido is a new district in the Arusha region created in 2007 and is inhabited primarily by members of the Maasai community. The district comprises 3 divisions and 16 wards and according to the national census of 2012 has a population of more than 120,000 people. A majority of the areas in the district are not connected to the national grid, though the district headquarters is linked to the Kenyan national grid as per a power purchase agreement between the two countries.

The lack of access to electricity has meant that the majority of the people in the district have to rely on traditional sources of lighting including

paraffin lamps, candles and open fires. Areas in the district remain quite remote and inaccessible from major urban centres, especially in the rainy season as there is only a dirt road linking the district to Arusha city. The lack of accessibility and poor infrastructure constrain the choices available to local people and also contribute to the low levels of educational attainment among students. While communication technologies like mobile phones have penetrated the district, most people have to walk substantial distances to charge their phones using car battery operated systems.

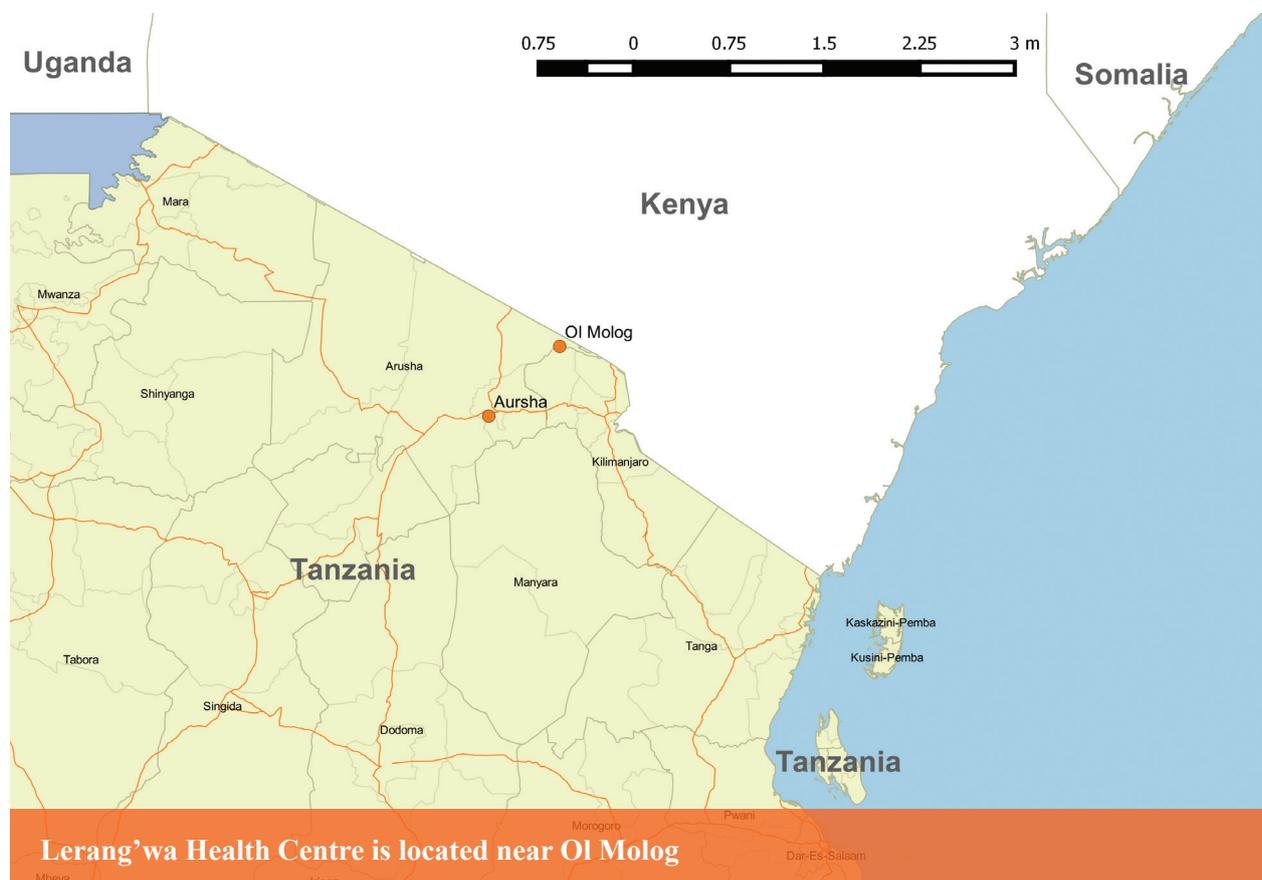
Modern health care facilities in the district were non-existent with very high mortality rates among pregnant women. In view of this high mortality rate, the representative of the Archdiocese in Arusha laid the foundations of the Lerang'wa Health Centre in Enduimet Division of Longido District. According to Joab Wanjala, the resident physician at the centre, Lerang'wa Health Centre was conceived as a maternity hospital, however, soon people from the community and surrounding areas started coming in for treatment of other ailments and the hospital had to be expanded. As there was no access to electricity the hospital had to use a

diesel generator for some of its basic needs with the generator consuming on average 60 litres of diesel per day. Generating electricity at such a high cost was economically unsustainable in the long run for the Centre as it had no revenue generation and was dependent on donations for funds. The generator only provided power to the hospital's main building and there was no electricity in the staff quarters. Attracting and retaining doctors and other medical staff was a major problem for the Centre as doctors and other staff members did not want to work in a remote area with no access to electricity, completely cut-off from the modern amenities of life. The lack of electricity also meant that there were a limited number of services that could be provided to local communities.

To solve the problems of access to energy and to improve healthcare provision at the hospital, Kakute Projects Company Limited, a social enterprise operating in Arusha since 1995, started work on a project in 2013 to

install a 5.4 kW Solar photovoltaic (PV) cell based mini-grid system at the hospital. Based on a detailed technical study and keeping in view the envisaged future expansion of the hospital, an upgraded 10 kW system has been installed against the original plan. The project to electrify the hospital was supported by the local administration of Longido District and received financial backing from the Renewable Energy Agency (REA) of Tanzania. Technology partners for the project included Mobisol UK Limited and Energibau GmbH.

The installation of the mini-grid has had a truly transformative effect on the day to day operations of the hospital. Joab Wanjala observed that in the period without access to electricity, on average he could only see about 6 patients in the out-patient department per day. However, now with stable access to electricity, the length of the working day has increased and the positive impact is visible on the operation of the out-patient department with staff treating



Lerang'wa Health Centre is located near Ol Molog

anywhere from 50 to 100 patients in a single day. The number of diagnostic services that the Centre can provide has also increased which has contributed to the increased flow of patients to the hospital.

Perhaps equally important is the demonstrative effect that the installation of the solar system at the hospital has had on the surrounding community. The demonstration effect was further strengthened through regular engagements with the community by Kakute's outreach representatives. Within a period of 18 months, 174 households have installed Solar Home Systems (SHS) supplied by Mobisol. The systems have been installed in households with a down-payment of only 10%, with the rest payable in a series of instalments over a period of 6 months. The SHS has a warranty of 3 years, however, to ensure buy-in among the community and to develop local enterprises, Kakute has trained a team of local youth to provide marketing and after sales services. These teams also provide end-user training to members of the household on steps to maintain the equipment to ensure trouble free operations.

From the point of view of system providers/contractors, especially for renewable energy based mini-grid projects, there are a number of challenges including:

- capital constraints and dealing with the bureaucracy which could delay signing of contracts;
- lack of local technical expertise means that there is a dependence on imported components with associated concerns about quality; and
- dilapidated infrastructure and isolation of the area hinders communication which has a negative impact on project completion.

There are a number of different methods to mitigate the risks brought about by these challenges. To deal with the capital constraints, project executors need to ensure access to credit is available so that once a formal contract has been signed, work can commence on the project without delay. For import of components, it is extremely important to work with reputable suppliers and order products in advance to reduce time delays, however forex movements could affect cost. Finally, lobbying the government and involving other partners in the project could provide a solution to the infrastructural constraints. Off-grid energy has had a transformative impact on health care provision in the Enduimet Division. The success of the project has been brought about through cooperation between public and private parties.

The discussion kicked off with a question on the financial sustainability of the hospital. Joab Wanjala explained that the solar mini-grid has supported many revenue-generating activities that are operated by the hospital including a welding station, a timber workshop where they make charcoal to sell to the community, and a dairy centre. Access to electricity has made it easier for the hospital to attract trained human capital and they now have thirteen medical staff including two more doctors, a technician and three nurses from the government. The government only pays seven out of the thirteen workers. Two more nurses from the community are being trained at nursing school. They are much more likely to stay and work in the hospital than to move elsewhere. The workshop participants then explored the role of partnerships in the uptake of renewable technologies. Livinus Manyanga explained that in the case of the Lerang'wa health centre, which had no ability to pay for installation, the mini-grid system was provided by Kakute Projects Company as a social enterprise for the community's advancement.

Roundtable on Village Energy Services and Skills Provision and Wrap up

Richard Sidebottom and Nungari Mwangi, CDS

The first day of the workshop raised a number of extremely interesting issues and insights. The wrap-up session and discussion was led by Richard Sidebottom and Nungari Mwangi, from the Centre of Development Studies (CDS), University of Cambridge. Throughout the day workshop participants were asked to independently write words or short sentences on post-it notes about some of the key learnings and themes that they thought emerged from the presentations and discussions. The group then discussed the patterns that appeared across these individual comments.

Foremost amongst these was the importance of focusing on local concepts, knowledge and development priorities. There was a strong consensus that development priorities at global forums did not necessarily reflect those at the village level. This reflected a lack of local problem diagnosis in policy formulation. Sustainable development at the village level seems to be a local collective action issue.

Consequently, participants emphasised the importance of local community, partnerships and strong leadership in the success of off-grid energy projects. This entails not only visionary leadership but community ownership and continued consultation. Local leadership has to ensure that deeply entrenched gender inequalities are addressed. Furthermore, for sustainable rural development it is important to engage local youth and develop their skill-sets. Participants emphasised empowerment for marginalised elements of society as both a means and end goal of community based rural energy initiatives.

Technology transfer is not just about receiving information about innovations. The fact that the obstacles to adoption of new technologies are wide ranging and include significant social, cultural, institutional and economic hurdles, requires concerted and sustained efforts from internal and external stakeholders to encourage information transfer via social relationships based on trust and demonstration. This highlights the need to address the role of external institutions: state (including the national and local governments), local politicians, NGOs and the private sector. All these external stakeholders have key roles to play in providing technical support and training, ensuring quality product supplies, and in developing supply chains and local infrastructure to utilise local energy most effectively. Furthermore, to catalyse local development, there has to be an emphasis on initiatives that promote the productive use of energy and which deal with factors that constrain the growth of such productive enterprises in rural areas.

The nature and timing of engagement with actors outside local communities depends upon how well communities are able to independently manage business models that are financially sustainable. In some cases this would require establishment of revenue sharing arrangements between distributors and rural entrepreneurs; in others, the ability to exclude free riding consumers. In larger projects such as mini-grids, financial sustainability may be facilitated by engaging with local anchor customers such as agricultural processing units.

Day 2

Village level Energy Provision in Lake Victoria**Reverend Christopher Walusimbi**

The Kalangala District comprises a chain of 84 islands which are called the Ssesse Islands located in Lake Victoria. The total population is approximately 59,000 which is spread across 64 of the islands while the rest are uninhabited. The largest island in the system is Bugala Island where approximately 30% of the total population of the islands is based. The islands have historically been neglected by the government because of the distributed nature of the population and the high cost of service provision as they are located almost 40 miles from the mainland of Uganda.

Reverend Walusimbi is a priest and local community leader based on the island of Bukasa which has a population of approximately 6,000. He has been playing an important role in providing services to the community throughout the islands as the

traditional King of the Ssesse Islands appointed the Reverend as the chief of the entire chain of islands. He has been trying to bring about improvements in people's lives and started a number of interventions related to improving education and healthcare outcomes in the islands. The success of many of these initiatives depended on the involvement of the community and a bottom-up approach to development as opposed to bringing in notions of development from outside. Rural electrification projects also need to be seen as a means to develop the community and the involvement of local people in these projects also has to be ensured.

The Reverend highlighted the importance of self-reliance for communities. This self-reliance can be built by investing in education and community training which can ensure the long-term sustainability of development projects. Financial resources need to be used in order to support such initiatives, and subsidy programmes such as cash transfers need to be targeted towards promoting projects that can translate into long-term



Reverend Christopher Walusimbi



Bugala Island, Kalangala District, Uganda

income generation as opposed to a one-time cash offering which can do more harm than good. These programmes have to be accompanied by educational programmes on the purpose of the transfers and how to effectively use the resources for poverty alleviation. There are a number of development challenges in the islands which are complicated by the extreme isolation in which the communities have been living. This means that people are likely not to be aware of the technological changes that are taking place in other parts of the world. People of the islands are not integrated with the rest of the country because of their remoteness.

There is also evidence of increasing environmental change in the islands as jungles are being cleared for large-scale monoculture agriculture. On the island of Bugala, a major contributor to the deforestation has been the growth of oil palm plantation due to the establishment of a palm oil plant with the government's backing. On the one

hand there has been an increase in farmer incomes as out-grower schemes involving local farmers have been promoted, on the other hand there are questions regarding the environmental damage as pristine jungles are cleared. The environmental changes brought about by deforestation have to be accounted for in development interventions and it is important to develop frameworks involving the community to ensure sustainability of the natural habitat.

Despite the isolation of the islands there has been a gradual improvement in access to modern forms of energy, especially on the main island of Bugala. The main energy requirement of the population is for lighting and heating. A majority of the households depended on candles and kerosene based lamps for their lighting needs. A few households had access to solar home systems and this has had a positive demonstration effect. For cooking, while there is continued dependence on solid biomass, there have been some

moves to use improved cookstoves that have better thermal efficiency and use less firewood. There have also been some moves to introduce improved charcoal cookstoves on the island. Much of the infrastructure on the island, however, remained in a dilapidated condition or was absent

Biogas entrepreneurship in rural Uganda and the challenges

Ojok Denis

A young entrepreneur from Northern Uganda, Ojok Denis is passionate about expanding biogas use in rural Northern Uganda, an area that has historically been marginalised. There are high rates of poverty in the area and years of insurgency have wreaked havoc with the existing infrastructure. Biogas presents an ideal solution to solving some of the energy access issues in the region and as a means of countering negative effects of deforestation. The dependence on traditional stoves to meet the cooking and heating needs of the local population have contributed to deforestation and environmental change. As most households own livestock, fuel for biogas based solutions is easily available, however, there has been no effort to further develop this potential.

A major challenge facing young entrepreneurs wishing to enter the field is the lack of support given by elders in a society that remains deeply patriarchal. Entrepreneurs who want to work with local communities to develop improved energy access solutions are dissuaded from doing so. Other barriers include the lack of access to credit and affordable sources of finance for those who do not have collateral. Another major challenge is getting the right technology that meets the requirements of local people. Sustainability of bio-gas initiatives could also be negatively affected by the high levels of poverty and the

low ability of people to pay for digesters and the allied technology.

Bringing Energy into village level development initiatives

Francis Nazombe, Millennium Villages Project

Malawi is a land-locked least developed country (LDC) in East Africa with a population of 16.7 million and Gross Domestic Product (GDP) of US\$ 14.58 billion and a per capita GDP of around US\$ 900. Agriculture is the mainstay of the economy and provides employment for approximately 90% of the labour force. There is rampant poverty in the country and about 51% of the population is classified as poor. Energy use and consumption is dominated by biomass which accounts for 88.5% of the primary energy requirement of the population. Access to, and use of, modern forms of energy like electricity remain extremely low in the country.

Francis Nazombe, a farmer and general secretary of the Mwandama Millennium Village project in Malawi discussed some of the major benefits to the community arising from access to pico-solar lighting systems (PLS). He also highlighted a few of the challenges in ensuring the long term sustainability of the initiative.

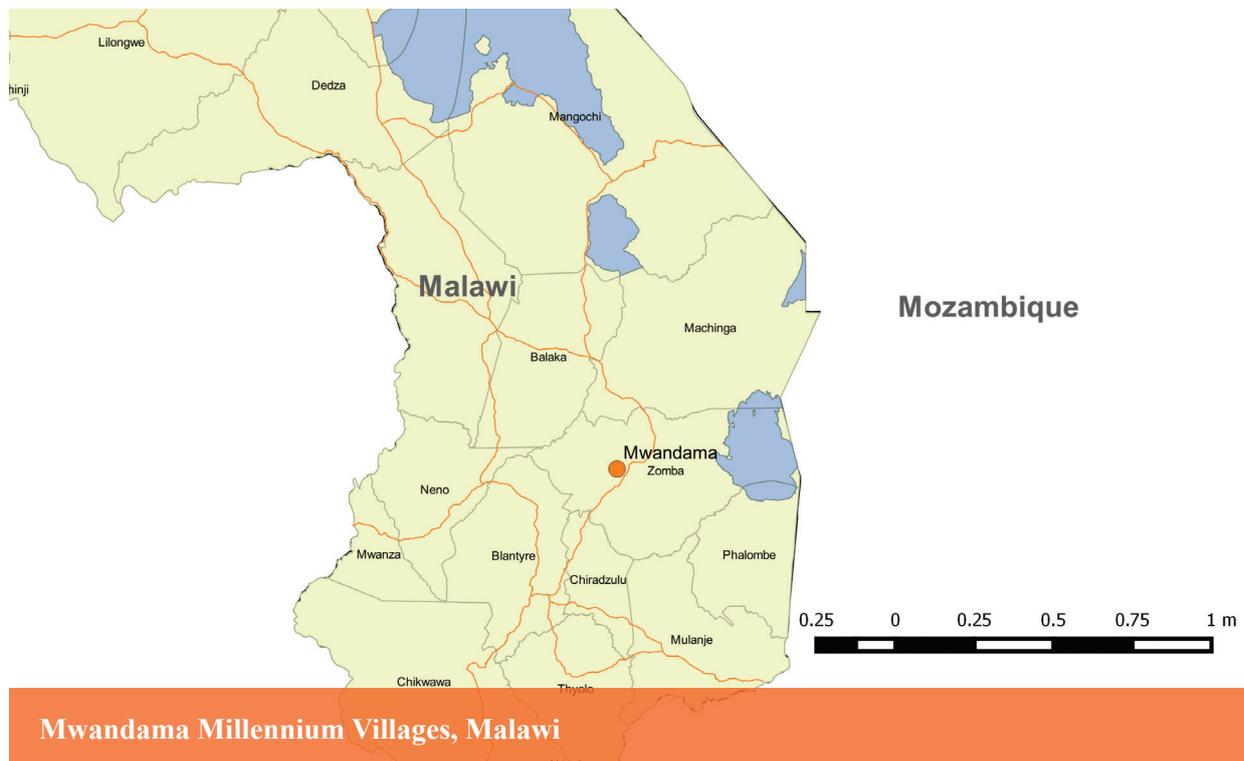
The Mwandama Millennium Village is located in the Southern region of Malawi. The area is located 5 km from the nearest road and it takes half an hour to get to the nearest town. The national grid has been extended to the village by the state utility company – ESCOM, however, the village has not been connected due to the local political dynamics. Another factor that has acted as a deterrent for people wishing to access the national grid is the high upfront cost of connection which has to be paid to the state utility company. A majority of the people in the village and the adjoining areas remains poor and cannot afford the

cost of connection, even if they wish to gain access to grid based electricity.

The Mwandama Traditional Authority is a cluster of 114 villages. These villages have a combined population of 37,153 which is distributed in more than 9,000 households. The project started in 2006 with interventions planned in the area of health, education, infrastructure and private sector development. The aim of these interventions was to support rural areas to meet the Millennium Development Goals (MDGs). Around 1,500 solar lamps have been distributed in the community since 2008 at subsidised cost. These pico-solar lighting (PLS) systems have been imported from Kenya and Tanzania. There has been a positive uptake of the PLS systems as they are cheaper in comparison to the average monthly household spend on kerosene to meet the lighting needs. One of the interventions of the project was aimed at training local members in the operation and maintenance of the equipment. A group of 3 men and 5 women was trained initially by trainers brought in from Tanzania.

The availability of these pico-solar lighting systems has helped students study longer and has had a positive impact on their results. It has also enabled women to better care for their children, especially at night. The availability of PLS has enabled community members to improve communication as they can now charge their mobile phones in the village and they don't have to travel substantial distances to do so. Micro entrepreneurs have started mobile phone charging enterprises.

Despite the success of the initiative and the positive impact on the local community, there are a number of challenges that could constrain the long-term sustainability of the project. One of the key constraints is the lack of after sales service and spare parts. Even though some members in the community have been trained to maintain the equipment there has been little emphasis on developing the spare part supply chain. The link between local bottom-of-the-pyramid entrepreneurs in the village and spare parts distributors based in urban areas is missing. In case of any problem, users have little choice



Mwandama Millennium Villages, Malawi

but to dispose of the PLS. Another challenge to sustainability is the lack of a commercial approach to distributing the pico-solar lighting systems. Households not a part of the initial programme are awaiting the provision of subsidised PLS which is unlikely to happen as the project reaches its conclusion and the government has cut-back on subsidies. The perversion of the market mechanism and a lack of foresight mean that despite the presence of powerful demonstration effects, the uptake of PLS at commercial rates has not taken place.

Access to modern forms of energy and rural development

Adam Sebitt, University of Makerere

Adam Sebitt from the Mechanical Engineering Department, University of Makerere commenced his keynote address by painting a macro picture of the Ugandan economy. In 2014, the country had a population of almost 34.5 million people. High rates of population growth mean that by 2025 the population is projected to increase to 45 million and by 2050 it will more than double to 95 million. More than 80% of the population is based in rural areas. Access to electricity remains low in the country and only 15% of households are connected to the national grid. In rural areas the situation is worse and only 7% of households have access to the national grid. Almost 89% of the total primary energy consumption in the country is generated through biomass. Electricity contributes only 2.7% of the energy balance with oil accounting for the rest.

Adam Sebitt highlighted the importance of ensuring access to energy as a pre-requisite to meet national development goals. In rural areas, access to energy can spur the development of small and medium sized enterprises that can feed into larger industries based in urban areas. From an environmental sustainability point of view, developing countries

need to invest in developing modern sources of energy. These modern sources of energy have low carbon emissions and are environmentally friendly. They include renewable sources of electricity production such as solar thermal and PV, the replacement of charcoal based cookstoves by Liquid Petroleum Gas (LPG) based cookstoves, and improved application of biomass through gasification and the use of biogas.

In rural areas, access to modern forms of energy can spur local development and can contribute towards poverty alleviation through job creation in various sectors. It can also have an impact on skill enhancement in these areas through worker training programmes and the establishment of training centres. In the agriculture sector, access to stable sources of energy can contribute towards increasing yields through improved water supply for irrigation purposes. It can also reduce food wastage and help improve food security in vulnerable areas. Finally, value addition through agro-processing can contribute to improved livelihoods in these areas. Local processing can increase the value added that is captured by village level entrepreneurs. Processes such as solar drying can also be used to preserve high value agricultural products like mangoes and pineapples and reduce wastage. Improved livelihoods and communication technologies can also reduce pressure on cities by reducing rural-urban migration.

Adam Sebitt also talked about some off-grid energy projects that he has been involved in in Uganda. The Nyabeya Forest College (NFC) is a government run institute that trains forest officers to manage the vast natural forests in Uganda. The College did not have access to electricity. The abundance of wood waste in the area meant that this could be utilised for energy generation. To capitalise on the renewable sources of energy available, a gasification system has been installed at the college:

the first in Uganda. The system has a capacity to generate 140 kW of electricity. Although the project is running successfully, one of the key constraints to emerge is the retention of trained human resource. Two technicians were trained to operate and maintain the gasification plant, however, now only one remains.

Another example showed the importance of how policies can exclude local people from the benefits of accessing electricity. Kagando Hospital in North Uganda is supplied with electricity from a 60 kW micro-hydro plant. The plant is located 2 km away from the hospital and electricity is supplied to it via overhead wires, however, policymakers did not make arrangements to supply the communities living nearby. This means that while power lines are passing directly over the houses of villagers, they cannot access the electricity.

These examples serve to show that there are a number of benefits to deploying off-grid energy systems in rural areas, however, there are also substantial challenges. These include:

- high upfront costs of technologies and the importance of technology transfer;
- sustainability of modern energy systems especially in rural areas and ensuring the availability of adequately trained human capital to maintain the equipment;
- ensuring the economic sustainability of projects, especially mini-grids: while rural communities are often willing to pay the economic cost of generation and supply they are constrained by low incomes;
- retention of trained human capital in rural areas requiring development of technical expertise within the local community;
- empowerment and buy-in of the local economy at the start of off-grid energy projects being critical for the continued success of such initiatives; and
- weak implementation of policies by national and regional governments.

Despite the challenges, low levels of access to modern energy systems means that there are a number of opportunities. For example, in semi-arid areas, apart from water pumping, infrastructure for rainwater harvesting can also provide a means of dealing with water scarcity. Instead of relying on electricity or solar driven pumps, in areas with adequate wind resources, wind pumping can be used to improve access to water. Additional resources can be generated for such projects through avenues like the small grant schemes of the United Nations Development Programme (UNDP).

The heavy dependence on biomass means that these resources cannot be ignored and investment has to be made in developing modern biomass technologies. To do so, implementation of existing patent laws by the government is important. There also has to be a constant dialogue with the government at all levels to ensure that laws and policies that improve access to modern forms of energy are enacted as well as implemented for the benefit of those that are at the bottom of the energy access ladder. There are also ample opportunities for the productive use of technology, however, in the absence of enabling frameworks, local communities often do not have the tools to take advantage of these opportunities.

In conclusion, Adam Sebitt indicated that off-grid energy providers should maintain and improve upon local social capital. For entrepreneurs it is extremely important to deal with the government and ensure that their initiatives are not appropriated. Evidence from across East Africa shows that the triple-helix model

of development which involves policy-making from the government, investment and risk taking from the entrepreneur, and input from universities, has been quite successful. In many of the examples of the successful use of this model, over time the government has sought to use these projects for political mileage and the role of the entrepreneur has diminished. Therefore, for successful energy access projects it is extremely important to guard them against political interference and appropriation by external stakeholders.

The role of government and the issue of subsidies came under close scrutiny in the subsequent discussion session. The free distribution of products especially to gain political mileage generates a sense of entitlement among the community, and then moving to a commercial model becomes difficult. To deal with this issue, participants agreed that a clear communication strategy has to be in place with the community which emphasises that in the long-run subsidised energy provision is not possible. Communities have to be sensitised so that they understand the long-term costs of replacement. Village leaders have a crucial role to play in this regard and off-grid energy providers have to engage with them to ensure long-term sustainability and continued adoption.

The lack of adequate human capital, was also deliberated. A solution highlighted by participants was to develop technical training and vocational institutions. These institutions run by the government in partnership with private entrepreneurs could provide the critical mass of expertise required for the maintenance and operation of renewable energy infrastructure in rural areas. For every engineer trained, there should be around 10 technicians who can operate the machinery and ensure its maintenance.

Off-Grid infrastructure provision and Village Initiatives

Ochieng Chisestom, KIS

To alleviate some of the persistent infrastructural constraints in Kalangala District, Uganda a multi-sectoral initiative was initiated as a public-private-partnership (PPP) in 2006. The Kalangala Infrastructure Services (KIS) Limited is an infrastructure company with the mandate to provide a number of services to residents of the district including:

- construction and operation of two ferries for passengers and vehicles;
- upgrading the main road of Bugala island;
- establishing water supply system to the main town and surrounding areas; and
- establishing electricity supply through a 1.6 MW hybrid power generation system.

The hybrid power generation system is capable of generating 1 MW through thermal sources while 600 kW can be generated using solar energy. The power plant operates independently of the national grid and KIS has developed the distribution network across Bugala Island. The project aims to supply electricity to remote parts of the island and to promote economic development and improve the lives of those based in areas where there is no access to electricity. A positive impact of electrification on the island is that the number of productive hours in the day has increased. Access to electricity has enabled local processing of staple crops such as rice and maize. Ability to process these commodities locally has led to a reduction in the price of these commodities. As fishing is one of the main economic activities on the island, access to electricity is likely to have a positive impact on the income of fishermen as they will be able

to preserve their catch for a longer period of time and consequently receive higher returns. It is also expected that tourism to the island will receive a boost as a result of the island's electrification and its improved access to the mainland.

Ochieng Chisestom, the Operations Manager, Electrical at the KIS, stated that within five months of operations, there are 1800 customers that have been connected to the system against a full year target of 2000 customers. These customers are based in 90 villages across the island. The vast majority of the consumers are households (1779), with commercial (20) and industrial (1) customers accounting for the rest. The ability to generate electricity using both thermal and solar sources means that in the day time, electricity is generated entirely from solar energy. As demand from households is low in the day time, electricity is supplied to pumping stations where 5 pumps are in operation supplying clean water throughout the island. Maximum demand currently is 350 kW with one customer alone (the palm oil mill) accounting for 30% of the demand. In future, KIS aims to expand the distribution network to the remaining Kalangala islands and the company has been granted an operating license for 25 years.

There are a number of challenges that face the electricity generation and distribution business of KIS. The high initial cost of connection and the low ability of consumers to pay mean that credit mechanisms have to be developed. There is a threat of power theft which could increase system losses. There are also problems of political interference as local politicians try to influence the company to provide electricity to preferred households. There are design flaws in the project including poor drainage for excess water and ventilation which can affect the working of solar PV cells. While it is early in the project, a lack of demand means that the power plant works below capacity. As KIS is

an integrated company working in other infrastructure areas as well, it can cluster services, however, in the long term demand has to be augmented through development of industrial enterprises in the island. Availability of skilled human capital on the islands is a constraint that is being faced by the company and they have to bring in people to run the plant from other parts of Uganda.

There are different ways to deal with some of these challenges. To curb theft and increase electricity consumption, it is important to sensitise the community and ensure continued engagement with stakeholders. This is why KIS has an entire department to engage with the local community and involve them in various activities. Sponsors of medium scale off-grid projects need to ensure that they use innovative business models that are in-sync with the local economic conditions. This is why the tariff rate for KIS is lower than that recommended based on the limited capability of local people to pay.

Keynote Speech: Smart Village Projects from a Tanzanian Perspective,
Livinus Manyanga, Kakute

Kakute is one of the oldest social enterprises in the country and has a long history of working on renewable energy projects including biofuel projects. The company was one of the founding members of the Tanzania Renewable Energy Association (TAREA), a lobbying association that is tasked with promoting renewable energy use in Tanzania. Apart from lobbying activities, the Association also develops and enforces standards of performance and code of conduct for those working in the renewable energy sector in the country. Market development for new renewable energy technologies and research activities also fall in the purview of TAREA's core activities.

Tanzania has abundant natural resources to develop a renewable energy sector. At the

government level, there has been increasing interest in developing the sector further. This is because promoting renewables is seen as a means of addressing the lack of access to energy for a majority of the population, especially those based in rural areas. At present, 36% of the population in the country has access to electricity with 24% of households connected to the grid. To promote rural electrification in the country and to regulate the sector, the government formed the Renewable Energy Authority (REA). The implementation of the REA Programme for rural electrification has seen rural connectivity levels increase from 2% in 2007 to 7% in 2013.

There are however, multiple challenges to disseminating these technologies especially in rural areas. These include:

- difficult terrains and a lack of infrastructure makes the cost of rural electrification projects quite high;
- low population density in rural areas means that the cost of grid extension is usually prohibitively high;
- security of the power supply infrastructure and high compensation demand from landholders where the infrastructure has to pass;
- markets remain underdeveloped due to low buying ability and the limited technical/financial capability of local entrepreneurs to scale up businesses; and
- lack of awareness among stakeholders about the opportunities for investing in rural electrification projects.

Further elaborating on the challenges of rural energy programmes, Livinus Manyanga observed that the implementation of many

initiatives aimed at rural energy provision fail because the technologies utilised are unsustainable in the long run. Donor and NGO led projects are often successful in the short run, but once the sponsoring agencies leave, these projects also fail because of a number of different reasons.

To ensure success, there have to be local champions who can promote renewable technologies in the local communities. Initially promoting simple technologies is likely to have a higher chance of success as they are easier to maintain. These technologies need to be in-sync with the requirements of the local communities. Based on community interaction, entrepreneurs should be open to make changes to the product offered as per requirements. Adoption rates are also affected by cost considerations and how long it takes households to own the particular product.

Off-grid technologies like PLS have strong demonstrative effects and therefore, it is important to have pilot sites where people can see these technologies at work so that there is a greater chance of adoption in the wider community. The benefits have to be clearly visible to the wider community and provision of further information can also catalyse adoption. These benefits have to be disseminated through an awareness campaign which is especially true for adoption of improved cookstoves. Training local people on operation and maintenance has to be built into off-grid energy provision initiatives to ensure improved chances of success. After sales service is an important part of successful adoption strategies and consumers are less likely to adopt products where spare parts are not easily accessible. Entrepreneurs also have to continue to engage with the government and ensure that they are aware of policies and support required before they approach state functionaries.

Sustainable models of commercialisation to meet village energy needs

Gussai Sheikheldin, University of Guelph

Gussai Sheikheldin is a Doctoral candidate at the School of Environmental Design and Rural Development (SEDRD), University of Guelph. His thesis focuses on the emergence of social enterprises as agents of technology diffusion in rural Tanzania. One of his case studies is on Kakute. Access to modern forms of energy through solar PV, biodigesters and improved cookstoves are important areas of interest in his research work. Sustainable access to energy, especially across bottom-of-the pyramid communities requires the development of sustainable business models. So while there is discussion of suitable technological solutions that improve energy access, there has to be an equal emphasis on ensuring the development of sustainable models of service delivery. The best technology cannot be widely diffused without being backed by an adequate business model. There have been many such examples in developing countries in the past where the spread of renewable energy solutions has been hampered due to insufficient emphasis on long-term commercial sustainability.

Delving further into sustainability of business models, Gussai Sheikheldin talked about the importance of social enterprises as important actors in the diffusion of modern energy solutions to local communities in developing countries. Social enterprises straddle the space between non-governmental organisations (NGOs) and the private sector.

Some of the models of electricity supply through renewable energy technologies including solar PV, biogas digesters and improved cookstoves are:

- Micro-franchising: This is especially important for last-mile distribution

to poor rural communities which are excluded by traditional service delivery models. Such models are extremely effective in the distribution of small products that require minimal maintenance such as pico-solar lighting systems (PLS).

- Sector micro-enterprise cultivation: The introduction of a new renewable technology in a developing country is accompanied by a new business model to popularise the technology. Such micro-enterprises have developed especially in the case of biogas construction enterprises as part of the Tanzania Domestic Biogas Programme
- Business Technology Incubation: Incubators work with start-ups that are in nascent stages of development and provide them with institutional support and guidance to emerge as fully operational businesses. Examples of such incubation from Tanzania include the support given by Kakute to Mobisol. The access to local knowledge that Kakute had access to through years of working in the renewable energy ecosystem was invaluable for Mobisol's growth in the local market. Starting with a proto-type, through a number of different development phases, the product was adapted to local conditions before being launched commercially. This incubation model can be replicated in other East African countries as well.

In conclusion, Gussai Sheikheldin highlighted the importance of looking at the institutional factors involved in increasing access to renewable energy technologies in rural areas. In the context of rural development, innovative business models and working with people who have local expertise is necessary to ensure sustainable access to energy.



Workshop Participants

Wrap up and Recommendations

**Tayyab Safdar & Shailaja Fennell,
Smart Villages Initiative**

The workshop ended with a discussion led by Shailaja Fennell and Tayyab Safdar who thanked the participants and asked them to summarise some of the major lessons from the workshop and how they would like the discussion to be taken forward. Key points arising are summarised below.

The relationship between community & politics

The theme of local democracy and empowerment featured very strongly. Reverend Christopher urged participants to encourage their local communities not to give up hope in what was possible or to accept arguments from national politicians that change and development was not possible. Reverend Christophe noted that the leaders act as the link between communities and the outside world. “We are their voices”, he said.

Participants spoke not only of ensuring that politicians at the national and global scale

heard some local voices but that they heard all local voices. Edwin Kinyatti spoke of the importance of local traditional institutions such as village chiefs and elders in a need to “engage with the community”, not just with external institutions, politicians or government officials. This encourages collective action by participants who have real ownership of local projects, ensuring that the prime motivation is not individual benefit or monetary compensation. As a young entrepreneur, Denis Ojok urged both local and national leaders to ensure inclusion by also listening to the opinions of sometimes quieter voices – those of women and the youth.

As well as listening to all voices within their communities, Livinus Manyanga noted that the role of leadership also involved managing the relationship between local communities and regional and national politicians. In some cases, this would require development projects to evolve incrementally and quietly to avoid undue political interference, capture or obstruction. This was reiterated by Martin Kariongi who emphasised the importance of patience and faith in local capacity to achieve

positive development outcomes, rather than waiting for external assistance from donors or national politicians. “It will take years to become a smart village” but “it IS possible”. By way of example, Martin told the workshop that he spent six years trying to persuade sceptical local politicians of the need and possibility for a local radio station which he has now successfully established.

The importance of sharing communal experiences and strengthening the local voice

Blessings Chinsinga commended the workshop for providing a platform for cross-community learning. Nungari Mwangi proposed that this conversation and social learning process could be continued via the provision of an online discussion platform. Richard Sidebottom noted that facilitation of this inter-community discussion could be a key outcome of the workshop and emphasised the importance of communication between groups at local and regional levels as well as effective communication to the national and global scale in order to ensure that local voices were heard. Tayyab Safdar pointed to specific practical elements of this future discussion such as sharing of lists and experiences with potential solar lamp suppliers in China or India.

How to improve subsequent workshops and take things forward

At the end of a long second day that finished at 7pm, Shailaja Fennell closed the workshop by thanking participants not only for their efforts in attending but their “positive energy” displayed over the two days. “We came with the intention of learning what a smart village looks like” from a community perspective but stressed that this was only the first of such workshops and that the debate would be ongoing. The key aim now was to “take your voices forward” through words, pictures and film to ensure that local stories were told and successes and failures well demonstrated

at a global scale at the Kigali conference in September and other such forums.

Tayyab Safdar explained how the Smart Villages website would be updated to include the proceedings for the workshop and asked for suggestions as to how to carry the fruitful exchange of ideas forward.

Blessings Chinsinga noted that whilst the Terrat workshop had spent a great deal of time engaged in discussion of the socio-political issues of implementation, subsequent workshops should analyse the economics of alternative business models in greater detail.

Nungari Mwangi also suggested the need for greater understanding of not only the business models upon which initiatives are launched but the process by which they transition from one to another over time.

ANNEX 1: WORKSHOP PROGRAMME

Saturday, 22 August

- 0915 Welcome and Introductions**
Martin Kariongi Founder and Executive Director, IOPA
- 0945 The Smart Villages Concept**
Dr. Shailaja Fennell, Smart Villages Initiative
- 0930 The role of entrepreneurship in availing Pico-Solar Lighting Systems (PLS)**
Edward Kinyatti, Chief Executive Officer, Green Energy Africa, Kenya
- 1000 Pico-Solar Lighting Systems (PLS): Women leadership and entrepreneurship.**
Jackline Naiputa, Masaai Village Leader and Entrepreneur
- 1015 Break**
- 1045 The role of cookstoves in Kenyan village level initiatives**
Emily Bunyasi and Mary Kibui, Improved cookstoves technology experts, Improved Stoves Association of Kenya (ISAK)
- 1130 Group Discussion on Village Experiences in Energy Service Provision**
- 1200 Keynote Speech: Opportunities and Challenges of Village-Level Programmes**
Dr. Blessings Chinsinga, Centre for Social Research, Chancellor College, University of Malawi
- 1230 Lunch**
- 1330 Visit to Power Plant and Local Entrepreneurs, Terrat**
- 1500 Keynote Speech: Barefoot Grannies Initiative in Rwanda**
Colette Umurunga, Rwanda UK Goodwill Organisation (RUGO)
- 1530 The Barefoot granny experience of off-grid energy provision**
Odette Mukarumongi and Dative Mukanabana, Barefoot Grannies, Karimba Village, Rwanda
- 1615 Medical Services and Improving Skills for Renewable Energy**
Dr. Joab Wanjala and Livinus Manyanga Lerang'wa Heath Centre, Longido District and Kakute Projects Company Limited, Tanzania
- 1700 Roundtable on Village Energy Services and Skills Provision and Wrap up**
Richard Sidebottom and Nungari Mwangi, Centre of Development Studies, University of Cambridge

Sunday, 23rd August**0900 Village level energy provision in Lake Victoria**

Uganda, Reverend Christopher Walusumbi, Community Leader, Kalangala District, Victoria Falls, Uganda

1000 Biogas entrepreneurship in rural Uganda and the challenges

Ojok Denis, Uganda

1030 Tea Break**1100 Bringing Energy into village level development initiatives**

Francis Nzombe, Mwandama Millennium Villages, Malawi

1145 Keynote Speech: Access to modern forms of energy and rural development

Dr. Adam Sebbit, Department of Mechanical Engineering, University of Makerere, Kampala, Uganda

1300 Lunch**1400 Visit to the Dairy Plant, Terrat****1530 Off-Grid Infrastructure provision and Village Initiatives**

Ochieng Chisestom, Operations Manager (Electrical), Kalangala Infrastructure Service, Uganda

1615 Keynote Speech: Smart Village Projects from a Tanzanian Perspective

Livinus Manyanga, Executive Director, Kakute Projects Company Limited

1715 Sustainable models of commercialisation to meet village energy needs

Gussai H. Sheikheldin, University of Guelph, Canada

1800 Wrap up and Recommendations

Dr. Tayyab Safdar and Dr. Shailaja Fennell, Smart Villages Initiative

1900 Close

ANNEX 2: PARTICIPANTS

Name	Organisation
Dr. Blessings Chinsinga	Centre for Social Research, Chancellor College, University of Malawi
Francis Nazombe	Mwandama Millennium Village
Livinus Manyanga	Kakute Projects Company Limited
Gussai H. Sheikheldin	University of Guelph, Canada
Dr. Joab Wanjila	Lerang'wa Health Centre
Martin Kariongi	Masaai village leader and Institute for Orkonerei Pastoralists Advancement (IOPA)
Engr. Dr. Adam M. Sebbit	School of Engineering, Makerere University
Ochieng Chriseptom Runda	Kalangala Infrastructure Services Limited
Ojok Denis	Biogas Entrepreneur
Reverend Christopher Walusimbi	Community leader, Kalangala Islands
Colette Hughes	Rwanda UK Goodwill Organisation (RUGO)
Grace Mwemere	Rural Development Researcher
Odette Mukarumongi	Barefoot Grannies, Rwanda
Dative Mukanabana	Barefoot Grannies, Rwanda
Samuel Kebede Borde	Ministry of Rural Affairs
Edwin Kinyatti	CEO, Green Energy Africa
Jackline Naiputa	Masaai village leader and entrepreneur
Mary Kibui	Improved Stoves Association of Kenya (ISAK)
Emily Bunyasi	Improved Stoves Association of Kenya (ISAK)
Nungari Mwangi	Centre of Development Studies, University of Cambridge
Richard Sidebottom	Centre of Development Studies, University of Cambridge
Dr. Shailaja Fennell	Smart Villages Initiative
Dr. Tayyab Safdar	Smart Villages Initiative

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Cover: *'Toting panels on donkeys, Maasai women lead a solar revolution,'* with permission of Leopold Obi



SMART VILLAGES

New thinking for off-grid communities worldwide

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