



RURAL ELECTRIFICATION EXECUTIVE SECRETARIAT (REES)

Capacity building for Off-grid rural electrification planning at the regional level in Ethiopia

FINAL REPORT

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1. INTRODUCTION

This report describes the outputs of the contract with title “**Capacity building for off-grid rural electrification planning at the regional level in Ethiopia**” financed by the **Partnership Dialogue Facility** (www.euei.org). The project duration was 9 months starting from March 2007.

As each of the eight region’s in Ethiopia is ultimately responsible for their own development and planning it is important that each of these regions become fully proficient in the application of GeoSim, the rural electrification planning tool based on the GIS software “Manifold” developed by IED during the Off-grid Rural Electrification Master Plan in 2006.

The principle objective of this project was therefore to assist the REES to enable the regional energy bureaus primarily and the cooperative and BOFED bureaus to use the master plan and the GeoSim tool for developing local electrification plans on the one hand and on the other to inform interested project champions (e.g. cooperatives, private investors) about potential investment opportunities.

The main activities carried out in this action were:

1. a two week capacity building training course on GIS and the GeoSim rural off-grid rural electrification planning tool for assigned regional experts of Energy bureaus, cooperatives and BOFED. Two to three experts from each region were invited to the training. A number of federal institutions also attended namely: Ministry of Energy & Mines, EEA, EREDPC, REES, EEPCO & Cooperatives.
2. a pilot local off-grid rural electrification plan which acted as a basis for the training of the GeoSim tool.
3. development and putting in place a data exchange methodology for institutions within the region itself and between the regional energy bureau’s and the REES.
4. follow-up mission & final installation of software in four regions : Amhara, Tigray; SNNP and Oromiya to ensure that the development of local plans are being carried out and ensure the data exchange methodology is set in place. Additional Manifold and GeoSim licenses were also requested by a number of federal institutions: Ministry of Water Resources, EEPCO, EEA and the Commission of Cooperatives.

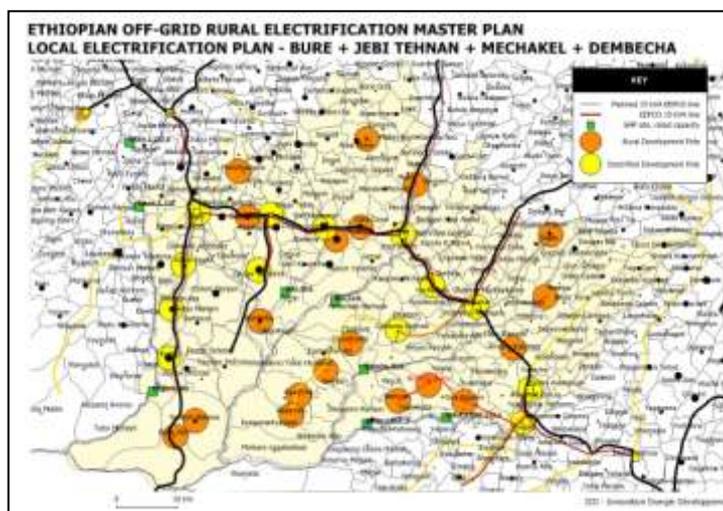
The following sections describe each of the activities.

The work was carried out by IED in close working partnership with IED’s local consultant Ato Mulugeta Ademu and the REES counterpart team.

2. PILOT LOCAL OFF-GRID RURAL ELECTRIFICATION PLAN

Two separate missions were carried out by Lara Bertarelli and Geoffroy du Crest of IED between the 26th February to the 8th March and 16th March to the 23rd March 2007, respectively, to obtain the range of inputs required to run the GeoSim tool so as to develop a pilot local off-grid rural electrification plan. This activity served to develop a full step by step methodology for developing a rural electrification plan which acted as a basis for the two week capacity building training for REES and main energy, planning and development regional stakeholders held between the 14th and 25th May 2007 in Addis Abeba (described in the next setion).

The selected pilot area was 4 adjoining worda’s - Bure, Jebi Tehnan, Dembecha and Mechakel, in West and East Gojam, Amhara with a total population of 600 000



people in an area of 3 832 km². The area was selected on the basis of its proximity to Addis Abeba, existence of more than two hydro sites, having at least 20 unelectrified rural development poles¹ and having a range of technical electrification options: grid extension and opportunities for off-grid electrification.

The specific sub-activities of this activity included:

1. Selection of the pilot area for local planning. A number of criteria for the selection of the area were agreed upon during the first mission.
2. Data collection for the pilot area:
 - (i) Identification of hydro sites in the identified area through collecting existing documents & discussions with locals
 - (ii) Topographic maps 1:50 000 of the area in question
 - (iii) Identify development poles in the area through discussions with wareda administration officials and rank them in terms of electrification priority.
 - (iv) Conduct a brief survey in each pole to obtain the following information:
 - population figures for all settlements in the pilot zone.
 - range of services available in the pilot area – schools (type), health centres (facilities), IT, drinking, road network, etc.
 - GPS points for each rural town, hydro site and industrial demand centres / potential bioenergy production points.
 - (v) Assessment of the existing electrification modes in the area
 - (vi) EEPCO grid – maps of the MV and LV lines in the area and or any plans for grid extension or substations in the area. Tally of settlements which are already electrified or which will be electrified in the near future by EEPCO.
 - (vii) Hydrological data: monthly or daily flow rates and any studies carried out on the hydro sites.
 - (viii) To carry out a SHP diagnostic in the area
3. Provide on the ground training on SHP development. Exchanging and clarifying the choices for installation for the various hydro sites visited and answering to the range of questions put forward.

The most important issues discussed were:

- (i) Preliminary fitting of the works for each visited site,
 - (ii) Principles of their location (in particular that of the power station),
 - (iii) Principles of their sizing,
 - (iv) Principles prevailing with the calculation of their stability (diversion weir),
 - (v) Optimisation of the diameters of the pressure pipes (penstocks),
 - (vi) Evaluation on maps of the watershed areas,
 - (vii) Evaluation of the water contributions to the sites starting from measured hydrological data.
4. Run the Geosim model, carry out a range of sensitivities.
 5. Preparation of a step by step guide on how to develop a local plan.

The report on the pilot local off-grid rural electrification plan is provided in Annex 1.

¹ A “pole” is a settlement which provides a range of services from education, health and economic activities thereby by nature of its services, the “pole” attracts people from neighboring or far-reaching settlements.

3. CAPACITY BUILDING TWO WEEK TRAINING COURSE

A two week training course on “GIS and GeoSim the Rural Electrification Planning Tool” was held at the Chamber of Commerce, Addis Ababa between the 14th and 25th May 2007.

The overall objective of the training course was to ensure that all eight regions:

1. Master the use of GeoSim
2. Can apply GeoSim to draw rural electrification plans
3. Can update data & exchange results

The agenda (see Annex 2) for the training therefore reflected these main objectives. The first three days focused on an introduction on GIS and Manifold wherein exercises on how to manipulate data were carried out (adding new points, polygons, lines; providing attribute data; creating new drawings; creating maps; importing data from different softwares, creating layouts and map images, etc.). An introduction to GeoSim and its structure including the parameters was presented during the thursday and friday of the first week and then applied to a concrete example of a local rural electrification plan conducted in four wereda's of Amhara between monday and wednesday of the following week wherein a concrete step by step approach was followed, so as to assist in replicating the same procedure:

Step 1: Define your study area

Step 2: Identify rural settlements (poles) & rank them

Step 3: Update & add data in your study area

Step 4: Define your demand & import tables

Step 5: Define your technical parameters + catalogues

Step 6: Define your scenario parameters

Step 7: Run Geosim

Step 8: Understanding results

Exercises and technical support were provided throughout the two weeks of the training including Saturday 19th May wherein participants were provided focused exercises applied to GeoSim. The training also provided a valuable practical opportunity to participants on how to use a Geographical Positioning System (GPS), download data and import onto Manifold.

Participants were then provided an opportunity to apply what they learned by developing a plan for a specific area of their choice.

The training focused on a real learning by doing approach. The presentations are provided in the enclosed CD-ROM.

A final presentation by REES was made to inform participants on the procedures for applying for a rural electrification loan. The role and responsibilities between the Cooperative bureau's, BOFED's and Energy Bureaus has to be clearly understood by each main stakeholder.

A total of 43 experts participated in the training from regional Energy Bureau's, Cooperatives and BOFED from Afar, Amhara, Benshangul Gumuz, Gambela, Oromiya, Somali, SNNP and Tigray. Representatives from the federal government EREDPC, REES, EEA, the Ministry of Energy and Mines and EEPKO also actively participated in the training. All showed enormous interest and dedication to understand and master the tool and thus a lot of ground was covered over the two weeks. A certificate award ceremony was carried out at the end of the two weeks awarded by Ato Asress from EREDPC and REES and the IED Consultant's. The list of participants is provided in Annex 2.

A total of 20 Manifold and GeoSim licenses were installed, and a new computer (eight computers in total) was provided to each region (with the software), one to REES and the Ministry of Energy and Mines. Participants were clearly satisfied with the training, compliments focused particularly on getting the right mix between theory and practice. One main concern expressed by representatives of Cooperative bureaus understandably expressed a desire to also have a copy of the Manifold and GeoSim programmes.

Materials provided included:

- A computer to each region + 1 for REES and 1 for MoEM
- Licenses were installed on 20 computers:
- GeoSim User Guide (electronic and hard copy)
- Geosim Methodology (electronic and hard copy)
- Copy of all Exercises (electronic and hard copy)
- Copy of all presentations (electronic and hard copy)
- Copy of all photos taken during the two week training course
- A list of participants

At the end of the two week training course the regional energy bureau's were assigned an exercise to put into practice what they learned, the selection of a study area in their Region and applying GeoSim to develop a local plan. The following mission by the IED experts would then assess the progress achieved by each region.

4. INSTALLATION OF GEOSIM IN THE REGIONS

The final mission to the four selected regions was carried out between the 7th August to the 18th August by Lara Bertarelli and Cyril Perret of IED. Their schedule was:

Training location	Dates	Trainers
Bahir Dar, Amhara	9 th to 11 th August inclusive	Cyril Perret & Eskender Akalewold
Awassa, SNNP	8 th to 11th August inclusive	Lara Bertarelli & Eyasu Chiroka
Mekele, Tigray	13th to 15th August inclusive	Cyril Perret & Eskender Akalewold
AA, Oromia	13th to 15th August inclusive	Lara Bertarelli & Eyasu Chiroka

The objectives of the mission were:

- Review the progress made on the use of the GeoSim tool and local plan exercise assigned during the training course and if required go through specificities of the training or problem areas
- Install Manifold and Geosim in one additional computer at either bureau of Cooperatives of BOFED depending on the decision of the region itself.
- Discuss & set in place the data exchange protocol.

Three days (16th, 17th and 18th August) were also dedicated for the installation of Manifold and Geosim softwares, after a special request from REES, at MoWR (1 license), EEPCo (2 licenses), EEA (1 license) and the Commission of Cooperatives (1 license). An updated version of the GeoSim tool together with an addendum on the user guide was installed in all computers. A licence for Manifold and GEOSIM was provided together with a computer to all Regional Energy Bureaus in Ethiopia during the training.

The outputs from the mission to the four regions were:

- Three experts, Ato Abera Tekle, Ato Misfin Bartiso of energy bureau and Ato Abebe of BOFED attended the 2.5 day follow-up training held within the premises of the SNNP energy bureau office in Awassa, all three had attended the two week capacity building training in Addis. The expert from the Cooperatives office unfortunately could not attend due to another prior commitment. The team had worked on a local plan, selecting a woreda as their study area which is distant from the EEPCo grid network. The area in question unfortunately has no hydro potential. The team had collected information on the settlements in the study area by asking the woreda administrator to provide information on the range and type of services provided. This data was then used to rank the settlements in order of their individual Electrification Priority Value (EPV). The SNNP settlement database was updated for this particular woreda and the team tried to run the GeoSim model but encountering some problems. We believe that the structure of the manifold SNNP database file was mistakenly altered hence the difficulty in launching the tool. All areas of difficulty were addressed and a number of exercises were carried out, repeating numerous times the range of procedures needed to successfully launch GeoSim. The SNNP has recently carried out a pre-feasibility of six micro hydro power plants,

time was therefore allocated to update their database of hydro potential and a number of simulations were run for each hydro site to assess the viability. The procedure for data exchange and update was discussed and agreed upon, the region will do its utmost to follow the procedures defined. It is believed that additional assistance and support is needed for the team in SNNP to really master the tool and fully understand the range of its functionalities. It was also noted that unfortunately the regional experts rarely use their notes from the training nor consult the geosim user guide, so we tried to highlight the importance of using these tools so as to not forget the step by step methodology, the needed layers and needed fields. It should be noted that SNNP, like Oromiya, do not have a complete settlements database – the tool is thought therefore to be of more use once the CSA has updated its national census on GIS. A license was installed in the computer of BOFED.

- Four experts: Ato Tewodros Kebede of BOFED, Ato Amensisa Tsefaye and Ato Bayisa Abalti of energy bureau, and Ato Mitiku Degefa from cooperatives attended the three day training held in the Bureau of Energy in Oromiya. With the exception of Ato Bayisa Abalti all experts attended the two week training course held in Addis in May 2007. The team had not carried out the exercise requested as the energy bureau has been undergoing restructuring and the experts did not have time to dedicate to the tool in the last two months. The training was therefore focused on identifying study areas and running the GeoSim tool and repeating the exercise multiple times over the 3 days. The group split into two teams and worked in pairs. We believe that the energy bureau has a very good understanding of the tool, its parameters and the results. The team was enthusiastic and will be updating the status of electrification data from the recent published list of electrified settlements, by EEPSCO, in 2006. Local plans were run on a range of hydro sites, the experts tried to change parameters to understand the sensitivities of the model. In addition data on the hydro potential was updated and we discussed about the data exchange protocol. We believe that the energy bureau team will require minor assistance.
- Two experts: Ato Mesafint Ayalew Gelaw and Ato Molla Melesse Alemu of energy bureau attended the two day training held in the Bureau of Energy in Bahir Dar - Amhara who participated both to the training held in Addis Ababa. The expert from the Cooperatives office unfortunately could not attend due to another prior commitment. The team worked on the assignment. So far they selected two weredas as their study area. Surveys have been carried out for 42 villages. The collected information has been updated into Manifold and the ranking achieved for all surveyed villages. Nevertheless, hydro potential data still have to be found for the selected area. The difficulties came from the GIS structure which has been modified when creating a new study area Manifold file. This structure is essential for GEOSIM to run correctly and should not be modified as described on the provided user guide. The model was consequently upgraded and the experts ran different scenarios using the collected data to improve their understanding of GEOSIM parameters and sensitivity. Manifold and GEOSIM licences have been installed at the cooperative office and an update was provided to the Bureau of energy. The experts are quite confident on the software and on GIS technology but might require minor technical assistance.
- Two experts: Ato Yared Mulu Abay of energy bureau and Ato Habtom Gebrenedhin from BOFED attended the two day training held in the Bureau of Energy in Mekele -Tigray who participated both to the training held in Addis Ababa. The expert from the Cooperatives office unfortunately was on a field mission and could not attend to the training. Detailed data have been compiled from the 1994 national survey for 47 villages on the previously identified study area. Some data on Hydro potential have been collected (mainly from a Tekeze river study) but still need to be updated because the hydro potential scale required for rural electrification is much smaller. Pole identification and ranking has been achieved. Bureau of Energy and BOFED worked very closely on the project and GIS. A very constructive synergy has been built in terms of GEOSIM understanding and GIS manipulating. Training has been focusing on running GEOSIM model, producing outputs from GEOSIM and data exchange with REES. A license was installed in the computer of BOFED.

5. DEFINITION OF MODALITIES FOR DATA EXCHANGE AND VALIDATION

The following methodology has been set up for data exchange within the region and between the Bureaus of Energy & Mines and REES.

Each individual region is responsible for drafting its own local rural electrification plans and at the same time keeping the GeoSim database up to date. Within each region it is envisaged that there will be data exchanges between the BOFED, Cooperatives, regional EEPKO office, Bureau of Water Resources and the Bureau of Energy & Mines, the latter being ultimately responsible for drafting annual electrification plans wherein economically attractive projects will be identified and the information disseminated to potential private investors or communities.

Each institution and in particular the Energy & Mines Bureau have assigned specific experts who will be responsible for this assignment. The list of assigned experts can be found in Annex 3.

A second level of data exchange is between the regional Energy & Mines bureau's and the national REES who administers the rural electrification fund, updates the national off-grid rural electrification master plan every 5 years and updates some of the economic and financial parameters needed for the GeoSim.

This methodology for both types of data exchanges: (1) within the region and (2) between the region and the REES.

Data exchange within the region: relevant Regional Bodies and the Regional Energy & Mines Bureau:

- The Regional Energy Bureau's will coordinate with BOFED, EEPKO, Bureau of Water Resources and Cooperatives to update the parameters and database made available in GeoSim for each region. Meetings between the institutions will be held at least twice a year to review the status of data collection, the outputs of the model and the implementation of projects.
- The types of data, of more importance, which should be collected on an annual basis will include:
 - Population of each settlement – data will be collected from BOFED and/or from the national statistics bureau.
 - Electrification Priority Values – for each settlement the EPV will be calculated on the basis of available infrastructure in each settlement (schools, health and economic activities) or will be given by local government administrators / BOFED.
 - Electrification status – whether settlements have been electrified or have been earmarked for electrification in the coming year – data will be collected from the regional EEPKO office on an annual basis.
 - Exact location of new and planned substations & distribution lines (MV & LV) - data will be collected from the regional EEPKO office.
 - Hydro Power potential (run of river) – information on the size, investment cost and exact location of potential micro hydro power stations will be collected from the Bureau of Water Resources and/or any other bodies which may be collecting this information.
- All updates to the database should be noted and provided together with the map file to REES.
- It is suggested that rural electrification plans be carried out for some specific study areas selected by the region itself. The outputs of this work will be provided to potential investors and rural cooperatives who may be interested in investing in the project and thus apply for a loan to REES. The rural electrification plan will also be discussed with the regional BOFED, cooperatives, Bureau of Water Resources and EEPKO office.

Data exchange between the Regional Energy & Mines Bureau and REES

- It is important to centralize at the national level the wealth of information being collected by each region. Two main data types will be collected by REES:
 - Geographic data exchange : the person in charge at the Energy & Mines Bureau of running the GeoSim model and keeping the database up to date will burn a CD-ROM with their whole map file (*.map) then simply send by mail this CD to the project officer responsible for compiling the national database at REES. This will be done twice per year and integrated into the REES national GeoSim database. The person in charge in the project at REES will have to keep track of all changes / updates made and even ask for it if some regions forget. Then the project officer at REES will have to integrate/compute all these data into the nation-wide GeoSim database. It is recommended that when the next population census comes up, that it will be the REES responsible for updating the settlements layer and then distributing to each region.
 - Projects data exchanges & map : the project officer at the regional energy & mines bureau will print the project report together with a map and send to the person in charge of the project in REES each time a plan has been approved locally.
 - GeoSim Parameters: The REES will also update and ensure that the parameters being used in the regions to run the local rural electrification plans are all within a correct range. We suggest that specific parameters are updated by the REES and they in turn will inform the regions of the updates. See Annex 4 for a set of parameters.

6. CONCLUSIONS

- The World Bank Universal Access programme has recently decided not to finance diesel based projects anymore, the GeoSim tool can therefore be used to assess the least cost option between micro hydro power development and grid connection.
- The importance of the continuation in the data updates and exchange within the region and between the regions and the REES can not be overstated. REES will need to provide continued support to regions in the use of the tool. The value of the tool and the database for the region itself and its development needs to be still fully understood by the regions.
- The success of the project will depend on whether the regions adopt the tool for their rural electrification business plan development.
- Experts involved in the project are quite motivated with the software. Huge progress have been made on GIS manipulation and the level reached is good enough for GEOSIM planning.
- Experts demonstrate good confidence on the software and a good understanding on the main issues raised and GEOSIM functionalities which will assist their work.