SIGMA PROJECT
Field work findings in Tanzania

E. Sawe, M. Katyega & S. Meena

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Information on visited sites

Type	Number	OP/NOP	Grid/MG	Grid/MG coexist	Private/ Public/ Community /Faith based
Hydro	4	2 OP/2 NOP	3 Grid/ 1 MG		2Pr/1 Pb/1FBO
Wind	1	1 OP	1 Grid & MG		1Pr
Biomass	2	2 OP	2 Grid		1Pr/1PPP
Diesel	1	1 OP	1 MG		1Pb
Biodiesel/ diesel	1	1 NOP	1 MG		1Pr
Solar PV	3	3 OP	3 MG		3Pr
Biomass + solar hybrid	1	1 OP	1 MG	1 Coexist	1Pr
Solar PV + diesel hybrid	2	2 OP	2 MG	2 coexist	2Pr
	15	12 OP/3 NOP	6 Grid/ 9 MG	3 coexist	11Pr/2Pb/1PPP / 1FBO

Detailed Summary of visited Minigrid

Site/ Village	Type	Region	Capacity kW	Operating status	Connection	Additional Information
Tulila	Hydro	Ruvuma	5,000	Operational	National grid	SPP + FIT with TANESCO
Chipole	Hydro	Ruvuma	400	Non-operational	Mini-grid	Earth dam failed and part of it washed away
Mwenga	Hydro	Iringa	4,000	Operational	National grid & mini-grid	Mwenga hydro and Wind integrated mini-grid
Mwenga	Wind Power	Iringa	2,400	Operational		
Kikuletwa	Hydro	Kilimanjaro	1,650	Non-operational	National grid	Plant ceased in 1989
TANWAT	Biomass	Njombe	2,500	Non-operational	National grid	Under refurbishment, Trial operations since Feb 2022
TPC	Biomass	Kilimanjaro	17,500	Operational	National grid	Plant has a single boiler.
Kibindu	Biomass gasification + solar hybrid	Coast	30kW+20kW	Operational	Mini-grid	
TANESCO	Diesel	Kigoma	6,250	Operational	Mini-grid	Solar Diesel integrated mini-grid
NextGen	Solar	Kigoma	5,000	Operational		
Leganga	Solar	Dodoma	15	Operational	Mini-grid	Community business stopped, mini-grid privatized
Ngutoto	Solar	Dodoma	15	Operational	Mini-grid	
Songambele/Kitaita	Solar + diesel hybrid	Morogoro	6kW + 10kVA	Operational	Mini-grid	Private PAYGO business model
Leshata	Solar + diesel hybrid	Morogoro	6kW + 10kVA	Operational	Mini-grid	Private PAYGO business model
Mji Mwema MFP	Biodiesel/diesel	Kilimanjaro	8.8	Non-operational	Mini-grid	Plant sold, customers now connected to national grid

Stakeholder Interviews

S/No.	Stakeholder
1	Ministry of Energy
2	Energy Regulator (EWURA)
3	Rural Energy Agency (REA)
4	Power Utility (TANESCO)
5	Mini-grid Operators
6	Households, Institutions, SMEs

Hydro based mini-grids

- During plant development the rural communities were involved and were given compensation to give way for project development and environmental aspects.
- Four visited hydro mini-grids: two are 100% locally owned, one is 20% locally owned and one is 100% foreign owned.
- Hydropower technology is robust, reliable, durable and sustainable if optimally designed, built, spare parts are availed and its environment is protected.
- Development financing is available from REF and development partners via the legal and regulatory framework in Tanzania contributes to financial sustainability of mini-grids under SPPA provided they have robust business model for O&M and revenue collection.
- Environmental education to the surrounding villagers is undertaken by water basins authorities
- Feed in tariff is technology based & is pegged to the US$.

….. Hydro continued…..

- Electrification has made rural life more comfortable, has induced employment opportunities, improved health and education services and has reduced urban to rural youths migration.
- Developers lend productive use equipment to customers i.e. milling machines, oil pressing, carpentry, welding and cooling facilities.
- Social corporate responsibility; school, health, prayer houses constructions

Challenges include:

- ❖ Many mini-grids are designed without adequate long term hydrology data and suffer from floods and droughts.
- ❖ Power supply reliability is not good during the wet season due to lightning strikes, power cuts due to line cables touching plants.
- ❖ Some of the spare parts are not available in the country.
- ❖ In faith based mini hydro grids sustainability is questionable if revenue collection is not emphasized
- ❖ Poor human activities along river valleys contribute to soil erosion and siltation of the hydro facilities
- ❖ Water conflicts caused by upstream consumptive uses in irrigation activities`
- ❖ Bush fires cause deforestation of the catchment areas
- ❖ No expertise for major maintenances (experts comes from abroad)
- ❖ Can not export to TANESCO at their full generation capacity (limited by utility) on rain season,
- ❖ Water hyacinth in some of the hydro dams, pose challenge to the inflow turbines

Wind based mini-grid

- Communities were involved, compensated for land during project development done.
- There is only one wind based mini-grid that is integrated with a mini-hydro grid thereby serving 35 villages and excess power sold to the national grid as part of the hydro based mini-grid SPPA.
- The 2.4 MW wind plant supplements the 4 MW hydro during the dry season.
- The hydro and wind integration is working well.
- SPPA and FIT regulatory framework applies.
- Potential in the area exist for additional 2x0.8 MW plant if the tariff could be renegotiated.
- Electricity is affordable via lifeline tariff.
- A business model and PAYG is employed.
- Gender is considered in operation of the plant

Challenges –

- Maintaining reliable power supply during the wet season (lighting strikes) and when wind is unavailable.
- Uncontrolled tree harvesting by villagers-affects the distribution lines

Biomass based mini-grids

- Biomass based steam engine followed by steam turbines fired by wood and bagasse date from colonial times.
- They are robust, reliable, durable and sustainable if optimally designed, built, fuel and spare parts are availed and its environment is protected.
- Wood fired plants can run the year round whereas bagasse fired plants are seasonal due to availability of fuel and also to allow plant's annual major maintenance.
- Biomass gasification technology has a challenge in maintenance of stable power supply due to availability of feed stocks and technology limitations, is often supplied as a biomass + diesel hybrid system.
- Gasifiers being small capacity mini-grids, its tariff is not regulated, as such care has to be exercised in minimizing O&M costs, revenue collection and improved customer care services
- Gender is considered in operations, committee which governs the systems

Challenges include:

- ❖ Supply reliability is low for gasifiers due to readily unavailability of feed stock and spare parts.
- ❖ There are no redundant plant components to provide 7x24 energy supply services as such it is supplemented by expensive diesel sets which also is limited to power supply during 6 -22 hours.
- ❖ Multi Function Platform biodiesel mini-grids failed due to insufficient Straight Vegetable Oil from jatropha seeds and had to be propelled by expensive diesel fuel.

Solar PV based mini-grids

- Solar PV and wind technologies' costs are going down fast, are waived from import duties and their development include land compensation to the communities.
- The technology depends on availability of day time insolation levels and hence has to be supported by enough battery storage levels or diesel or gasification plants.
- PV panels can last 20 years, battery packs 3-5 years and minimal O&M costs.
- Solar PV without storage facilities can pose challenges when integrated with diesel plants in same network due to changes in insolation levels within a day.
- Many PV minigrid are small in size and are not able to supply grain mills and other sizeable productive uses in rural areas which is contrary to communities expectations.
- Some operators have introduced cooking with high efficient electric pressure cookers to help women and girls (relief them from wood collection) and increase revenues.
- Some of the solar mini-grid operators works in other 9 African countries, and only 4-5 operators are responsible for almost all the solar mini-grids in Tanzania.
- **Challenges include:**

❖ Supply reliability is low (rain seasons/ cloudy day, spare parts are not readily available.

❖ Solar PV mini-grids being small are unregulated and therefore establish their own tariffs which tend to be a great departure from regulated tariffs.

❖ Customers complain of high tariff and sometimes non reliable power supply.; flat rate tariffs charged in community owned pose challenge on sustainability (no load limit meters)

❖ Often national grid is extended unexpectedly causing commercial uncertainty.

❖ Solar PV systems are vandalised and stolen.

❖ Grid supply into the rural areas exhibit long MV and LV lines and low supply reliability as such 3 out 6 solar mini-grids co-exist with national grid due reliability reasons.

❖ Some systems have been decommissioned; after Government directives on lowering tariffs

Stakeholder Interviews

Ministry of Energy

- MoE is responsible for policy guidance and support to sustainable and inclusive power development in the country.
- Enhance equitable power supply and energy justice.
- Ensure adequate, reliable and affordable electricity in the country.
- Encourage private sector participation and/or PPP arrangements in energy sector.
- Power system master plans should diversify energy sources and over the years reduce carbon generation technologies.

Overviews on minigrid

- High initial costs in constructions and installations of minigrid plants,
- Lack of funds & loans-developer possess licenses but cant develop sites timely
- Tariff costs is different and higher than utility, so rejected by end users
- Little awareness on productive uses/ industrial activities
- Propose for horizontal turbines to reduce investment costs in hydro plants
- Propose investors to have enough operation time to get returns (bank negotiation)
- Urge developers to follow procedures, rules/ regulations (not by-pass steps, substandard equipment)

Stakeholder Interviews contd..

EWURA

- Provision of legal and regulatory framework that will support development and operation and maintenance of energy services in the country
- Establish rules, conditions, standards and directions in the daily provision of services
- Register, license and regulate services by different suppliers to different customers
- Approve PPAs, SPPAs and tariffs/FIT for various services in the country.
- Undertake dispute resolution between energy suppliers and their customers
- Grid and mini-grid tariffs and FIT tariffs are the major challenge for the regulator
- Grid extension to existing mini-grid supply areas is another challenge despite existence of regulations for it.

Overview on Minigrid

- Political leaders can influence the sector development (due to low awareness on procedures, sizes, investment costs analysis etc)
- Emphasis on closer collaboration among actors who support MG development)

Stakeholder Interviews contd……..

RURAL ENERGY AGENCY (REA)

- Promote, stimulate, facilitate and improve modern energy access in rural areas of Tanzania Mainland in order to support economic and social development
- Promote the rational and efficient production and use of energy.
- Facilitate identification and development of improved energy projects and activities in rural areas.
- Via REF finance eligible rural energy projects
- Provide technical assistance and capacity building to project developers and rural communities

- **Challenges:**

❖ Shortage of funds to implement the electrification access projects in the country

❖ Prioritization of projects for financing and implementation

❖ Lack of personnel at local level to institute the implementation on the ground

Stakeholder Interviews contd……..

Power Utility (TANESCO)

- Generate, transmit, distribute and sale to end use customers and bulk supply to Zanzibar and Pemba islands
- Act as a single buyer from IPPs and SPPS
- Optimally operate and maintain the national grid system
- Provide efficient energy services to its customer

Challenges:

- ❖ Non cost reflective tariff for rendered services
- ❖ Fuel and currency fluctuations risks associated with the business
- ❖ Shortage of funds to implement the projects

Local Government Authorities (District Councils)

- Support developers to get land access and water rights
- No records of statistical data available to assist the developers for a right energy demand assessment at local levels.
- No staff responsible for energy issues, is not prioritized in their plans
- Previously not aware of minigrid developments (currently need to apply to President Office Local government authority

Stakeholder Interviews contd……..

Mini-grid Operators

- Generate, distribute and sale to end use customers and for SPPs bulk supply to TANESCO
- Efficient O&M of the network
- Improved customer care and services
- For VSPP set tariff that is cost reflective to the services being provided
- Abide to rules, regulations, standards applying in the industry

Challenges:

- ❖ Delayed payments for services rendered to the off-taker
- ❖ Political directions given by the government affects business
- ❖ Delays in getting feedbacks from Government authorities on tariffs review applications

General challenges in the field

- Delays in getting appointments with stakeholders
- Some of the key informants didn't want to be recorded during discussions
- Mini-grids are remotely located, bad infrastructures, long distances drives.
- Few of Minigrid operators keeps records of their operations.

What Next?

Pending Works!

- Visit mini-grids in isolated islands in the country
- Compilation of mini-grid field visit briefs
- Interview of financiers, development partners, technology suppliers