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Changing rural economies in Tanzania following small-scale electrification: Opportunities and challenges coming with hydropower development in farmer communities

The Mawengi hydropower scheme

Report from Stakeholder Workshop held in Dar es Salaam, 6 May 2014

HELENE AHLBORG & SVERKER MOLANDER

Department of Energy and Environment
Division of Environmental System Analysis
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden, 2014
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About this publication

This workshop report has been mainly written by Helene Ahlborg, based on notes and recordings from the discussions held at the workshop and the presentations by participants. It does include slight interpretations of the statements in order to make the report more readable. Participants have had the opportunity to comment on the draft version before publication. The views presented do not necessarily reflect the group at large, as we did not strive for consensus in discussions and conclusions. Also, in the small group work, the groups sometimes held diverging opinions. Any misunderstandings or mistakes in the report are on behalf of the authors.

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Changing rural economies in Tanzania following small-scale electrification: Opportunities and challenges coming with hydropower development in farmer communities: The Mawengi hydropower scheme

Report from Stakeholder Workshop held in Dar es Salaam, 6 May 2014

The following report presents what was said during the discussion in large and small groups at the stakeholder workshop in Dar es Salaam, 6th of May 2014. The workshop was organized by ACRA-CCS Tanzania and Chalmers University of Technology, and hosted by the Rural Energy Agency (REA), at their offices in Dar es Salaam. This one-day workshop gathered stakeholders from government, universities, international and national development organizations and private sector actors, to discuss the topic of Electrification and Rural Economic Change, using the Mawengi hydropower scheme as base for discussions.

List of participants

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Victoria Mwanukuzi	Programme officer, Ministry of Finance - EDF
William Malima	Community development officer, Ludewa District

Workshop topic and initial presentations

The workshop was held as a follow-up and presentation of results from recent studies on the Mawengi hydropower scheme, Ludewa district. See power point slides for the workshop presentation. The implementation started in 2006, led by ACRA-CCS following an invitation by the Catholic diocese of Njombe.

In May 2014, the hydropower station of 300 kW supplied 7 villages and 2 sub-villages with electricity to about 1200 customers, including households, mills, workshops, schools, businesses, and health care institutions. The project displays a number of positive outcomes and improved livelihoods among local communities; and it is unique in East-Africa for its ownership and management model. The Mawengi case was used as a starting point for discussion during the workshop. The day started with an introduction to the workshop topic by Helene Ahlborg, Chalmers, followed by a presentation on the implementation of the Mawengi hydropower scheme by Alice Michelazzi, ACRA-CCS.

After explaining the background of the project, how implementation was carried out, and the state of local livelihoods, the presentation moved on to results from a recent study of the project. The study has been carried out as part of collaboration between ACRA-CCS and Chalmers University of Technology within the STEEP-RES research program. The workshop presentation focused on two important challenges for future sustainability of the hydropower system, which are also of general interest for Tanzania as a country, and many other developing countries struggling with rural electrification:

1) The *seasonality of local agricultural economy* leads to irregular incomes and a following difficulty for many households to pay monthly bills. This constrains the access of local people to electricity, which in turn hampers local economic development if not appropriately handled. This also impacts the economic viability of the community-based organization LUMAMA that is managing and owning the hydropower system.

2) The *need for environmental conservation and protection of water sources* upstream of the hydropower plant regards both the long-term conservation of the water catchment area and availability of fertile agricultural land, and the functionality of the hydropower plant. The current land use practices with farming along the riverbeds contribute to soil erosion but also provide important sources of income and food for the population.

The Mawengi case is of general importance when it comes to understanding challenges faced by rural communities in their transition from an agrarian, non-electrified subsistence economy, to a cash-economy with larger share of rural production, small-scale industry and services. Within communities, different groups in society have different abilities to benefit from electricity and poor families face particular problems. The experience of ACRA-CCS and LUMAMA offers insights on how to mitigate conflicts and achieve positive social and economic impacts in electrification projects. The integrated approach of the project and strong focus on local ownership and responsibility has created economic and social values of relevance to the local community and is an interesting example for the energy sector at large.

The presentation highlighted the complexity of these challenges and discussed them from different perspectives.

Comments from participants on presentation of findings and challenges

Following the presentation, a number of questions were asked about the Mawengi project. The following section summarizes comments made, points of interest and discussion.

Ownership and legal status:

In the legal frameworks there are many challenges associated with being an NGO compared to being a company. Problems may come when NGOs in rural areas want to enter into legal agreements. There may be a 'founder member syndrome' where founding members are not willing to leave their posts. These NGOs have been advised to have at least a dual registration of trustees among the leaders of the NGO, in order to have legal personality of the organization. *Is this a problem in the case of Mawengi?*

The legal owner of the hydropower plant and distribution system is LUMAMA, a local NGO. Ownership was transferred from ACRA-CCS to LUMAMA in 2010. LUMAMA was initially consisting of members from the villages of Lupande, Madunda and Mawengi.

Today (May 2014), this community based NGO has a formal constitution and membership base of in total about 1600 members, from each and every village and sub-village where the grid reaches, both downstream (initially) and upstream (after extension 2012-2013). Members chose their own representatives to the different organizational levels - from transformer level, to zone level, General Assembly and Board. The LUMAMA board consists of 5 LUMAMA members and 2 advisory members: one from Ludewa District and one from the diocese in Njombe. It was the local church and diocese of Njombe that took the initiative to invite ACRA-CCS to come and implement the project. Also, since the district is represented on the board of LUMAMA, in case of difficulties it is very easy for the district to intervene and give advice and directives in order for LUMAMA to be sustainable. The challenges often experienced by NGOs are not a problem for LUMAMA because of the way the constitution has been formulated.

Potential for grid-connection:

The project area is about 30 km away from the Tanesco grid in Ludewa. The national grid is currently about 60 km away. However, it is the plan of Tanesco to develop an extension line to Ludewa and it will pass very close to the villages. So in the future, it will be possible for LUMAMA to connect to the national grid and sell electricity during the night hours.

Project financing and economic approach:

The project has been totally donor funded. ACRA-CCS committed with co-funding but the money has come from various donors. The total project cost, including everything, is roughly 6 million euro. No repayment of initial investment will be done by LUMAMA.

At the time (May 2014), LUMAMA covers the operation and maintenance costs. It is in the business plan to also cover future reinvestments. In 2013-2014, the average monthly operational cost was around TZS 6.5 million and average monthly income around 6 million TZS. During this time the number of customers grew from 700 to 1200. In May 2014, the tariffs are still below the national average, and the national average is already subsidized. LUMAMA, i.e. people from the villages, has decided the tariffs. The project has just shifted to pre-paid metering at differentiated tariffs from flat tariffs for households (also

differentiated but at fixed monthly price). The VAT is not yet in place but will come in a year or so and add 18 % to the price of tariffs.

Since the workshop, the General Assembly has decided on higher tariffs (in July 2014) that will be charged from the 1st of August 2014. In the budget for 2014-2015, based on the new tariffs applied from 1st of August 2014, the average monthly cost is projected to 9.6 million TZS and the average monthly income to 11.4 million. The total yearly surplus is projected to 16 million (after investments), which partially covers the yearly depreciation cost of 57 million TZS.

For customers, the connection cost represents the main barrier. The project is since the beginning covering the cost of connections up to inside of the houses, up to the pre paid meter, further internal wiring is paid by the household owner. Only LUMAMA technicians are allowed to do the internal wiring.

The existence of a number of heavier commercial loads and other commercial customers is a result of active intervention by ACRA-CCS. A business program supports 20 local businesses to start up new income generating activities, including the provision of electric machines by grant up to a maximum of 4 million TZS. In comparison to other projects where no assistance has been given to local businesses that want to use electricity productively, the Mawengi project has a higher share of businesses, mills and workshops using electric equipment among the customers.

The challenge of seasonality:

There will be fluctuation in incomes due to economic seasonality of the agriculture, but it remains to be seen exactly how this will play out for LUMAMA incomes. Diversification of the economy and a growing number of businesses can reduce seasonality, in a more long-term perspective. Currently, the peak of demand is 200-220 kW with a daily average of 100 kW. It has grown a lot over the last two years. The system generates according to demand, the capacity is not fully used. It is expected that the introduction of pre-paid metering will change loads, and decrease use by households.

General challenges in implementing Small Power Projects (SPPs):

It takes long to complete feasibility studies, for ACRA-CCS it took more than one year. REA has been providing support to projects like ACRA-CCS to undertake their studies. Also after completing the studies and submitting the business plan it is very hard for projects to convince the banks to give capital funds. For most commercial banks they have no history of lending to SPPs, this is a new area where they need to learn. In response to this the REA with support from the World Bank (WB), has been assisting project developers to negotiate with banks.

REA, WB and Ministry of Energy and Minerals (MEM) have set up a long-term loan facility for renewable energy projects, called ICREP line facility. They have shortlisted six banks that developers can contact. United Nations Capital Development Fund (UNCDF) is undertaking a similar exercise, and maybe we can share experiences to see how in future we can assist SPPs.

Hydropower development requires hydrological studies and the minimum is one year. And 5 years to assess the water flow. It would be good if REA and MEM could take a lead and work with the National Environmental Management Council (NEMC) – who undertakes the Environmental and Social Impact Assessment, which also takes very long time. There is need for a water permit from the basin authority, and then working with Energy and Water Utilities Regulatory Authority (EWURA) and Tanesco for those who want to connect to the grid. Time and compliance are issues here. So if we want to achieve rural electrification we should work to manage the institutional weaknesses that have been hindering the good objectives of the country.

Measuring outcomes:

The audience was asked whether in their experience, Mawengi is similar or different and in what respects, from other rural electrification projects.

One difference that was brought up was the important share of income for the project that is coming from small-scale businesses in the area – primarily from the milling machines (see presentation slide 35). In many electrified villages, these productive customers, who use substantially more electricity than households, are often missing, even after 10-20 years. This is the crucial difference between Mawengi and other places.

The participants asked to see detailed numbers on the economic changes taking place in the area following electrification. However, the baseline study was done after the project had already started and the follow up will be done in August. So there is no quantitative study of impacts yet. However, some economic impacts are obvious: the price of milling was halved with the new milling machines. This benefits all families in the area. From the qualitative study, the impacts are clear and they can also be observed visually. Today there are more vehicles in the area in comparison to some years back. There are new electric machines, such as welding, sunflower oil pressing and coffee pulping machine.

Can you attribute these changes to electrification? What is because of electricity and what is because of the general spending by the project? The project must have come with capital to the area? It is very difficult to separate clearly what is due to electricity in itself and what is due to other changes, such as e.g. the change in administrative areas. Mawengi is now a township and Njombe has become a region. Ludewa has been electrified with a diesel-powered local grid managed by

TanESCO. There are many aspects to consider that can explain the development. Only some clear impacts can be seen as directly attributed, such as the lower milling prices, lower costs for lightning, schools and health centers having better services. For these reasons, there is need for a combination of quantitative and qualitative data. By talking to people you learn about casual relations. In interviews, people explain that they have made investments as a consequence of the new opportunities that they see now with electricity.

Another example of indirect benefit is the importance of new networks. The project gets visits from all over the world and they explain how this helps them with knowledge, exposure, connecting the villagers to the rest of the economy. They used to perceive themselves as very remote but now they feel connected and part of a larger society.

Reflections by participants in small groups

After the initial presentations, comments and questions, the participants moved into small group work (4-5 participants) where they discussed two sets of questions related to what could be learnt from the experience in Mawengi, and what questions that were of general importance and what could be done by actors at national level.

The groups took notes and wrote down their answers on flipcharts. The following section summarizes the contributions of the five groups for each set of questions. The style of writing below reflects the oral presentations made by the groups.

The first set of questions addressed by the groups concerned the specific case and what can be learned from it.

Lessons from the case

1. What are the key lessons, and pros and cons, from the Mawengi case so far?

Key lessons:

- The electricity has had positive impacts on the local communities, and it has been transformative, although there is need for more data to know the extent of change. But local factories and services have been improved and people get extra time in the evenings, more effective use of time and they don't need to travel to charge their phones. The positive impact is due to the external initiative coming to morph into the local community. Someone has to step in and take initiative, the communities cannot do it by themselves. It was a positive thing in this project, but can also be a negative aspect.

- The Mawengi project is donor dependent, and has required many resources in terms of time, finances and materials. A strong organization must be established and build capacity to implement such a project. It is a big project and it needs an integrated approach in order to be successful.
- There are many lessons from the project. Number one is education, education is a lesson in itself. After going through the processes there is much to learn, most importantly on the impact of the project.
- It is striking how the need for external support makes the difference in the success of a project.
- The importance of capacity building for community based organizations and the importance of community ownership.

Advantages:

- The main advantage of the project is the community ownership and participation. It is locally driven with LUMAMA being owned by the people. There is a lot of service delivery so the project objectives have been met. The project has brought capacity building, new knowledge and local employment. It is generating incomes to LUMAMA and to entrepreneurs and has developed the social infrastructure: we have the transformer groups and houses people are building. There are also improved livelihoods and some industrial development – LUMAMA is like a small industry in itself.
- The initiative came from the community. There are a lot of people ready to support, but you need to have an idea before you bring them. There have been a number of supporters bringing their ideas.
- The positive aspects are that the project provides low cost electricity to the villages. It has been environmental cautious and that is why it is still existing.

Drawbacks:

- Growing social inequalities and negative effects on the self-esteem of poor people who cannot afford to connect. Not all community members are benefitting, some are excluded because they are poor.
- The project is very donor dependent.
- Financial viability – payback in this case is more than 20 years. If you use the exchange rate of 2000 between euro and Tanzanian Shilling, the 2000 x 6 million Euros is around 12 billion Shilling. So with the current surplus of 3 million per month (being the monthly surplus in April 2014), it will take more than 300 years to pay back. But, it doesn't mean that the project is not viable. The shadow benefit should also be considered. However, it is not easy to quantify. You cannot quantify the benefits of having power for education and health services. It will be a challenge if

you take such a project to a commercial bank. Banks need to change perspective.

- Lack of clarity when it comes to future integration to the national grid.
- The issue of seasonal income generation is a limitation. As the community is isolated from other economic hubs in the country, it is vulnerable.
- The existence of this project depends on the availability of water, and there is a lack of backup when the water level is low. The future water availability is not certain.
- The problem with people farming within the water catchment area is not solved. There are various reasons why people continue farming there. Farming done on the slopes cause environmental impact with soil erosion, but there needs to be a balance between shifting people away from farming on the slopes and assessing how the power plant impacts the environment. Electricity is necessary to reduce soil erosion, to reduce deforestation. But with new infrastructure there will also be impact on the environment. Any economic development will have an impact on the environment. With a growing economy and population people will consume more. However, in rural areas people are consuming too little in comparison to people in cities and richer countries. There is a potential win-win between creating a clear economic value of preserving the water, forest and land resources upstream and achieving better livelihoods. But how to reach there?

2. Is there anything in this case that may be transferred to my own/my organization's work with rural electrification?

- Lessons to be learned for future implementations are for example the importance of having a grassroots organization like LUMAMA that is involved in ownership and maintaining the project and how they keep the assets secure and maintained.
- The manner in which tariffs were set up is a good lesson to learn from.
- It is positive with long-term projects, in Mawengi they could follow up and solve issues that arose.
- The case is instructive when future projects are to be assessed.
- The awareness on productive activities, and need for training on business ventures. The increase in productive usage of electricity is very positive. In Mawengi the businesses were there before and just because a place gets electricity it doesn't mean that businesses will be started just like that. It takes time, especially more complex uses of electricity. So for a private developer a criterion should be to look for a big customer nearby, that could contribute to the overall viability of the economy.

- The community buy-in and participation is very important – sensitization, community involvement – bringing the stakeholders together to work in this project is something we could bring back to our organizations.
- Community demand-driven projects are successful. Not only Mawengi, but for any electrification project. If you meet the demand of the community the possibility of success of the project is very high.
- Taking advantage of the national agencies that are involved in this project is quite important, in fact you have Tanesco, REA and MEM supporting this project and this is very important for the community.
- Success through coordination between different stakeholders. Different donors played different roles.
- Also supporting connection to the national grid is very important, these are ongoing efforts, in order to avoid duplication, and extension of transactional cost. This will also ensure reliability of supply of energy and generate income for the community.
- It is also the issue of ensuring environmental conservation and a sustainable water source, but it is a broad question.
- The Mawengi case is not really replicable in its business model, but the community involvement and setting of the organization that is replicable.
- It is important with awareness of Mawengi among other developers and REA should initiate field visits, so that other developers can be aware of how things can be run. This project is relevant even for financing institutions. The measuring of the effects on the population is often left out of the financial considerations, but is interesting to think about during a feasibility study.

3. What in my experience might be of relevance for the Mawengi case?

- There is no need of generation license for projects below 1 MW.
- A challenge is the lack of entrepreneurial skills. We suggest that Sido could go and train local entrepreneurs. Also to bring equipment on credit basis to make productive use possible. We see a role for Sido and similar organizations here in business training.
- The relevance of our experience for Mawengi is related to the viability of exit strategy. As ACRA-CCS is preparing to exit, they need to ensure that the exit is smooth and that the project can continue running.
- There are also other technologies than hydro, such as solar panels. It may be used for backup and for alternative sources for light. Electrification projects could also address demand for cooking and heat.
- In terms of things to develop in Mawengi, there is potential to overcome barriers due to distance for people to the office. There are technologies for mobile payment systems so as to pay bills and buy electricity. There

are also other examples of service delivery, e.g. where you get access to light in return for becoming a provider of mobile charging. Also, there are organizations coping with seasonality of consumption through internal set ups between the utility and the users so the users are allowed to buy more credit the time of the year when they have more cash availability. These are things for LUMAMA to consider and see if it is feasible for them.

General challenges and opportunities for small-scale rural electrification

The second set of questions addressed by the groups took the discussion to the national level and general relevance of the Mawengi case.

4. What aspects of the Mawengi case can be generalized and replicated in other settings?

- The question raises the issue of implementing actors. Who can be the Tanzanian entity to play the role that ACRA-CCS did? Without ACRA-CCS the project wouldn't be the same. How is the documentation done, can it be shared and made accessible to future developers?
- The entry point was very important in this case, it was the Bishop and diocese who invited ACRA-CCS to come and help them. That is almost like a local initiative and creates trust that allows the project to develop smoothly.
- External initiatives need to be balanced with local demand. If the community has nothing to do with it then it can be a problem. Demand driven is the key, but without external support it can be difficult.
- It is hard as no size fits all, but local inclusion is very important, for people to understand that this is for them and they need to be responsible and take care of it.
- The idea of infrastructure protection is interesting to replicate because we know e.g. Tanesco has been experiencing issues with security in infrastructure. The way LUMAMA has done it is something good to copy from, they have shares in the system that can help protect the system. And it will reduce a lot of cost for the government.
- The collaboration between different customers in managing loads over the day can help reduce problems with overload and blackouts. It is important to replicate.
- Having user-friendly technology is important, technology that is easy to operate and maintain but also understandable by the local community, but also that it is flexible and easy to upgrade in the long-term. Also one that is environmentally friendly.
- It is a small hydropower system and such systems can be replicated in other area. Therefore, the community involvement is of interest.

- Currently the average electrification rate in Tanzania is around 21 -22%. This means that we need more of Mawengi in other parts of the country. But in rural areas the percentage is not more than 6%. How are we going to do that? By encouraging private sector to be involved, and by involving not-for-profit organizations – we can see that Mawengi is the brainchild of the church. Through facilitation and involvement of REA and other partners.
- Areas with good renewable energy potential should to be utilized, both hydro and wind. Apart from replicating Mawengi, we can also use other energy sources.
- This model is dependent on size, it is not possible to replicate no matter what scale. Size matters both in terms of generation capacity and management. It is also dependent on location and characteristic of the population. Maybe it is easier in places where the population is denser, because of organization and management and maintenance.
- Solutions are available, it is a matter of finding the right solution for the place you want to implement.

5. What are the most important conditions for successful implementation of small-scale rural electrification schemes?

- The most important condition for small-scale energy systems we believe is the existence of heavy users in the proposed project area. Without them it is hard to bring them in later. A lot of people in these villages are not businesspeople, although they may be learning. It takes at least 1 year, maybe 10 years.
- Community awareness is an important condition for success. A participatory approach and integrated approach allow for communicating with community members and stakeholders. The environmental conservation and strong link with other government institutions, regulations, co-financing, land use planning and use of bylaws whenever necessary are important conditions.
- The use of grants is important and maybe unavoidable. If this project would have been done on a fully commercial basis and depend on the tariffs the project developers are charging now it would take ages to pay back. So we should have a hybrid model of grants and commercial investments.
- Good governance is very important, and building institutions. If the organization is run fully on NGO merits it may not be functional. We need good governance and institutionalized actors to manage the projects.
- Need for effectiveness of various actors, e.g. EWURA, REA and NEMC, and more importantly, REA should take a facilitator role in the process. You go

to seek a certain certification and it takes a year. REA can assist developers through the process.

- The first thing is availability of financing and commitment of the developer. In our group we mentioned a case where people located in Dar es Salaam are developing a scheme in Ludewa. This is the case because they are from the area and are committed to their place of origin.
- Other important things are knowledge transfer and strong community setup. These are necessary for setting up an organization such as LUMAMA.

6. What are the most important support actions? What organizations can perform them? What partnerships are needed?

- At national basis there needs to be a master plan for renewable energy projects, with standardized processes to make sure that someone coming from outside can have access to all the information on earlier projects that have already been implemented. *REA had in pipeline a renewable energy master plan. Is it coming?* REA had started developing it but it has to pass the Ministry, they are the ones to do it. Internally REA has the rural electrification business prospects developed with assistance from NORAD. It can help developers. It is a document REA can share with developers.
- A possibility is having one center for coordination and information. It is important for a project to be successful, to have all the tools you need.
- The most important support actions are about having support from all stakeholders. It is helpful the way REA is giving financial and technical support. The agreements under which Tanesco buys power are important. All the legal permits and other tools necessary for operation of similar projects are important. We also see a need for ability to solve conflicts that may arise, such as the example of Water Basin authorities providing help on land use issues.
- Support actions: License exemptions to small-scale rural electrification projects to be given by relevant government agencies, and provision of relevant documents and guidelines to developers. The organizations to perform them: REA, Tanesco, EWURA, Ministries and local government.
- The organizations can provide education on the importance of small-scale projects, providing licenses and license exemptions and establish and implement the bylaws whenever necessary to handle environmental degradation.
- There are two types of support actions: studies and compliance. A number of studies are needed for a project to be successful and legal frameworks must be complied with.

- It is important with clarity and flexibility of regulations and how they are applied. Most things are there in the law but sometimes it is difficult to see them in practice. So from a regulator point of view it is to create an environment that is conducive also for small developers.
- Public – private partnerships are necessary.

7. What management and business models can provide a viable and sustainable project (economically, technically, socially, ecologically)?

- Looking at the project overall, we come back to how the project was financed, it is quite unusual. A private person couldn't do it this way. You need to look at this in a global perspective, what happens not only in the project itself but also in the communities around it. We think the cumulative benefits outweigh the cost over time. There is an opportunity cost. But what is the proper way to go forward? What is the right hybrid model, how do you do it? We don't believe in a completely private sector driven model either. A private investor would not invest in Mawengi and expect to get his or her money back. There wouldn't be any micro-hydro if it was 100% privately owned.
- Management and business models should be joint ventures. Having private-public-partnership agreements are very important. We need both, government cannot meet all investment needs, therefore private sector and community buy-in is necessary. Transparency is very important for the public to accept the arrangements and the project. Sensitization is important before the project even starts, because if the public doesn't understand it, why would they support it? Also legal support for different management and business models needs to be retrofitted for that specific area. This leads to a comment that the importance of public acceptance is true but challenging. In Mawengi there was support from local people but the majority of people did not believe that the project was real. They thought it was “only politics” and they didn't start to believe in the project until the lights were turned on. So sometimes you cannot achieve this beforehand but have to carry on anyway and continue the construction. But upstream villages they believed in it after seeing the lights in the valley below, so it was easy to mobilize them.
- On the business model, the issue of corporate governance is very clear. We need a clear management structure and integrated resource management, i.e. a multidisciplinary team. There should be a lot of control by the beneficiaries but we need to involve many stakeholders managing the environment and infrastructure etcetera.
- Based on the Mawengi case, it is important to have a connection with local communities. And concerning the financial model, it is necessary to take

into consideration the willingness to pay, not only of monthly fees but also connection fees of the users.

Summary of large group discussion

The discussion following presentations by groups dealt with a variety of topics and gave further nuances and depth of understanding. These are summarized according to theme.

Benefits and outcomes:

There is need for capacity building and training of people, not only in Mawengi but also elsewhere. There is need to develop the mindset in terms of personal benefit. Because people say that they are not benefitting, but they do. They benefit indirectly. Also if they do not have electricity at home, they benefit from the public service.

We tend to think about benefits and cost as if they are stable and clear. But in fact they are dynamic. And some benefits are temporary. For example, there was a lady in Mawengi having lights in her small café and the first year she was having many customers and benefitting a lot. But the next year, there were two more cafés and much more competition and she was no longer benefitting from more customers. Similarly, the first milling machines will get many customers, but with many more there will not be profit. All these benefits are dynamic. And we can differ between the actual economic and social benefits, and what people perceive. Sometimes they will appreciate the public services but still feel like they do not benefit.

Another aspect of the growing economy is that electrification is leading to new houses being built. Some people move back to the village. And it shapes the urbanization of the area as people build their new house in proximity to electricity. Many Tanzanians have two houses; they have one house in Dar es Salaam and one in their home village. *So maybe people are not moving back, only building a new house?* There is in Mawengi a mixture. Part of migration is due to people who are coming back because they were not successful in town. Other people who live in town built a new house. Also among young people there are employment opportunities in the village so they don't have to move away from the village. People's mobility changes, they travel less as they have more services available locally, but they are also more connected with better communication.

The need for "anchoring loads":

There are different aspects to consider regarding some heavier loads as key customers. Isn't it more secure for an organization selling electricity in the

village to have a number of milling machines rather than relying on one local factory, e.g. a cotton factory? And is there a difference between vulnerability depending on where the end-users or customers are located? Milling machines service the local market and money circulate in the community, in the sense that both businesspeople and customers live and spend mostly locally. A factory selling to an external market may create an inflow of money, but often, factory owners live in towns rather than in the village itself, and may spend most of the profit outside of the community. However, jobs can be created locally. The external market is possibly less stable than the local market, but if something happens in the community and the purchasing power goes down, it will affect the project. (For example a very poor harvest in an entire area, leading all milling machines to have few customers) All in all, for stable income an electricity provider needs a diversity of customers with higher consumption, but also milling machines are big enough to generate substantial income and an economic base for the provider.

Economic vulnerability in an electricity-dependent economy:

The comment on lack of backup is very important. Ilskog (2011)¹ has studied the effects on the economy of Zanzibar from the serious blackouts they had some years ago. It was devastating to the local economies. When the economy becomes electricity-dependent it becomes vulnerable to blackouts. There is need to plan for backup so that local economies can be preserved in case of breakdown or temporary failure. Too foresee the risk of that is a responsibility of government at national level.

About environmental impacts:

There have been some initial reductions, before the hydropower plant there were only diesel generators in the area and many of those are now replaced.

The small power projects have been at the forefront of conserving the environment. But the environmental degradation might affect the Mawengi project if mitigation measures are not taken.

The role of NEMC and the EIA is for us to know about the environmental impact with and without the project. The assessments are done in order to reduce the potential impact and mitigate it.

¹ Ilskog, E. 2011. The Zanzibar blackout: A case study on consequences from an electricity power crisis. Conference paper. 6th Dubrovnik Conference on Sustainable Development of Energy Water and Environment Systems, Dubrovnik September 25-26, 2011

Technology transfer and capacity building:

There have been a number of technology transfer issues in Tanzania over the last 30 years. Most donor-supported projects bring technical expertise from Europe but do not take initiative to train local capacity. At times it is not very expensive to acquire technology, but the cost of maintaining and replacing it is high. Many hydropower manufacturers in China, Italy and Germany know the potential of small-scale hydro here and they are bringing their people here to lobby in order to sell their transformers and turbines. Before ACRA-CCS leaves Mawengi, please make sure you take into account the issue of technology transfer, maintenance and replacement. If you want to produce locally you need the technology and knowledge for doing so. But at least there must be training of people locally and especially in that area.

In Mawengi, the turbine, generator, transformer, and switchgears are components that an electrician coming from Mawengi could not have managed to repair in the past. But the technicians of LUMAMA have worked in the project since 6 years. They have been trained on all devices during installation. The system was designed in order to be possible to maintain and operate for people with low or medium technical expertise. There are no devices requiring very high capacity. For example, the turbine comes from Italy but it is clear for the operators of LUMAMA that they can do certain repair, but if they do not know what to do, they have to call maintenance service from Italy. It is a cost, but just a matter of including it in the budget. If there is a problem they know how to contact the manufacturer. Two months ago there was a breakdown of one transformer due to lighting. LUMAMA managed the situation by themselves, ACRA-CCS assisted only with a car. LUMAMA got in contact with the manufacturer in Arusha and went there and got it repaired under guarantee in a few days.

Further, the switchgears are ABB products with the supplier here in Dar es Salaam who maintains the gears. It is only the turbine that is from Italy. It was chosen because there were similar turbines installed in the highlands, and this company was planning to organize a small service team in Tanzania.

Discussing capacity building and involving the locals, it is also relevant to consider feasibility studies. Tanesco has been doing these for years and training their staff. When an NGO comes in and involves these engineers they can pay Tanesco half of the money charged by European consultants, and these money go into the Tanzanian economy. There are tasks at different stages that could slowly be passed on to local talents.

Final conclusions

Moderator Suzana Samson wrapped up the discussion highlighting some key points that had come out of the workshop. She emphasized the value of an

integrated approach, targeting businesses, entrepreneurial skills, improving agriculture, adding value to local products and assisting people in gaining access to the benefits of electricity. The discussion clearly showed the value of community participation. For Tanzania as a country, to make full use of available natural and human resources, there is need for public-private and community partnerships, as the government itself cannot manage to electrify the country by itself. Partnerships require good institutions, good frameworks and compliance. The Mawengi case shows how this type of a project can help strengthen institutions. The issue of environmental degradation has come out as important. It is the role of NEMC to weight the cost and benefits and find ways to lower the cost. Finally, on the issue of replication the lesson is that parts of a model – in this case the community ownership – can be replicated into other settings. We should combine components that work.

Thereafter, Professor Sverker Molander from Chalmers University of Technology reflected that a return of investment period of 300 years is really a long period. But maybe it is related to how we try to finance this kind of development and what we count as benefits. Financing and economic viability is also related to size and productive use. With more productive use of electricity investments pay off better. The workshop has also highlighted the importance of networking. Both the social networking and building of institutions, as well as networking on the technical side, that is, the importance of developing local technical networks that are Tanzanian and not relying on imported knowledge. One important group that was not represented in the workshop is the group of developers. Next time there is a workshop the developers should be among the participants as well.

Finally, Giuseppe Buscaglia from ACRA-CCS thanked the participants for the many contributions and insights that will help ACRA-CCS improve and develop their work strategies further in coming projects.