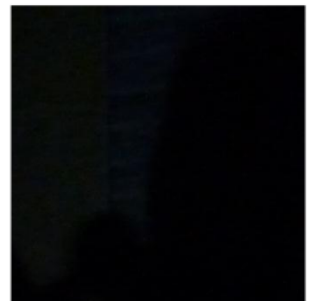




ANALYSIS OF HOUSEHOLD AND INDIVIDUAL LIGHTING CONSUMPTION IN MALI



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Photos: Villagers in eastern Mali checking out a solar lantern, March 2010, N. Stam

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List of Acronyms

AMADER	Agence Malienne pour le Développement de l'Énergie Domestique et de l'Électrification Rurale
BDS	Business Development Services
CNESOLER	Centre National d'Énergie Solaire et des Énergies Renouvelables
ECOWAS	Economic Community of West African States
DZK	Dialakoroba, Zambroula and Kokole
FCFA	Francs CFA, common currency of former French colonies in West Africa
FMCG	Fast Moving Consumer Goods
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICCO	Dutch Development Organisation with regional office in Bamako
IOM	International Organization for Migration
MFC	Mali Folkecenter Nyetaa
MFI	Micro-Finance Institution
NGO	Non-Governmental Organisation
NOTS	“Not One The Same” - Dutch Private Foundation active in Mali
PADDY	Projet d'Appui au Développement Durable de Yelimane
PCASER	Projets de Candidatures Spontanées d'Électrification Rurale
SARL	Société Anonyme de Responsabilité Limitée (Private company)
SESA	Sustainable Energy Solution for Africa
SNV	Dutch Development Organisation active in Mali
TF	Triodos Facet

Executive Summary

This report presents the outcomes of desk and field research into consumption and purchase patterns of households in peri-urban and rural villages in Mali, as related to solar lighting products. The research was carried out at the request of Lighting Africa, a joint IFC and World Bank program, in the month of June 2013. An important component of the field research was a consumer survey among 79 households in 5 different geographic locations. The information from the survey was combined with information from interviews with distributors of solar lighting products, NGOs promoting solar lighting, and retailers.

Ten different solar lighting products were identified that are currently on the market in Mali, but only three types appear to have a considerable market share. Six of these ten solar lighting products meet both the minimum quality standards and the performance targets set by Lighting Africa. The retail price range of the solar lamps ranges from USD 14 USD 150. Eight out of the 13 models we found have the option of recharging a cell phone battery in addition to the light function.

All in all, solar lamp owners were found to be quite satisfied with their lamps and several expressed interest to buy another solar lamp. The models with the additional option to charge the cell phone battery were clearly in higher demand, as cell phone usage in Mali is very high. Many multi-person households had several cell phones, and monthly expenditures of USD 10 or more per cell phone are not unusual. Each recharge of the battery in a shop costs USD 0.20, so it is not unrealistic to assume that some households spend over USD 10 per month just to recharge phone batteries. If that is added to the average expense of USD 3 per month for disposable batteries used in lanterns and flashlights, it is clear that the investment in a solar lamp with a recharging option can be recovered in 2-3 months.

Nevertheless, solar lighting products are not very common in Mali. Based on limited information obtained from the main distributors, it is unlikely that more than 100,000 solar lamps total have been sold in Mali, although there is clearly an upward trend. As many of those households that do use solar lamps have more than one, this still leaves a lot of households without connection to the electricity grid, that do not have solar lamps. Based on the assumption that there are over a million households in Mali without grid-connection, probably no more than about 5% of those households have some type of solar lighting equipment¹.

Thus, there is an apparent contradiction between, on the one hand, the clear advantages of solar lighting products both in financial and non-financial terms, and on the other hand, the relatively small percentage of households that have these products. In some cases, there may be households that can really not afford to buy a solar lamp, but there is reason to believe that this is not the main reason.

There are several constraints that can explain this contradiction:

1. There is a lack of consumer awareness on the advantages of solar lighting products.
2. There is very little market information on the availability, models, and prices of solar lamps.
3. There are very few shops in rural villages that sell solar lamps.

¹ Estimates on Mali's access to electricity rate vary, but based on various studies it's safe to assume that it's not higher than 20%. Thus, at least 12 million inhabitants are not connected to the electricity grid. Based on average household size in our sample (11), this means that 1.1 million households are not connected. Sales information from solar lamp suppliers in Mali, suggests that not more than 100,000 solar lamps have been sold. Once again, based on the average number of solar lamps per household with at least one solar lamp in our sample (1.6), this suggests that less than 60,000 households have a solar lamp, which is about 5.5% of the non-connected households.

4. Shops that stock solar lamps do not promote those products very actively.
5. There is a lack of spare parts for solar lighting products.
6. There are no technicians that have been trained to repair solar lamps.
7. Some households – in particular in rural areas – lack the cash to acquire solar lamps.
8. There is insufficient financial insight to realize the savings that can be obtained in a relatively short period by buying a solar lamp.

Two strategies may be considered to overcome the last constraint:

- a. Facilitating the purchase of solar lamps by providing credit to the buyer. This can either be done directly by the retailer, in those cases where the retailer knows the client well enough and has reason to believe that the client will pay the debt on time, or through a microcredit institution.
- b. A focused promotion campaign combined with financial education. By explaining clearly what the financial and non-financial benefits are of solar lighting, the threshold can be lowered. Some households may still need credit to be able (or willing) to purchase solar lamps, but for others it will be enough to realize how they can recoup their investment through savings on other cost categories. In some cases, a temporary reduction in their mobile phone expenses may be enough to have the cash required to buy a solar lamp.

On the whole, there is reason to believe that the market in Mali is ripe for a rapid expansion of solar lighting products. Unfortunately, the present security situation in the northern part of the country does not contribute to a very stable and promising investment climate. Nevertheless, there is still a lot of scope for expansion in other parts of the country.

Such an expansion should be accompanied by adequate follow-up services, availability of spare parts and a training program for technical repair services. Importers and distributors should promote consumer awareness of solar lighting products more aggressively. Retailers should be trained and accompanied in improving the marketing of solar lighting products in their shops.

1 Background and research methodology

1.1 Background of the assignment

Lighting Africa is a joint IFC and World Bank program that seeks to improve access to energy in the Sub-Saharan region through accelerating the development of commercial off-grid lighting markets. In Mali access to energy, and more specifically to electricity, is very limited, with only an estimated 20-25% of the country's population being connected to the grid. In rural areas this figure is substantially lower (around 5%) due to the limited availability of transport and distribution networks in these areas. Households not connected to the grid predominantly use kerosene for lighting.

To provide access to better quality and safe lighting options to households in Mali, the Lighting Africa program is intending to introduce and rollout various solar lanterns that have undergone quality testing and met LA's Minimum Quality Standards. This study aims to determine consumers' willingness to pay for these products. The study will, in turn, inform the design and market development of product deployment activities for those lanterns that have had their quality verified.

More specifically, the study will assess:

1. Consumers' expenses on individual / household lighting products and categorization of consumers in various stages of product adoption.
2. Consumers' spending on other products such as mobile telephones, including the upfront cost required to purchase the phone and the recurring costs associated with the use of the phone. The acquisition and use of mobile phones may be used as a proxy.
3. To what extent off-grid products complement grid-connected electricity services.

1.2 Research methodology

To come to an estimation of consumers' expenses on individual / household lighting products and categorization of consumers in various stages of product adoption, in line with the terms of reference, the team implemented a survey among 79 households in Mali and performed semi-structured interviews with relevant stakeholders and entrepreneurs.

Survey implementation

Desk research was performed, reviewing existing studies on market development and expenditure trends in rural energy, including solar lanterns, as well as related other relevant consumer goods such as cell phones.

Quick interviews of the energy sectors were carried out, about the assignment and available documentation on ongoing projects and program links with solar lighting products:

- AMADER
- ICCO / Shared Solar
- NOTS Foundation
- SNV

Documents that were consulted include:

- Stratégies nationales pour les énergies renouvelables
- Politique Nationale de l'Énergie

- Loi des finances portant l'exonération des produits d'énergie renouvelable
- Sustainable Energy Solution for Africa : Mali Market Entry Report (Nienke Stam, Tamara Flink, Amadou Diallo, ETC-TF, March 2010)
- Evaluation et Elaboration de Stratégies de l'Approche EASE/MFC : Appui aux operateurs PCASER (Mamadou Diallo, April 2010)
- Technical Discussion Paper on General Energy Access in the ECOWAS Region (Jan. 2012)

Data from relevant locally-based organizations, including the national bureau for statistics, mobile phone companies, and microfinance institutions was accessed, to be able to build on additional household income expenditures information. Information already available in their MIS systems (on household income, geographical location, type of housing, expenditures on airtime, sales of phones, etc.) further supported the research findings on trends in income and expenditures, as far as relevant for the market research for lanterns that have met Lighting Africa's Minimum Quality Standards.

Phase 2: Semi-structured interviews and walk-through-shop surveys

During this phase the team identified which lighting products are currently available in the market for the target group identified for solar lanterns that have met LA's Minimum Quality Standards, and gathered information on consumer trends for solar lanterns as well as comparable products. Data on comparable products will be used as a 'proxy' to assess the potential market demand for products that have had their quality verified.

Products that will be looked into as part of the study include:

- Batteries
- Battery chargers
- Torches
- Kerosene lamps
- Battery operated lamps ("lampes chinoises")
- Solar lanterns
- Solar home kits
- Mobile phones
- Phone chargers

Instead of trying to get data from national mobile phone operators, rural based mobile phone businesses were interviewed and various elements in the consumer survey were analyzed, including mobile phone expenses.

In order to gather data on current market volumes, consumer preferences and trends for solar lighting products, a series of semi-structured interviews was held, as explained below:

- Interviews with 5 importers of solar lighting products to gain insight in current market volumes, pricing levels and main markets (in terms of customer categorization as well as geographically), as well as the business model used, the type of relationship with the retailer, and the sales mechanism (cash or credit).
- Interviews with 2 PCASER mini-grid operators on tariffs, reliability, and complementary services being offered.

- Walk-through surveys conducted in 10 small shops selling solar lamps in urban and rural areas, checking on product availability, pricing and interviewing shopkeeper on (estimated) monthly turnover:
 - ✓ Bamako: 3 shops
 - ✓ Senou: 2 shops
 - ✓ Sanankoroba: 1 shop
 - ✓ Bougouni: 4 shops

Phase 3: Survey methodology and implementation

Given the limited time allocated to this study, a qualitative data collection method was conducted, combined with a more quantitative consumer survey among a sample of 79 households. To get a well-balanced perspective of the effective demand for high quality solar lanterns in peri-urban and rural areas, specific areas were selected during the inception phase of the assignment.

In order to assess to what extent off-grid products complement grid-connected electricity services, 25% of the selected sample was made up of grid-connected households. Most of the households in this subsample were located in a peri-urban area (Sénou).

A methodology of random stratified sampling to arrive at the sample of grid connected and non-grid connected, solar owning and non-solar owning, mobile phone owning and non-mobile phone owning households, in peri-urban and rural locations was proposed. Originally, the intention was to include an equal number of households with and without cell phones for the non-grid-connected households (75% of the total sample), yet in practice, it was found that nearly every household has at least one cell phone, so that idea had to be abandoned. As a matter of fact, only two households in the entire sample (one in Sanankoroba and the other in Dialakoroba) did not have a cell phone.

Due to limited time available and the lack of information from traders on the location of households that had acquired solar lamps from them, it was not possible to locate as many solar lamp owners as had been intended in the peri-urban areas. In the rural areas recipients of targeted credit schemes for solar lamps in Kokole and Zambroula could be fallen back upon. In the end, only 28% of all the households in the sample had one or more solar lamps (34% of the non-grid-connected households).

Thus, the final composition of the sample was as follows:

Table 1: Composition of the consumer survey sample

Location	Type of sample	number
Senou / peri-urban	Grid connected – non solar lamp owning	15
Senou / peri-urban	Grid connected – solar lamp owning	1
Senou / peri-urban	Non-grid-connected – solar lamp owning	3
Sanankoroba / rural	Grid connected – non solar lamp owning	3
Sanankoroba / rural	Non grid-connected – non solar lamp owning	24
Sanankoroba / rural	Non grid-connected – solar lamp owning	3
Dialakoroba / rural	Non grid-connected – non solar lamp owning	5
Dialakoroba / rural	Non grid-connected – solar lamp owning	5
Zambroula / rural	Non-grid-connected – non-solar lamp owning – phone	5
Zambroula / rural	Non grid-connected- solar lamp owning- no phone	5

Kokole / rural	Non-grid-connected – solar lamp owning	5
Kokole / rural	Non-grid-connected – non-solar lamp owning	5
Total		79

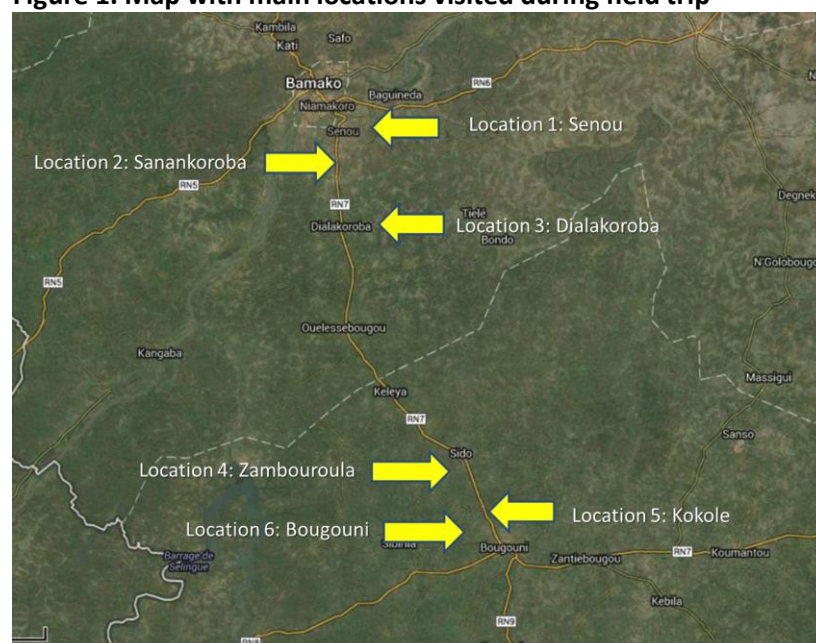
Peri-urban is defined as within a range of 25 km from Bamako, rural as more than 25 km from Bamako. Thus, Senou (15 km from Bamako) can be considered as peri-urban, whereas Sanankoroba (30 km), Dialakoroba (45 km), Zambroula (140 Km) and Kokele (155 km) as rural. (See figure 1)

Total interviews conducted:

- 19 households in the peri-urban area of Bamako (Senou)
- 60 households in 4 different rural areas (Sanankoroba, Dialakoroba, Zambroula and Kokole)
- 19 households that had access to electricity from the main grid or a mini-grid (PCASER)
- 22 households that had at least one solar lamp
- 28 households with solar panels connected to batteries

Thus, the whole sample was drawn from villages within a radius of about 150 km to the south of Bamako, which should be taken into account when interpreting the data. Nevertheless, the households clearly represented different segments of the population in terms of income levels, main source of income and access to the electricity grid, as is seen in the next chapter.

Figure 1. Map with main locations visited during field trip



2 Lighting Market in Mali

2.1 Background on energy access and the off-grid lighting product market in Mali

An estimated 12 million Malians (80% of the total population, and 95% of the rural population) have no access to electricity from the grid². They use firewood or charcoal for cooking, candles, kerosene and oil lamps for lighting, and some households own solar panels or lanterns to meet basic energy demands such as lighting, phone charging, and powering a radio and TV. Very few households have access to a generator, which are used mostly for business purposes.

The government of Mali launched an ambitious plan in 1998 to upgrade the electricity sector in the country, including in the rural areas. This resulted in, among other things, the creation of AMADER (the National Agency for Rural Electrification) in 2003. AMADER's mission is to promote access to electricity in rural and peri-urban areas. One of the most important strategies applied by AMADER to achieve this goal is support to the so-called PCASER³ ("spontaneous candidates for rural electrification projects"), which are essentially small power plants of up to 250 KW, most of which are powered by diesel but some of which use solar panels. At present, there over 100 PCASERs distributed across the country, which each provide electricity to between 65 and 1400 households⁴.

Nevertheless, access to electricity is still very rare in the rural areas. Furthermore, even in the grid-connected urban areas, as well as in the rural areas where the PCASERs are operational, clients have to deal with power rationing (having energy for only 4 to 10 hours per day), as well as periodic blackouts. Thus, there is clearly a potential demand for alternative sources of energy for a wide range of home appliances, in particular lighting. Kerosene lamps and battery torches are traditionally the most common sources of lighting, but solar lamps are slowly but surely becoming more popular.

2.2 Description of available lighting products of the market

Mali has a vibrant market for solar lanterns. Solar lanterns have been in the market since the 1980s. One manager of AMADER remembers introducing the solar lantern in Mali in a project with Fondation des Energies pour le Monde. The project established solar lantern recharging stations, and disseminated lanterns. Lanterns at that time still suffered from many quality issues and most households in Mali opted to use solar panels combined with home batteries.

About 5-6 years ago, a second generation of solar lanterns was introduced, and there are now about 10 different brands available in Mali. Prices vary widely and can range from 3,000 to 75,000 FCFA. Likewise, the quality of the products varies widely. The table below provides some insight into types of solar lanterns and prices that were observed in the market.

² Estimates on Mali's access to electricity rate vary, but based on various studies it's safe to assume that it's not higher than 20%. Thus, at least 12 million inhabitants are not connected to the electricity grid. Based on average household size in our sample (11), this means that about 1.1 million households are not connected.

³ Programme de Candidature Spontanée pour l'Électrification Rurale

⁴ "Évaluation et Elaboration de Stratégies de l'Approche EASE/MFC: Appui aux operateurs PCASER" (M. Diallo, 2010).

Table 2: Types of solar lamps found on the market in Mali

Brand	Met LA's Minimum Quality Standards	Types	Retail Price (in USD)	Observations
Barefoot	Yes	Firefly Mobile*	24	First lamps introduced in Mali
		Firefly Family*	30	
D-Light	Yes	S-2	14	These lamps are the most common in Mali, together with Barefoot lamps.
		S-20	20	
		S-300*	34	
Fosera	Yes	Solar lantern*	na	Not yet sold on local market. Very strong light, compact model to use as a torch.
Green-Light	Yes	Sun King	24	Lighting Africa award winner in 2010. Very robust, but not so popular as it lacks tel. charger.
Horonya	No	Solar Lantern*	35	Strong demand for lanterns in the north, in particular from soldiers.
K-Solar	No	??	??	This local entrepreneur has developed his own solar lamp, using other components, but cannot compete with imports.
Mama-Light	No	Solar Reading Lamp	25	Lamp was developed with help from Philips.
Philips	Yes	Udaymini Solar*	90	Less than 10 units of this lamp sold, this lamp is too expensive for Mali's market.
Saituo	No	LED Lantern*	25	This lantern also offers the option of a manual charger (combined with solar panel).
Schneider	Yes	GN1 1-1 Solar kit*	150	The most expensive lamp on the market, targeting mainly Malian immigrants in France.

*) Recharging of mobile phone battery option.

2.3 Consumer trends in mobile phone segment (outside Bamako)

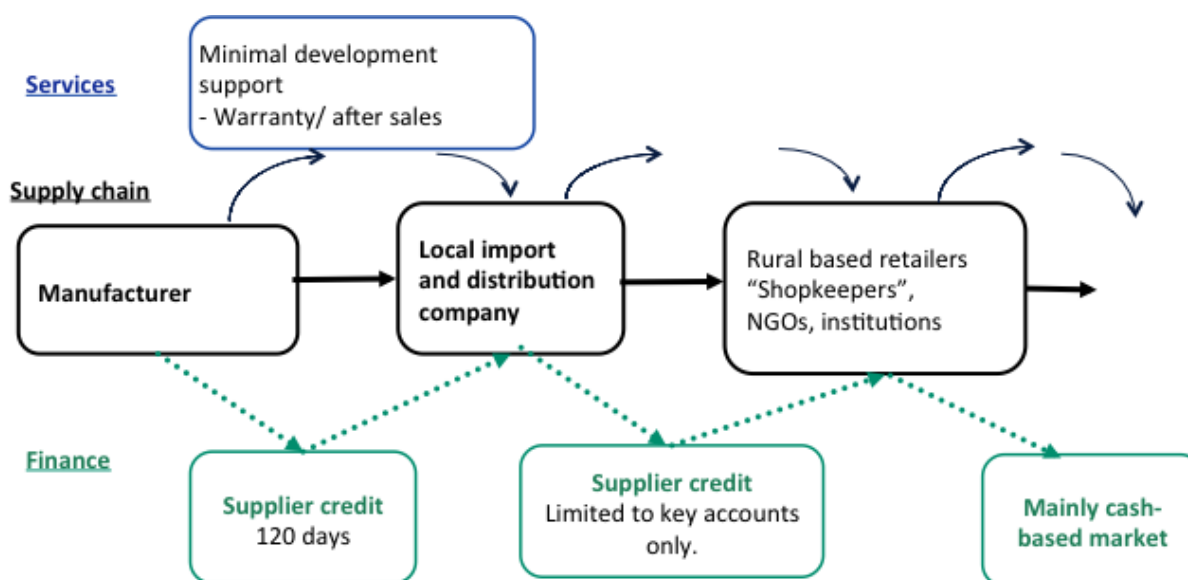
The mobile phone is to Africa what the Industrial Revolution was to Europe. The fact that very few Africans have access to the (fixed) telephone network and/or the electricity grid, makes the added value of a mobile phone in Africa much higher than in more developed countries. Add to this, the option of using mobile phones to transfer money and (in some countries) to make payments or obtain credit and it is clear that mobile phones have become practically indispensable in most African countries. Mali is no exception to this rule. Mobile phones were found in virtually all surveyed households, and expenditures on mobile phones are in the top three of household priorities (see 3.1.3).

There are two types of expenditures on mobile phones. The main expense is airtime, which, as we shall see from the survey, is an important expenditure for most households. In addition, most rural households spend money on charging the phone battery. Each recharge costs FCFA 100, and depending on the number of calls made and the quality of the battery, a phone needs to be recharged every 2-5 days. Each household in the survey spends at least FCFA 600 per month per phone on charging the battery. But with an average of 3.75 phones per household, most households in our survey spend more. Households with a multi-purpose solar lamp can save these costs. Interestingly, some small shops in the villages use solar lamps to charge mobile phone batteries, thus creating a new market opportunity for solar lamps.

2.4 Main distribution strategies of existing solar lighting companies

The most commonly used business model is based on cash sales through a network of rural traders. The figure below provides an overview of the main actors in the solar lantern supply chain and the main financial and non-financial (BDS) services that are provided in the chain. The market is characterized by limited product knowledge and little to no external financing. Organizations like the NOTS foundation (an NGO promoting solar lanterns) are making a serious attempt to develop the market and train retailers on sales skills and product quality awareness. NOTS also offers supplier's credit to their distributors, enabling them to off-take large quantities of solar lamps, for which they only need to make a down-payment of 30%.

Figure 2: Rural trader's network for solar lighting products



Box 1: Horonya Electronique

Horonya Electronique was set up by Mr. Bakary Doucouré. After starting with a clothing business, he switched to electrical products (FMCG) in the early 90s. The company started importing and distributing solar panels about 15 years ago and was also the first importer of solar lamps in Mali. Horonya trades in a wide range of energy related products from international manufacturers, as well as having recently set up its own solar module assembly plant.

Mr. Doucouré stocks a wide range of solar lanterns. During the interview, Mr. Doucouré suggested that there is a demand for bigger and stronger solar lamps, such as those which have three light bulbs. Horonya also owns a PCASER in Touba (about 120 km from Koutiala).

Several foreign development agencies and local NGOs have been actively involved in promoting the sales and use of solar lighting products in Mali. For instance, a market study was carried out in Mali in 2010 as part of the SESA program, funded by the Dutch government. Mali-Tilé has been actively promoting solar lamps and cookers through the use of remittances from Malians living in France.

Mali Folkecenter has been involved in a project that was funded by Christian Aid to develop the market for solar lamps in rural areas around Bougouni. The key actors besides MFC were:

- MFC's microfinance institution Nyetaa Finances: to provide credit to beneficiaries;
- MFC's private company Access SARL: to supply the solar lamps to the villages;
- Various women groups in selected villages: to organize and train the beneficiaries.

The lamps were stored and distributed through selling points in Bougoula, Bougouni, Garalo and Yanfolila. Clients could either buy the lamp in cash or with interest within 6 months. The total interest charged for sales on credit was 10% (flat rate). Although the project was successful in creating awareness of the advantages of solar lamps and distributing many lamps among the beneficiaries, the credit scheme suffered when some lamps turned out to have problems with the batteries, which could not be easily solved.

Box 2: Mali-Tilé SARL

Mali-Tilé is an NGO set up by Didier Delval and Soumaré Sira, who is the director of Mali-Tilé SARL in Mali. They focus on the promotion and sales of solar cookers and – to a lesser extent – solar lamps, mainly in the Kayes and Ségou regions. They have also supplied a few solar charging stations to GIZ.

Mali-Tilé's business model draws heavily on the "French connection", targeting Malian immigrants – many of whom come from the Kayes region – living in France, to invest in solar equipment for their families back home. They also work closely with women's groups and farmer cooperatives that receive support from donor agencies. They promoted their solar cookers at the "Festival in the Desert" at Tombouctou in 2011.

NOTS started importing solar lamps in 2010 and sales have been steadily increasing since.

Box 3: NOTS Foundation

The **NOTS Foundation** is an NGO from the Netherlands set up to improve the livelihoods of people in developing countries by creating, building, and investing, in social enterprises. The first country that they started to operate in is Mali, where they are involved in promoting sustainable charcoal production and the import and distribution of solar lighting products. For this purpose they set up a locally registered private company called NOTS Mali SARL.

NOTS works with distributors spread out strategically across the country. Their current network consists of 10 wholesalers. The distributors only need to pay a down payment of 30% and get credit for up to 30 days for the remaining amount. They also distribute the solar lamps through development projects, for instance collecting money from immigrants in France to buy lamps for their relatives back home, just like Mali-Tilé.

3 Consumer spending trends

3.1 Presentation of survey findings

3.1.1 Main characteristics of the households in the consumer survey

Rural families in Mali stay on a compound, called a ‘cour’. Households tend to be quite large consisting of several adults, in some cases including various wives and other members of the “extended family”. The compound generally consists of several buildings, including the main house as well as houses for each adult. There is usually no fence around it, but the back of the buildings provide some privacy.

The ‘cour’ usually consists of the following buildings:

- The *courtyard* usually has a ‘hangar’, a roofed space where people gather in the evening or where cattle are gathered during the night. The kitchen can also be found in the courtyard. Most households don’t have a separate building for the kitchen, but cook in the open air.
- The chief of the household resides in the *main house*, sometimes with some of his sons.
- Most compounds have *separate houses* for each wife and her children. A Malian man can have a maximum of three wives. Each house usually consists of two rooms.
- Occasionally, *extended family* also lives on the ‘cour’, usually in a separate building.

Concerning the lighting needs, most ‘cour’ have a light available for the following:

- In the main house, there is usually a light available in the living room. This can be a fixed light if there is grid access, a kerosene lamp, a so-called Chinese lamp (powered by batteries) or a solar lamp. If the household owns a television, it is usually located in the main house.
- There is usually a light in the courtyard to provide light to the kitchen and the ‘hangar’.
- The head of the household, as well as other family members generally have their own torch.

As mentioned above, the total sample of the consumer survey consisted of 79 households, including 19 households in the peri-urban area of Senou (15 km from Bamako) and 60 households in different rural areas: Sanankoroba, Dialakoroba, Zambroula and Kokole (30, 45, 140 and 155 km from Bamako, respectively).

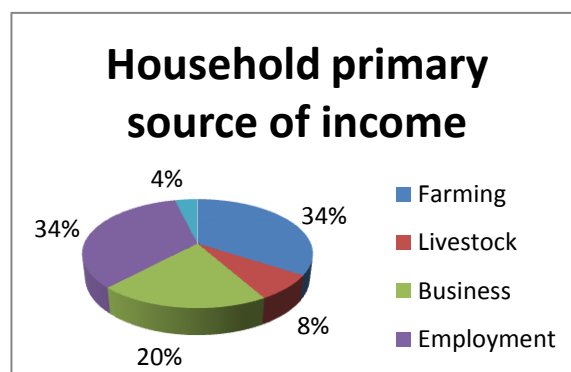
Table 3: General characteristics of the households in the survey sample

General characteristics of the head of the household	Senou		Sanankoroba		Dialakoroba, Zambroula, Kokole		Total sample	
Ave. age head of family	50 yrs		45 yrs		42 yrs		45 yrs	
Gender (male/female)	16/3	M:84%	23/7	M:77%	22/8	M:73%	61/18	M:77%
Education								
<i>No schooling/illiterate</i>	9	47%	18	60%	20	67%	47	59%
<i>Primary school</i>	2	11%	2	7%	3	10%	7	9%
<i>Secondary school</i>	6	32%	7	23%	5	17%	18	23%
<i>University</i>	2	11%	3	10%	2	7%	7	9%
Occupation								
<i>Agriculture</i>	1	5%	14	47%	24	80%	39	49%
<i>Livestock</i>	3	16%	6	20%	10	33%	19	24%
<i>Commerce</i>	5	26%	9	30%	8	27%	22	28%
<i>Salary (paid job)</i>	10	53%	12	40%	5	17%	27	34%
<i>Self-employed</i>	6	32%	1	3%	4	13%	11	14%

Household composition								
Adult men	69	3.6	59	2.0	75	2.5	203	2.57
Adult women	67	3.5	63	2.1	75	2.5	205	2.59
Children	124	6.5	165	5.5	172	5.7	461	5.84
Total	260	13.7	287	9.6	322	10.7	869	11.00

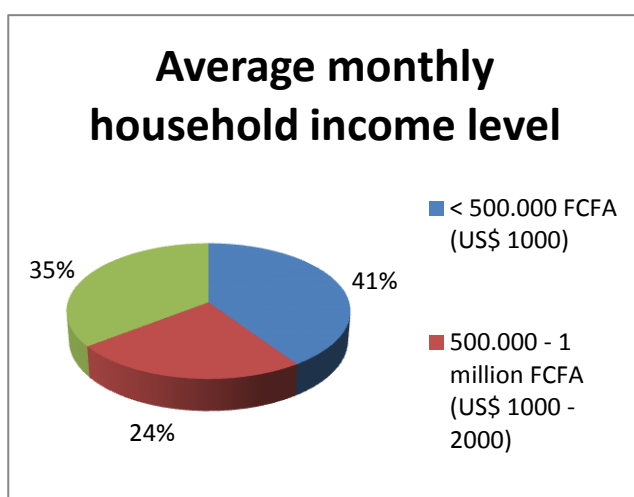
Figure 3. HH Primary Source of Income

The average size of these households was 11, roughly consisting of 2.5 male adults, 2.5 female adults and 6 children each. The interviews were conducted with the head of the household, who were mostly men (77%). The average age of the head of the household was 45 years. The education level was relatively low, with 60% being illiterate, 30% having had primary or secondary education and only 10% having had higher education.



For 42% of the households agriculture/livestock was the main source of income, for 34% it was their salary and for 20% it came from some kind of commercial activity. In the rural areas of Dialakoroba, Zambroula or Kokole, agriculture/livestock was the main source of income for 70% of the households and salaries only for 17%. Regardless of their primary income activities, about half of the households (49%) were involved in agriculture, a quarter (24%) had livestock – cows, sheep or goats – and 28% were involved in commerce.

Figure 4. Average Monthly Household Income



As for the actual amount of income, this was difficult to assess accurately as most households in Mali do not keep track of income and expenditures, in particular in the rural areas. Thus, instead of asking open questions we offered three options for their annual income:

- Households with less than FCFA 500,000 (USD 1,000) per year
- Households with FCFA 500,000–1 million (USD 1,000–2,000) per year
- Households with more than FCFA 1 million. (USD 2,000) per year

Most households (41%) were found in the lowest income bracket (A), 35% in the highest bracket (C) and 24% in the mid bracket (B). The main indicators linked to income levels were the number of household members, the location, the level of education, and to a lesser extent the gender of the head of the household (female-headed households tend to have a lower income level).

As was to be expected, there is a big difference in income levels between peri-urban and rural areas. In fact, the sample showed that the larger the distance from Bamako, the lower the average income levels. In the rural areas of Dialakoroba, Zambroula and Kokole (DZK) 50% fell in the lowest income category, whereas in Senou this was only 26% and in Sanankoroba, which is in between Senou and Dialakoroba, it was 40%.

Table 4: Annual income per household in the three different survey locations

Geographic location	< USD 1,000	USD 1,000 –2,000	> USD 2,000
Senou	26%	11%	63%
Sanankoroba	40%	27%	33%
Dialakoroba/Zambroula/Kokole	50%	30%	20%
Overall distribution	41%	24%	35%

This self-reported income information was checked against other data in the questionnaire, e.g. the livestock owned, the type and number of electrical appliances owned and monthly expenses on energy and, in particular, cell phones. In a few cases some minor corrections were made in consultation with the enumerators⁵.

Nevertheless, one should be careful when drawing the conclusion that real incomes are significantly lower in rural areas. In part the difference may be due to the smaller households in DZK than in Senou (10.7 vs. 13.7 persons p/hh on average) and in particular the lower number of adults per household in DZK than in Senou (5 vs. 7). However, these numbers were even lower in Sanankoroba (9.6 persons and 4 adults p/hh).

A more plausible explanation for the higher income levels in Senou and - to a lesser extent - Sanankoroba, may be the fact that a much higher percentage of the households in those places mention that their main source of income comes from salaries: 58% in Senou and 34% in Sanankoroba, as opposed to only 17% in DZK. While their real income may not necessarily be that much higher, they may either be more aware of their income level or are more integrated into the cash economy.

Rather than on income, rural households tend to depend more on their own produce and what they can obtain from trade with their neighbors or from the surrounding area for free. This is perhaps best illustrated by the amount of money they spend on firewood/charcoal, which is negligible in Dialaroroba, Zambroula & Kokole (FCFA 1,500 per hh on average) and less than half as much in Sanankoroba (FCFA 4,683 per hh) than in Senou (over FCFA 10,000). There is no reason to assume that households in Senou do a lot more cooking, so the most likely explanation is that the rural households obtain firewood/charcoal free of charge. In fact, 70% of the households in DZK mentioned that they do not buy any firewood/charcoal.

This is obviously an important factor to take into account when promoting solar lighting products in rural areas: the fact that due to their lower (cash) income levels, the amount of money rural households can spend on the purchase of non-essential products tends to be a lot lower than in urban or peri-urban areas. Altogether 25 out of 60 households in the rural areas estimate that their annual income is less than USD 1,000. At the same time, these same households spend a relatively high amount of money on cell phones.

3.1.2 Access to electricity and use of household lighting products

About 25% of the households in the survey sample (19 of 79) had access to electricity from the main grid or a local mini-grid (PCASER). Furthermore, 28 households had solar panels with batteries, including 5 households that were also grid-connected. The reason for this is simple: nowhere in Mali is the power guaranteed for 24 hours a day, so some kind of additional source of energy is always welcome. On average, the households that were connected to the grid had about 10.5 (out of 24) hours of electricity. There were also 5 households in the sample with access to a generator, 3 of which were also connected to the grid.

⁵ The survey was carried out in three days. At the end of each day the results were compared and discussed to fleece out unreliable data and instruct the enumerators on how to improve the data collection.

Nearly all the households in Senou (84%) were connected to the main grid, only 10% in Sanankoroba were, and none in the other villages. Most households with solar panels were found in Sanankoroba (50%), followed by DKZ. Only 5 households in Senou (26%) had solar panels, including all 3 households that were not grid-connected, 2 of which also had a generator. All 3 grid-connected households in Sanankoroba also had solar panels and 4 households had a home-battery, but no solar panels, leaving only 12 households without any source of electricity for their home appliances.

Thus, a total of 12 households in Sanankoroba and 21 households in Dialaroroba, Zambroula & Kokole, in other words nearly 42% of all the households in our sample (33 out of 79) did not have any source of electricity for electrical appliances such as a TV, DVD-player, or refrigerator. This figure matches exactly with the number of households without a TV, which seems to be the main need for electricity, besides lighting and recharging cell phone batteries.

In total, 22 households in our sample had at least one solar lamp. The average number of solar lamps per household with at least one lamp was 1.6. On the whole, solar lamp owners appear to be higher educated, are more likely to have a salary and tend to fall in a higher income category. These characteristics apply more strongly in the peri-urban area, which have not as yet been targeted by NGO's and other development projects aimed at promoting the use of solar lamps.

Table 5: Main characteristics of households with(out) solar lamps for different locations

	Gender	Education level	Occupation	Income level	Phone expenses p/mth
With solar lamp in Senou	75% men 25% woman	50% illiterate 50% university	75% salary 25% commerce	75% high 25% middle	Not specified, but probably high with an average of 6 phones per household of 8
Without solar lamp in Senou	80% men 20% woman	47% illiterate 53% prim/second	53% salary 27% commerce 20% other	60% high 7% middle 33% low	FCFA 23,000 p/hh with 5.8 phones on average per household
With solar lamp In Sanankoroba	67% men 33% woman	33% illiterate 67% secondary	67% salary 33% commerce	100% high	FCFA 37,000 p/hh, with 7 phones p/hh on ave.
Without solar lamp In S'koroba	78% men 22% woman	63% illiterate 26% prim/second 11% university	33% salary 22% commerce 44% agric/livest	26% high 30% middle 44% low	FCFA 15,000 p/hh, with 3.5 phones on average per household
With solar lamp in DZK (rural)	67% men 33% women	60% illiterate 27% prim/second 13% university	20% salary 13% commerce 67% agric/livest	20% high 40% middle 40% low	FCFA 12,500 p/hh, with 2.5 phones on average per household
Without solar lamp in DZK	80% men 20% women	73% illiterate 27% prim/second	13% salary 13% commerce 73% agric/livest	20% high 20% middle 60% low	FCFA 11,500 p/hh, with 2.6 phones on average per household
With solar lamp (full sample)	68% men 32% women	12 illiterate 6 prim/second 4 university	36% salary 18% commerce 45% agric/livest	41% high 31% middle 27% low	FCFA 15,300 p/hh, with 3.6 phones on average per household
Without solar lamp (sample)	81% men 19% women	35 illiterate 19 prim/second 3 university	33% salary 21% commerce 40% agric/livest 6% other	33% high 21% middle 46% low	FCFA 14,500 p/hh, with 3.8 phones on average per household
Overall	77% men 23% women	59% illiterate 32% prim/second 9% university	34% salary 20% commerce 42% agric/livest	35% high 24% middle 41% low	FCFA 14,750 p/hh with 3.75 phones per household (4,000 per phone)

Interestingly, there seems to be an overlap between those households that have solar lamps and those that have solar panels (connected to a home battery). Exactly half of the solar lamp owners also had solar panels, including all the (7) solar lamp owners in Senou and Sanankoroba. Another correlation that stands out is the fact that all the (7) university graduates in the sample had solar panels, thus representing 25% of all the solar panel owners (whereas only 9% of the sample has a university degree). This is compatible with what would have been expected, though probably not statistically significant.

The observation that solar lamp owners (i) appear to be higher educated than average, (ii) are more likely to have a salary and (iii) tend to fall in a higher income category, may be useful to bear in mind when developing a marketing strategy to promote the sales of solar lamps in Mali. Building awareness of solar lamps through marketing campaigns in secondary schools and higher education institutions seems like a good strategy to start off with. Financial education to explain the economics of solar lighting to poor, uneducated families in rural areas would also help to develop market demand for solar lamps.

Women-led households also seem to be slightly more likely to have solar lamps, though this outcome may be biased due to the focus on two villages that were part of the Christian Aid project to promote access to solar lamps through the link with a credit scheme managed by the MFC Nyetaa, which targeted specifically members of women co-operatives. Nevertheless, the percentage of women-led households with a solar lamp is also slightly higher in Senou and Sanankoroba.

3.1.3 Consumers' one-off and recurrent expenses on lighting products

Nearly all the households in the survey had at least one cell phone. 77% had at least one radio, 58% at least one TV and 33% at least one DVD-player. None of the households had a refrigerator. As was to be expected, there is a high correlation between the presence of electrical equipment in a household and being connected to the grid. Only two of the 19 households that had a grid connection did not have a TV and 13 (68 %) also had a DVD player. Nearly all the other (non-grid connected) households with a TV had solar panels and/or a battery⁶.

The main type of (non-grid connected) lamp in use in the sample of 79 households was the simple torch / flashlight with disposable batteries. Around 90% of all the households (71) had such a torch, and there were over 3 torches per household on average. About half of the households (39) had a "lampe chinoise" and less than 30% (22) had one or more solar lamps. Kerosene lamps seem to be the least popular with only 22% (17) of households owning one, and some of those are no longer being used⁷. Households with a solar lamp had an average of 1.6 of them; close to none of them were connected to the electricity grid.

As to recurring expenses for electrical and lighting equipment, these are highest in the peri-urban area of Senou where average income levels are also highest, as seen above. Monthly electricity expenses for households that have electricity vary between FCFA 1,500 and 20,000 in Senou, depending on the size of the household, with an average of about FCFA 8,500 per month (about USD 170). Average monthly expenses for (disposable) batteries in Senou are FCFA 1,200. The latter expenses are 10-50% higher in the rural areas, as was to be expected given the prevailing absence of regular electricity.

⁶ Surprisingly, there was also a household in Zambroula that had both a TV and a DVD, but no source of electricity.

⁷ Candles are even less popular. Only 4 households mentioned that they use candles for lighting.

Table 6: Selected household expenses in different locations⁸

Ave. monthly expenses per household (in FCFA)	Senou	Sanankoroba	Dialakoroba, Zambroula & Kokole	Total sample
Electricity	7,368	467	0	1,949
Cell phone	23,000	15,120	11,610	14,761
Kerosene ⁹	526	393	333	2,891
Batteries	1,200	1,330	1,827	1,491
Charcoal/firewood	10,094	4,683	1,517	4,714

An important category of recurring expenses for energy is the purchase of charcoal, which varies from FCFA 4,500 to 22,500 in Senou, with an average of about FCFA 10,000 per household per month. This is much lower in the rural areas (on average less than FCFA 5,000 per household per month), where many interviewees stated that they make their own charcoal or collect their own firewood.

Once more, the average expenses as shown in table 6 confirm what was observed above (see 3.1.1), namely that households in the (peri-)urban area, and in particular those that are connected to the electricity grid, tend to spend more money on energy and cell phones. The only category on which they spend less is that of (disposable) batteries. It is not surprising that households in rural areas tend to be more satisfied with their energy situation, as their costs are lower and they do not have to cope with regular power cuts and rationing of electricity.

All in all, it is not surprising that most households interviewed in the survey mention cell phones as their main expense category after food¹⁰. Except in Sanankoroba, where clothing scored higher than cell phone expenses, cell phones were the second category in all the locations, way ahead of energy, which was the least important category in the rural areas of Dialakoroba, Zambroula & Kokole. Interestingly, very few respondents in these locations mentioned that they would like to have a connection to the electricity grid. Most would prefer solar panels or solar lamps, which do not lead to recurring costs.

3.1.4 Consumers' spending on mobile telephones

What comes out clearly in the consumer survey is the importance of cell phones for both peri-urban and rural households. This is clear from the number of cell phones per household, as well as the amount of money each household spends on cell phones. Only 2 out of 79 households included in the survey, did not have a cell phone. On average, each household consists of 11 persons with 3.75 cell phones (nearly three times as much as the average number of radios per household)¹¹.

As mentioned above, in all the villages where the survey was carried out, except Sanankoroba, expenses on cell phones were the second most important category immediately after food; in Sanankoroba it was third after food and clothing. Although exact expenses on cell phones were difficult to ascertain, with strong variations depending on the number of cell phones and the occupation of the users, there can be no doubt that these expenses are very important and in general much higher than for energy.

All cell phone companies in Mali use the "pre-paid system". Cell phone users buy credit or air-time whenever they need it, FCFA 500-1,000 at a time. Thus, estimates of monthly charges are at

⁸ The average amounts are calculated by dividing the total amount by the number of specific observations.

⁹ Only one household in Senou mentioned these expenses; thus the figure should not be considered as representative.

¹⁰ The 6 categories from which they could choose were: food, clothing, energy, transport, farm inputs and cell phones.

¹¹ The two households that did not have a cell phone were very small: a young man alone and a couple with one child.

best approximations, as very few if any of the cell phone users know exactly how many times he/she has recharged the phone credit, let alone what the average monthly expenses amount to. Nevertheless, when comparing phone costs with income levels and other costs, the average amounts shown in table 6 appear to be realistic. If anything, some of the amounts mentioned by respondents have been reduced, when they seemed extremely high compared to other data.

Besides the expenses of “buying credit” (air-time), an important expenditure for cell phone owners in rural and off-grid areas is the recharging of the battery, which costs FCFA 100 per recharge. Considering the amount of money that is spent on air-time, even in rural areas, it stands to reason that accumulated expenditures for recharging the battery add up at the end of the month. If the battery is only recharged twice a week, this is over FCFA 10,000 per year, enough to buy a solar lamp with a built-in recharger¹². As most households have more than one cell phone (on average 3.75 phones per household in our sample), the recovery time of such an investment is actually a lot shorter than a year.

Thus, it comes as no surprise that solar lamps without a phone charge option are not in high demand, although these may be popular among households that already have another solar lamp. In general, “repeat customers” are definitely an interesting market segment, as they are already aware of the advantages of solar lighting products.

3.1.5 Findings on-off grid products and electricity services complementarity

As seen above, solar panels and solar lamps often go hand-in-hand. Awareness of solar panels and the advantages they may bring pave the way for solar lamps and vice-versa. However, solar panel and lamps are also found in households that are connected to the grid, mainly as a fall-back option during power cuts. Households that are connected to the grid have only about 10.5 hours of electricity per day, thus it makes sense to have an alternative source of power for the off-hours.

Interestingly, many of the households in the rural areas that had solar panels and/or lamps were quite satisfied with their energy situation, whereas nearly all grid-connected households complained about the unreliability of the power supply. On a scale of 1 to 3, where 1 is low and 3 is high, households in Dialakoroba, Zambroula and Kokole – none of which were grid-connected – had a satisfaction level of 1.5, whereas those in Senou (84% grid-connected) only scored 1.37. Non-grid-connected households tended to be more interested in solar panels than grid connection, in particular in villages with a high share of solar lighting products.

An interesting new market opportunity was revealed: Well-to-do residents of Bamako that have bought a plot of land as an investment for their retirement and bought a lamp for the guard who watches over their land, who started to see the benefits of solar lamps. Most of these clients have a grid connection at home in Bamako, but this does not offer them round-the-clock electricity. Some of them have started to realize the benefits of solar lamps for their homes as well and have become interested in solar panels.

Thus, the interaction between rural and urban areas can lead to a new demand for solar energy products in grid-connected areas, which had been primarily targeted at off-grid areas. Something similar may also occur when soldiers who are sent to northern Mali, become aware of solar lanterns and bring them back to their hometowns. Thus, slowly but surely, solar panels and solar energy appliances, which used to focus mainly on rural, off-grid areas are becoming mainstream consumer goods in Mali.

¹² Only one respondent - in Sanankoroba - was able (or willing) to make an estimate of how much money she spent each month on recharging the phone battery, putting it at FCFA 1,500 (=USD 3.00) or 18,000 (=USD 36) per year.

3.2 Categorization of consumers

The following target groups can be identified in Mali:

Rural households with basic income

This group includes people on a fixed salary, such as school-teachers, military personnel, medical nurses, shopkeepers and village prefects. These are the opinion leaders in the rural communities, and are most likely to be early adopters. These rural households are reached through conventional retail channels.

Small shopkeepers and street vendors

In order to keep their shops open at night, shopkeepers need light. Some mentioned the fact that customers tend to come more often if there is good lighting in the shop. Street vendors usually make use of kerosene lamps. As these do not give off a lot of light, they are not practical for preparing food. Some shopkeepers also use solar lamps for recharging cell phones.

Cash crop farmers

Important crops in Mali are mangos, cotton and millet. All three are seasonal, and thus, people working in the agricultural sector have a seasonal income. Following the harvest, farming households temporarily have more money to spend, which would make this a particularly good time to target sales activities. This target group is accessible through co-operatives and associations of farmers, but also during market days and through local kiosks and shops. Major towns in rural areas have weekly markets that attract a large number of customers from rural villages in the area, which may be targeted pro-actively.

Clients of PCASER electricity and clients in the vicinity of a PCASER mini-grid

Close to 25,000 rural homes are currently electrified through the PCASER operators. Customers pay a monthly energy bill at the local administrative office. Some PCASER operators have opened a small supplies shop next to the administrative office, where they sell high quality energy saving lights, switches, etc. Since energy services are not available 24 hours a day, clients still require a back-up light for the night. The grid rechargeable lighting products can, however, also serve this end of the market.

Many villages are out of reach of a PCASER mini-grid. The PCASER operators, that have local sales staff and a positive reputation in providing quality energy services, can sell off-grid energy solutions to these communities. Some villagers may know the PCASER operator and may have established a relationship of trust. Also, households in the vicinity of the PCASER mini-grid can be convinced of the benefits of a quality home lighting system by the PCASER enterprise.

Medical services

In villages without electricity, the clinic or maternity ward usually has a generator. However, in some villages this is not the case. This is a specific niche market, for which the sales strategy needs to target national government/NGOs. There are already a number of development agencies and private foundations that are focusing on this sector. For instance, the Gates Foundation is funding a project to install solar-powered refrigerators in rural health centers. Daniel Dembele (AfricPower) has already installed 20 such fridges. But solar panels and solar lighting systems are obviously beneficial for health clinics.

Soldiers

Because of the recent conflict in the north of Mali, many soldiers, both from the Malian military forces as well as from France and other African countries, have been mobilized to this part of the country, where electricity is extremely scarce. Some of the soldiers have bought solar lanterns to

take with them to the *brousse (the brush)*. When returning home many of them bring the lantern back with them and in some cases buy new solar appliances.

Repeat clients

An important finding from the survey is that despite the number of development projects and private initiatives to promote the use of solar lighting products, there are still many people both in rural and peri-urban areas that are unaware of solar lamps, let alone what they cost and where to buy them. Part of the problem is that not much in terms of sales effort is done by retailers. Several shops stocking solar lamps that were visited did not display the lamps prominently and in some cases the lamps were hidden from sight.

When asked why they had decided to stock solar lamps, retailers mentioned that clients had asked for them, so they bought a few but without thinking of ways to promote this new product to other clients. Most of these clients already had a solar lamp, but wanted to buy another one for themselves or their relatives. Thus, repeat clients are an important market segment, which can also promote awareness in the local community and among their friends and relatives of the advantage of solar lighting.

Some of the respondents that did not have solar lamps had no idea that there were shops in their village (e.g. in Senou and Sanankoroba) selling them, and expressed interest in buying one. Of course, that does not mean that they will all go out immediately to buy a solar lamp, but there is reason to believe that with a bit more sales effort from retailers, combined with some marketing support from wholesalers, a great deal more demand for solar lighting products may be generated.

Malian immigrants living abroad

An important group of customers that is already being targeted by some, is the Malian diaspora. According to a study by the IOM, there are over a million Malians living abroad, mainly in neighboring countries. The largest Malian communities outside Mali can be found in Côte d'Ivoire and Nigeria, but there is also a sizeable Malian community in France (about 100,000) and other European countries¹³. Many Malians living abroad send money home to their relatives. According to World Bank figures, Mali was among the top ten recipients of diaspora remittances on the African continent in 2010, with an estimated inflow of about USD 400 million¹⁴.

Another study states that “migrants from the Kayes region pour about USD 7 million a year into collective investments in their communities – almost twice the budget of the Ministry of Malians Abroad and African integration¹⁵. Although only a relatively small part of the diaspora lives in Europe, they are responsible for about 75% of Mali’s remittance receipts. In some cases Malian migrants can be instrumental in mobilizing resources from their host country. The French town of Montreuil launched a development program for Mali’s Yelimane region called PADDY (Projet d’Appui au Développement Durable de Yelimane) with a total investment of €11 million, including €5.5 million from AFD, €1.5 million from the local Malian community (estimated at 60,000) and €500,000 from the Municipality of Montreuil¹⁶.

Thus, there is huge potential to set up solar lighting projects in Mali with the support of the Malian diaspora in Europe and elsewhere by harnessing their financial resources as well as their know-how.

¹³ “The Mali Immigration Crisis at a Glance” IOM, March 2013.

¹⁴ “Are Diaspora remittances a Solution to Africa’s Underdevelopment?” World Bank, 2010.

¹⁵ “Closing the Distance: How Governments Strengthen Ties with their Diaspora”, D.R. Agunias, MPI, 2009.

¹⁶ http://www.afd.fr/home/AFD/nospartenaires/Cooperation_decentralisee/Projets_collectivites/pid/256

4 Conclusion

There is clearly a huge potential market for solar lighting products in Mali. The fact that only about 20% of the total population has access to electricity through the main grid and less than 0.5% of the rural population is connected to mini-grids (called PCASERs), suggests a large window of opportunity for solar products. Add to this the limited and unreliable supply of electricity – on average about 10 out of 24 hours – for those households that are connected to the grid plus the cost of electricity, and the case is clear-cut.

As a matter of fact it is surprising that solar lighting products are not more common in rural areas. It is hard to get exact sales data of solar lamps in Mali, but based on figures available some 60-70,000 solar lamps have been sold to date by the main distributors. Thus, it seems unlikely that more than 100,000 solar lamps have been sold all over Mali, although there is clearly an upward trend. The present conflict creates obstacles, but may also provide new business opportunities, e.g. by generating demand from soldiers.

There is no doubt that there are still a lot of households without connection to the electricity grid, that do not have solar lamps. The survey found that the 22 households that had solar lamps had an average of 1.6 lamps each. Thus, if we assume about 100,000 solar lamps have been distributed; this would only cover around 60,000 households. If we also assume that all these households are not grid-connected – which is clearly not the case – this would still only represent about 5% of the households without electricity, assuming the average household in Mali has 10 members¹⁷.

There are a few constraints that hold back a more rapid expansion of the market for solar lamps:

There is a **lack of consumer awareness**, both in peri-urban and rural areas, on the advantages of solar lighting products compared to other options, such as lamps and flashlights with (disposable) batteries. This lack of awareness ranges from basic ignorance of the notion of solar lighting to unfamiliarity with the different brands and models that are available in the market.

1. There is very **little market information** on the availability, models and prices of solar lamps, both in peri-urban and rural areas. Most of the interviewed solar lamp owners had become aware of this possibility through the involvement of a donor-funded development project. Obviously the first two points are closely related. More market information and more active marketing of solar lighting products is an essential step towards increasing consumer awareness.
2. There are **hardly any shops in rural villages** that sell solar lamps. Thus, potential clients need to travel to nearby towns to buy the lamps, which they will only do if they are aware of their benefits. Most villagers do travel to provincial towns every now and then, but they need to be informed about the advantages of solar lamps beforehand.
3. The few shops in peri-urban areas that stock solar lamps **do not promote their products** very actively, except in rare exceptions. This lack of promotion does not only apply to solar lamps, but is a general constraint of retailers in Mali, who require training and follow-up support from the importer/distributor to change their behavior.

¹⁷ We also assume 80% of the population not to be connected to the grid. With a total population of 15 million this means that 12 million or 1.2 million households are not connected to the electricity grid.

4. For some models, **batteries and other spare parts are not available in Mali**. It should be clear that the successful introduction of a (relatively) new product such as solar lamps depends on good follow-up services.
5. There are **no technicians who have been trained to repair solar lamps** or replace deficient batteries or switches. There is a radio repair man in Zambroula who can fix switches and replace batteries, but he taught himself how to do it.
6. **Lack of cash to acquire the solar lamps**, coupled with insufficient financial insight to realize the savings that can be obtained over time by buying a solar lamp, in terms of less use of batteries, less payments for recharging cell phone batteries, etc. This is mainly a short vs. long term financial issue as becomes clear when we look at the large amount of money that is spent on cell phones. Nevertheless, this may be a real issue for some households, in particular in rural areas.

Two strategies may be considered to overcome this last constraint:

- a. **Facilitating the purchase of solar lamps by providing credit to the buyer**. In principle, there is no need to involve an MFI for such a relatively small investment. Some shop-keepers may apply a credit scheme themselves when selling to clients that they know well. For instance, retailers could possibly increase the sales of their solar lamps if they were to allow clients some flexibility in paying for the lamp. Instead of charging the fixed price, they could require a down payment and additional monthly installments. The consumer would have the choice: either a lower total payment in one go or a slightly higher total payment spread out over a given period of time.
- b. Another strategy, which should go hand-in-hand with the access to finance strategy and may in some cases replace it, is **a focused promotional campaign combined with financial education**. By explaining clearly to rural households what the financial and non-financial benefits are of solar lighting, the threshold can be lowered. As we saw in our consumer survey, many rural and peri-urban households are not even aware of the existence of solar lamps, let alone the advantages that these products can have in their own situation. Some households may still need credit to be able (or willing) to purchase solar lamps, but for others a temporary reduction in their mobile phone expenses may be enough to save the cash required to buy a solar lamp.

On the whole, there is reason to believe that the market in Mali is ripe for a rapid expansion of solar lighting products. Unfortunately, the present security situation in the northern part of the country does not contribute to a very stable and promising investment climate. Nevertheless, there is still a lot of scope for expansion in the rest of the country.

Such an expansion should be accompanied by adequate follow-up services, availability of spare parts and a training program for technical repair services. Importers and distributors should promote awareness of solar lighting products more aggressively, both in (peri-)urban and rural areas. Retailers should also be trained and accompanied to improve the marketing of solar lighting products, starting very simply with a more prominent display of these products in their shops.

Annex 1: Consumer survey

I. GENERAL INFORMATION HEAD OF HOUSEHOLD	Total Senou		Total S'koroba		Total Dia, Zam, Kok		Grand total	
	total	average	total	Average	total	average	total	average
Age	949	49.95	1,342	44.73	1,262	42.07	3,553	44.97
Gender (male)	16	84%	23	77%	22	73%	61	77%
Education								
<i>Illiterate</i>	9	47%	18	60%	20	67%	47	59%
<i>Primary school</i>	2	11%	2	7%	3	10%	7	9%
<i>Secondary school</i>	6	32%	7	23%	5	17%	18	23%
<i>University</i>	2	11%	3	10%	2	7%	7	9%
Occupation								
<i>Agriculture</i>	1	5%	14	47%	24	80%	39	49%
<i>Livestock</i>	3	16%	6	20%	10	33%	19	24%
<i>Commerce</i>	5	26%	9	30%	8	27%	22	28%
<i>Salaried job</i>	10	53%	12	40%	5	17%	27	34%
<i>Self-employed</i>	6	32%	1	3%	4	13%	11	14%
Household composition								
<i>Adult male</i>	69	3.6	59	2.0	75	2.5	203	2.57
<i>Adult female</i>	67	3.5	63	2.1	75	2.5	205	2.59
<i>Children</i>	124	6.5	165	5.5	172	5.7	461	5.84
<i>Total</i>	260	13.7	287	9.6	322	10.7	869	11.00
II. ECONOMIC SITUATION	total	average	total	average	total	average	total	average
Roof of the house								
<i>Zinc sheets</i>	18	95%	28	93%	23	66%	69	82%
<i>Thatch</i>	0	0%	0	0%	10	29%	10	12%
<i>Other</i>	1	5%	2	6%	2	6%	5	6%
Agric. land (% that owns)	3	16%	15	50%	25	83%	43	54%
Livestock								
<i>Cows</i>	0	0%	8	27%	10	33%	18	23%
<i>Goats</i>	3	16%	5	17%	12	40%	20	25%
<i>Sheep</i>	5	26%	6	20%	8	27%	19	24%
<i>Poultry</i>	8	42%	16	53%	20	67%	44	56%
Vehicle (car/truck)	7	37%	1	3%	0	0%	8	10%
Motorcycle	18	95%	16	53%	18	60%	52	66%
Bicycle	9	47%	19	63%	20	67%	48	61%
Donkey cart	1	5%	11	37%	17	57%	29	37%
Main source of revenue								
Agriculture	0	0%	9	30%	18	60%	27	34%
Livestock	0	0%	3	10%	3	10%	6	8%
Commerce	5	26%	7	23%	4	13%	16	20%
Salary	11	58%	11	37%	5	17%	27	34%
Ext. support / remittances	3	16%	0	0%	0	0%	3	4%
Annual revenue								
< USD 1,000	5	26%	12	40%	15	50%	32	41%
USD 1,000-2,000	2	11%	8	27%	9	30%	19	24%
> USD 2,000	12	63%	10	33%	6	20%	28	35%

Mali: Analysis of Household and Individual Lighting Consumption

III. ENERGY SITUATION	total	average	total	average	total	average	total	average
Home appliances								
Cell phones	111	5.84	106	3.53	79	2.63	296	3.75
Television	34	1.79	21	0.70	11	0.37	66	0.84
DVD player	24	1.26	6	0.20	7	0.23	37	0.47
Radio	39	2.05	30	1.00	45	1.50	114	1.44
Refrigerator	0	0	0	0.00	0	0	0	0.00
Sources of energy								
Grid-connected	16	84%	3	10%	0		19	24%
<i>Electricity (per 24 hrs)</i>	166	10.4 hrs	36	12 hrs	0		202	10.6 hrs
Solar panels	5	26%	14	47%	9	30%	28	35%
Generator	4	21%	1	3%	0	0%	5	6%
Home (car) battery	5	26%	18	60%	9	30%	32	41%
Lighting appliances								
Solar lamp/lantern	4	21%	3	10%	15	50%	22	28%
Kerosene lamp	2	11%	9	30%	6	20%	17	22%
Battery lantern/torch	15	79%	30	100%	26	87%	71	90%
"Lampes chinoises" (battery operated lamp)	10	53%	17	57%	12	40%	39	49%
Use of energy sources p/m								
Batteries (units)	146	8.11	263	8.77	343	11.43	752	9.64
Kerosene (litres)	1	5%	6	20%	3	10%	10	13%
Candles (units)	3	16%	1	3%	0	0%	4	5%
Charcoal/firewood (monthly costs in USD)	363.40	20.20	281.00	9.36	91.00	3.03	735.40	9.43
Monthly expenses (in USD)								
Electricity	280.00	14.74	28.00	0.93	0	0	308.00	3.90
Cell phone	460.00	46.00	756.00	30.24	673.40	23.22	1,889.40	29.52
Kerosene	20.00	1.05	23.60	0.79	20.00	0.67	63.60	5.78
Batteries	43.20	2.40	79.80	2.66	109.60	3.65	232.60	2.98
Ranking of hh expenses								
<i>Food</i>	19	1	30	1	30	1	79	1
<i>Cell phone</i>	49	2	97	3	101	2	247	2
<i>Clothing</i>	65	4	88	2	103	3	256	3
<i>Energy</i>	62	3	125	4	143	6	330	4
<i>Transport</i>	97	5	149	6	137	5	383	6
<i>Agric. inputs</i>	113	6	142	5	116	4	371	5
Satisfaction with current energy situation	26	1.37	37	1.23	45	1.50	108	1.37
Needs for improvement								
<i>Grid-connection</i>	3	16%	18	60%	13	43%	34	43%
<i>Electricity 24x24</i>	16	84%	1	3%	0	0%	17	22%
<i>Individual electricity post</i>	7	37%	0	0%	0	0%	7	9%
<i>Improved solar lanterns</i>	1	5%	1	3%	5	17%	7	9%
<i>Cheaper solar lanterns</i>	0	0%	6	20%	14	47%	20	25%
<i>Cheaper solar panels</i>	0	0%	2	7%	0	0%	2	3%
<i>More powerful solar panels</i>	0	0%	15	50%	8	27%	23	29%
<i>More durable batteries</i>	0	0%	3	10%	0	0%	3	4%

Annex 2: List of stakeholders and entrepreneurs interviewed

Organization	Name	Contact Details	Relevance
Abze Solar	Princess Abze Djigma	abze@abzesolar.com Tel: +31-611778550 (In the Netherlands)	Developed a solar lamp with support from Philips, which she sells through her own network.
ACCESS SARL	Mr. Diakala Traore Director	Access.sarl@gmail.com Tel: +223-20202957 / 66718279	Subsidiary of MFC. Importer of solar panels and solar lamps; installed 23 PCASERs around Sikasso.
Afriq Power	Mr. Daniel Dembele	ddembele@gmail.com Tel: +223-76128547 / 6015736	Started as importer of solar panels and phone chargers, but could not compete with cheap Chinese imports. Now mainly solar fridges for health centers.
AMADER	Mr. Lamine Coulibaly	lcoulibaly@amadermali.net Tel: +223-76378232	Govt agency responsible for rural electrification in Mali. Subsidizes 75-80% of setting up costs of PCASERs.
CNESOLER	Alhousseini Maiga	Maiga.alhousseini@yahoo.com Tel: +223-76465004	Govt agency to promote use of solar energy. Cooperation agreement with Indian govt to get PV-products at 50% off price. End consumers only pay 25%.
Fair and Sustainable	Victor van der Linde Manager West-Africa	victor.van.der.linden@fairandsustainable.nl ; vlvanderlinden@gmail.com Tel: +223-76910933	Provides BDS and support in the field of value chain development, in close cooperation with ICCO & SNV.
Horonya	Mr. Bakary Doucouré	horonya@yahoo.fr Tel: 20238630 / 66750498	Importer of solar panels and lanterns (mainly from China); electronics shop in Grand Marché, Bamako. Mr. Doucouré has his own PCASER in Touba.
ICCO	Mr. Leo Spaans Regional director Mr. Ataoulaye Bah PO Fair Economic Development	Leo.spaans@icco.nl Tel: +223-20293113 / 72027942 Ataoulaye.Bah@icco-cooperation.org Office: (+223) 20.29.31.13 Mobile: (+223) 77.53.57.93	Dutch Development Organisation active in Mali, mainly focusing on value chain strengthening in the Sikasso region. Also active in Ghana and Sierra Leone. ICCO set up Fair and Sustainable.
K-Solar	Mr. Moumouni Traore	Tel: +223-62118014	Entrepreneur supported by SNV who developed his own solar lighting products using other components.
Mali Folke-center	Mr. Mahamadou Diarra	mahamadou.diarra@malifolkecenter.org Tel: +223-20200617 / 76471707	NGO focused on local economic devt in combination with sustainable use of natural resources.
Mali-Tilé SARL	Ms. Soumaré Sira	sirasoum@yahoo.fr Tel: +223-76117374 / 66583435	Importer of solar lighting products that she distributes through women groups and farmer's associations.
NOTS Mali SARL	Mr. Badara Konaté National Manager Mr. Kandian A. Sidibe Client manager	Badara.konate@notsmali.com Tel: +223-20220270 / 72484381 Kandian.sidibe@notsmali.com Tel: +223-77592009 / 66906110	NOTS Mali was set up by the NOTS Foundation to promote solar energy in Mali. They import lamps, which they sell through own distribution network.
Quincaillerie Traore	Mr. Vieux Traore	Bougouni	Shop owner in Bougouni, sells solar lamps. Also wholesaler.
Quincaillerie Kolomba	Mr. Lassine Doumbia	Bougouni	Shop owner in Bougouni, sells solar lamps.
Quincaillerie Sanogo	Mr. Chounah Sanogo	Sanankoroba	Electronics shop owner in Sanankoroba, sells solar lamps.
SNV	Pierre Gravel Senior Advisor Renewable Energy	pgravel@snvworld.org Tel: +223-20233347 / 70049824	Dutch Development Organisation active in Mali. Focus is on biomass, solar energy and cook stoves.
Yandalux	Lamine Ouattara General director	louattara@yandalux.com Tel: +223-20219142 / 63115371	Importer of solar panels; solar pump systems; solar charging stations; solar fridges & lamps. They are also involved in building of PCASERs.

Annex 3: Solar lamps available in Mali




LES SYSTEMES D'ECLAIRAGE FREQUENMENT UTILISES AU MALI (quelque produit offert aux clients)

 <p>BareFoot- Firefly- Family</p>	 <p>Panneaux Solaires sur toit</p>	 <p>Lampes à pétrole</p>
 <p>Lampes Schnieder In-Diya</p>	 <p>Lampes Solaire ABZE</p>	 <p>Lampes Solaire Philips</p>

Enquête sur terrain (MFC/Nyetaa & Triodos/Facet/BV, dans le cadre de l'étude de la banque Mondiale « Lighting Africa » au Mali)



<p>d.light S2</p>  <p><i>The ultra-affordable study lantern for young people with big dreams</i></p> <p>DLight\$2\$</p>	<p>d.light S20</p>  <p><i>The most affordable lantern</i></p> <p>DLight\$20\$</p>	<p>d.light S300</p>  <p><i>Our premier lantern with four brightness settings and mobile phone charging for a modern lifestyle.</i></p> <p>DLight\$300\$</p>
 <p>Lampes\$pile\$</p>	 <p>4.7cm, 11.4cm, 3.6cm</p> <p>Torches\$pile\$</p>	 <p>Lampe\$Horonya\$</p>