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Experimental impact study on a micro-grid project in Rural Madagascar: The Café Lumière project

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Experimental Impact Study on a Micro-Grid Project in Rural Madagascar: The Café Lumière Project

Supplementary material: Note on sampling and data collection

Selection of the villages

The regions of Vakinankaratra and Itasy were not only selected because of their low access to electricity but also because of their proximity and relatively easy access from the capital city, Antananarivo.

First, villages were preselected based on objective criteria, national official data and meetings with the population. The selection criteria were the following:

- distance to the national grid: 10 to 15 km)
- population: minimum of 150 households in the Fokontany center (around 750 inhabitants)
- No existing electrification plan from the national electricity company (Jirama) or any other electrification projects
- Economic potential
- Spatial rationale: idea to consider cluster of villages to ease the management by the operator
- Local motivation

Based on these preliminary criteria, a short list of 18 villages was identified.

In these 18 villages, a more detailed demand analysis was conducted to sharpen the economic potential of the village, assess the electrification needs (both productive and domestic) of the local population, as well as of the public services.

This demand analysis aimed at making sure to implement only economically sustainable electrified services in the villages.

In the end, 12 villages were considered to have a full potential to host a Café Lumière.

Out of these 12 villages, 6 were randomly selected to effectively receive a Café Lumière. The remaining 6 villages are considered as control villages.

Due to administrative, budgetary and logistic reasons, baseline data collection prior to any project implementation focused on 6 villages (2 treated and 4 controls) in May 2017. The remaining 6 villages (4 treated and 2 controls) were investigated in May 2018 (to respect seasonality of the survey and comparability of the collected data).

Table S1. List of villages

Villages	Regions	Latitude	Longitude	Status	Year of installation
Ambatonikolahy	Vakinankaratra	-19.766667	46.921111	Treated	2018
Ambohimalaza	Vakinankaratra	-19.931944	46.858611	Treated	2019
Antanamalaza	Vakinankaratra	-19.427500	47.627500	Treated	2020
Antsampandrano	Vakinankaratra	-19.545000	47.592778	Treated	2020
Amparaky	Itasy	-19.308056	46.630000	Treated	2021
Dondona	Itasy	-19.198889	46.874167	Treated	2020
Ambatoasana	Vakinankaratra	-19.341111	46.763611	Control	-
Ambatolahy	Vakinankaratra	-19.732222	47.286389	Control	-
Ambatomiady	Vakinankaratra	-19.661667	47.425556	Control	-
Anivosaha	Vakinankaratra	-19.968611	46.957222	Control	-
Fenoarivo	Vakinankaratra	-19.552222	47.250556	Control	-
Mandrosohasina	Vakinankaratra	-19.577500	47.178333	Control	-

Selection of households

A household was considered to be all the members (related or not) who “permanently” shared the same living space under the authority of a head of household. We therefore considered as members people who sleep and eat at least once a day in the accommodation when they are present in the locality.

We considered “permanently” the fact to be present for more than 6 months of the year in the household.

A sensitivity analysis coupled with time and budget constraints led us to consider a sample of 50 households per village (hence a total target sample of 600 households). Among these 50 households, 30 were randomly selected in the center of the Fokontany and 20 were randomly selected in its catchment area (any hamlets within a radius of 5 km around the Fokontany center). This stratification strategy aimed at capturing any spill-over effects within the surrounding communities.

Selection of the households of the center of the Fokontany

The choice of the 30 households surveyed in the center of the Fokontany was made randomly and stratified according to the distance from the middle of the center of the

Fokontany, so that households were distributed equitably between the different zones of the center of the Fokontany.

The itinerary method was used to select the households surveyed. It consists of defining the route followed by the investigator as follows:

1. All the investigators place themselves in the center of the Fokontany, each chooses the direction indicated by the pen that they have previously thrown into the air.
2. Each investigator moves to the limit of the center of the Fokontany following this direction. He/she counts the number of households arranged along this axis between its starting point (the middle of the center of the Fokontany) and its arrival point, the limit of the center of the Fokontany (last dwelling, see Figure S1).
3. He/she then divides the number of households counted by the number of households he/she must survey. Take the case where there are 20 households between the middle of the center of the Fokontany and the boundary and where an interviewer must interview 5 households: $20/5$ is equal to 4.
4. Starting from the limit of the center of the Fokontany where he/she is located, the interviewer goes back towards the middle and surveys the 4th household encountered. Then, he/she counts 4 again and investigates the 8th household encountered, etc. stopping when he/she has surveyed his five households.

Figure S1 illustrates by example the selection of households to be surveyed in the case where there are 3 interviewers and they each have 5 households to interview.

Interviewer A counts 14 households up to the limit of the center of the Fokontany, $14/5$ is equal to 2 in absolute value, he/she interviews every second household on the way back to the middle.

Interviewer B counts 20 households up to the boundary of the center of the Fokontany, $20/5$ equals 4. He/she surveys the 4th household, then counts 4 to the next, then 4 to the next, etc., until he has interviewed five households.

Interviewer C counts 16 households up to the limit of the center of the Fokontany, $16/5$ is equal to 3 in absolute value, he interviews the 3rd household then counts 3 until the next one.

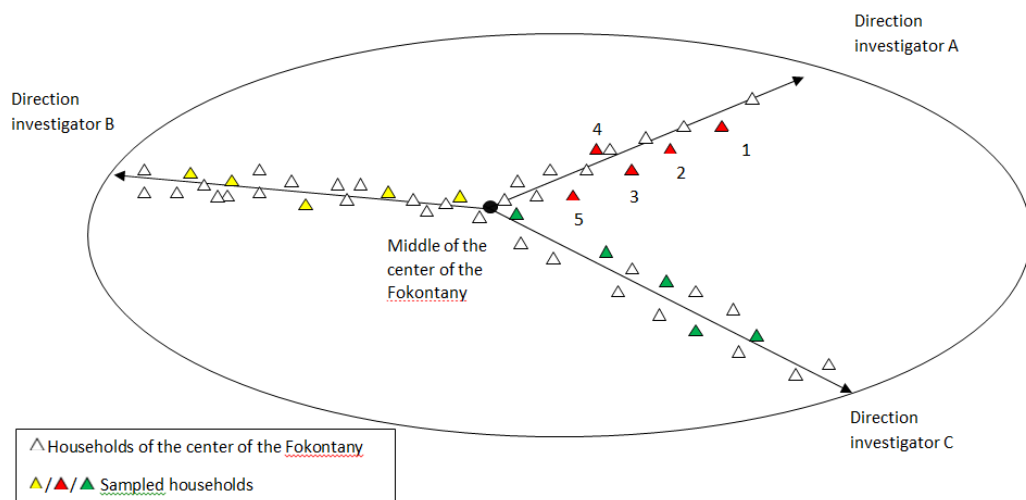


Figure S1. Itinerary method to select households in the center of the Fokontany

Selection of the households of the catchment area

As for the households in the center of the Fokontany, the choice of the 20 households surveyed in the catchment area was made randomly and stratified according to the distance from the center of the Fokontany, so that the households were distributed at different distances from the center of the Fokontany.

A preliminary mapping exercise was conducted by a FERDI cartographer prior to the baseline surveys. For each village, using satellite images, a map of the center of the Fokontany and its catchment area (5 km) highlighting habitation zones was prepared (see example below).

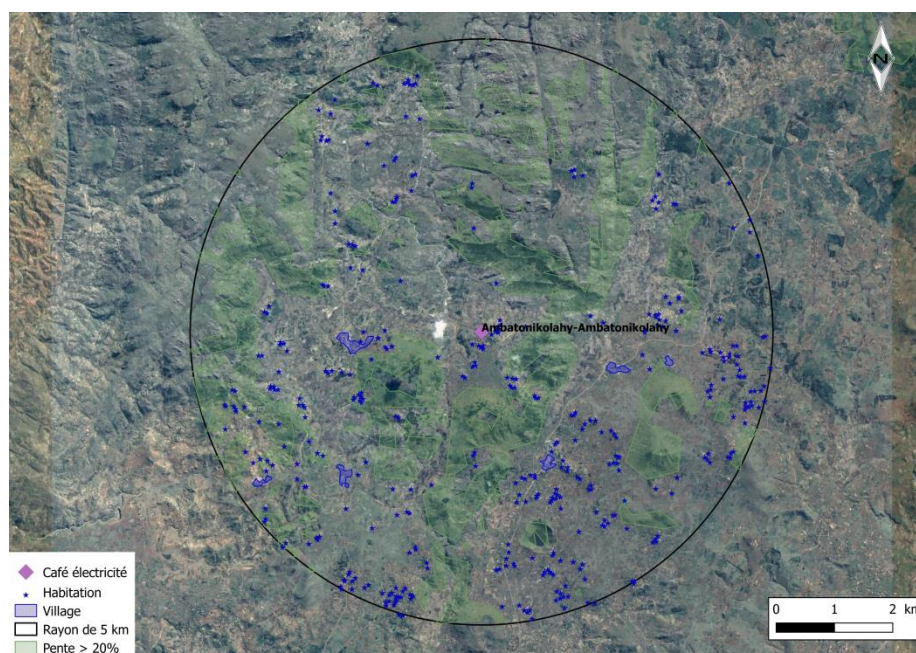


Figure S2. Map of the settlement areas of the village of Ambatonikolahy and its catchment area

Once in the village, the team of investigators validated the accuracy of these maps with the local leaders.

Then, as for the center of the Fokontany, each of the investigators randomly chose a direction marked by a road, a track or a path between the directions where they were more likely to find habitation zones at different distances from the center of the Fokontany.

For instance, for the village of Ambatonikolahy above, the North, North East directions were not considered in the random selection, since the likelihood to find settlements was limited.

Questionnaires

Household questionnaire

The household questionnaire was designed to identify and measure as many transmission channels (beneficial or harmful) of electrification by Café Lumière on the living conditions of households as possible.

For this, the questionnaire covered a wide range of the household characteristics while emphasizing the aspects directly impacted by the installation of Café Lumière: health, education and economic activity.

The questionnaire was sequenced in 5 stages:

- The head of household and/or any other member of the household likely to answer correctly were questioned about the general characteristics of the household and its members as follows:
 - **Identification** section listing all the household members with key demographic information (gender, age, relation to head of household) as well as literacy and education levels;
 - **Maternity and vaccination** section dedicated to gather information on the children below 5 years old;
 - **Education** section dedicated to all the school-aged children (5-15 years old) whether they were at school or not;
 - **Health** section listing all the household members who suffered from any diseases in the last 30 days;
 - **Housing, Land and Security** section to investigate the characteristics of the house (roof, walls, floor), its equipment (water, toilets, etc.), as well as the land use of the households and the security issues in the last 6 months;
 - **Durable goods** section listing the durable assets of the household (chair, table, bed, television, motorbike, etc.) and their cattle and farm animals;
 - **Energy** sections detailing all the domestic energy use of the households (including cooking), and the productive energy use of the households (transforming cereals and information and technology services);

- **Food consumption** section detailing the ingredients and their origins (purchase, own production etc.) of the regular meals eaten by the households in the morning, lunch and dinner times;
- The **head of household** was interviewed privately (in an isolated manner) about his personal living conditions as follows:
 - income generating activities and their revenues;
 - community and citizen life (member of community groups, participation in elections etc.);
 - savings;
 - access to credit;
 - access to information;
 - use of mobile phone;
 - personal security issues in the last 6 months;
 - timetable of a common day listing all activities from waking up to going to bed.
- The **spouse of the head of household** was interviewed privately (in an isolated manner) about her personal living conditions. The questions were the same as for the head of the household, except for some additional questions on **maternity and contraception**, as well as on the **decision-making power** within the household for different expenses;
- If the composition of the household permitted it, a **school-aged boy** (5-15 years), whether he was in school or not, was interviewed privately (in an isolated manner) about his personal living conditions (**access to information, school homework, security, consumption of meat, fish or fresh drinks, timetable**), a schooling test was also administered to him;
- If the composition of the household permitted it, a **school-aged girl** (5-15 years), whether she was in school or not, was interviewed privately (in an isolated manner) about her personal living conditions (**access to information, school homework, security, consumption of meat, fish or fresh drinks, timetable**), a schooling test was also administered to her.

At baseline, 599 households were interviewed representing 3,086 people. The following people were interviewed individually (in an isolated manner):

- 519 male head of households
- 547 women (30 being head of households and 516 being spouses to the head of households)
- 205 school-aged boys (5-15 years)
- 180 school-aged girls (5-15 years)

595 households were interviewed during the second wave of surveys. From the baseline survey 133 households were not found and were replaced by 129 new households living close to where the not found households of the baseline used to live.

In the second wave, the following people were interviewed individually (in an isolated manner):

- 527 male head of households
- 369 women (25 being head of households and 344 being spouses to the head of households)
- 214 school-aged boys (5-15 years)
- 185 school-aged girls (5-15 years)

Locality questionnaire

The locality questionnaire was intended to assess the dynamism, infrastructure, economy, etc. of the center of the Fokontany and its catchment area. It was administered to local resource people. Resource people in the locality were the president of the fokontany, the school director, the director of the health center, the teacher or any influential person who had good knowledge of the situation in their village.

The locality questionnaire was structured as follows:

- Localization, accessibility and electrification section;
- Demographic and commercial activities section;
- Community life (groups, associations etc.) section;
- External partners (present or past funded projects) section;
- Water infrastructures section;
- Education infrastructures section;
- Health infrastructures section;
- Services offered in the locality (cereal transformation, hair salon, tailor etc.) section;
- Security section listing all the security issues in the last 3 years;
- Catchment area section listing all the hamlets within a radius of 5 kilometers and their key characteristics (demographics, economic activities, infrastructures, etc.).

Questionnaire outline (french) :

Informations générales :

Identification des membres permanents du ménage

Maternité et Vaccination

Éducation

Santé

Ménages :

Logement Terre Sécurité
Statut d'occupation
Téléphone - eau – assainissement
Accès à la terre – valorisation
Sécurité
Actifs et biens durables
Energie
Sources de lumière
Combustible
Consommation Alimentaire
Services productifs
Services informatifs

Individus, homme/femme :

Religion – ethnie
Activités économiques personnelles
Vie sociale - citoyenne
Economie - pouvoir de decision
Crédit
Accès à l'information – ouverture
Téléphone
Sécurité
Emploi du temps

Individu, garçons/filles :

Général
Emploi du temps
Mathématiques
Lecture