



LIGHT UP KAKAMEGA

IMPACT ASSESSMENT

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Executive Summary

Kopernik distributed 205 d.light S250 solar lanterns in Kenya's Western Province in 2012 through a partnership with Action for Child Development Trust (ACDT). Kakamega and Busia counties encompass towns connected to an electricity grid and rural areas without access to electricity. There is a strong demand for solar lanterns in towns, where the electricity supply is unreliable, and villages, where people want to switch from kerosene to a brighter, cheaper and cleaner light source.

This impact assessment was conducted over three weeks in April and May 2013. Aided by ACDT, the information was collected from (i) 30 face-to-face interviews, (ii) field observations, and (iii) immersion in the local environment.

ACDT used its connections with local schools to market the solar lanterns. The lights were sold to individuals, community groups and one school on a first come, first served basis. Individuals paid a subsidised price in a one-off payment, while community groups paid market price and resold the lanterns offering payment in instalments.

The solar lanterns have made a tangible impact on people's lives. Of the 30 surveyed households:

- **87% reported health improvements**, mostly in terms of eye issues caused by kerosene fumes, followed by coughing and breathing-related issues;
- **43% have completely stopped using kerosene for lighting**;
- **97% are saving money (on average 9 USD per month)** as they no longer buy kerosene and can charge their mobile phones for free at home using their solar lantern;
- **97% are enjoying more light-hours per day** (on average, three hours more), which has led to an increase in:
 - social activity in 86% of households;
 - income-generating activities (such as tending to livestock and crops in the evenings) in 27% of households;
 - study time in 77% of households with school-aged children, of which 88% have seen the grades of their children improve.
- **100% are happy with their d.light purchase**, an impressive rate of customer satisfaction.

In light of the buoyant demand for solar lanterns generated by this project, ACDT plans to pursue a second phase of d.light distribution, with the goal of reaching more low income households while ensuring sustainability and scalability of the project. To achieve this, it is recommended that ACDT adopts a distribution strategy that offers both direct sales and solar light rentals in the form of a social enterprise.

Project Background

Snapshot of Location

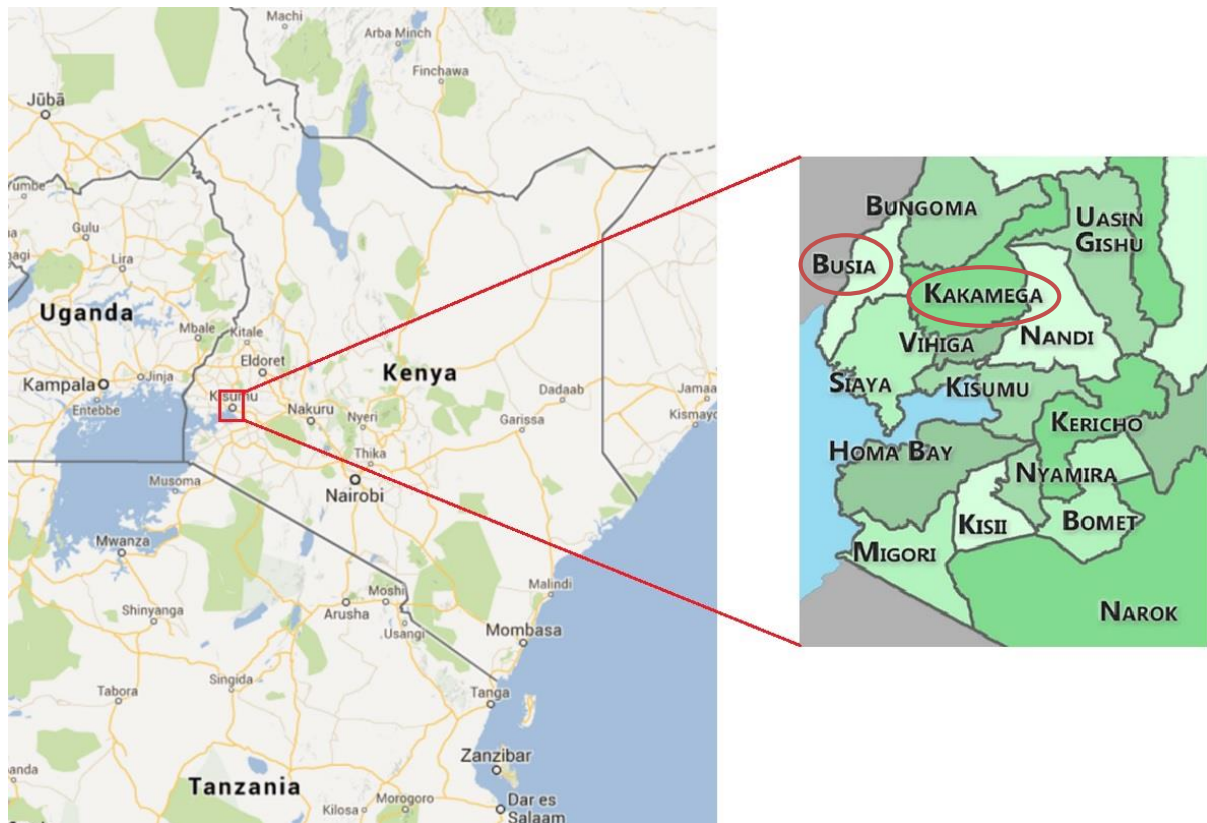


Figure 1¹ Busia and Kakamega counties are located in Kenya's Western Province.

Busia and Kakamega counties are situated in the Western Province of Kenya. Both counties have a primarily rural population and below national average access to infrastructure such as electricity and paved roads. Outside of towns, cash crop farming of maize, beans, sugar cane, cassava, potatoes, etc. is the principal source of income.

	Busia county	Kakamega county	Average of 47 counties in Kenya
Population	488,075	1,660,651	821,491
Surface area (km ²)	1,134	3,051	12,368
% of urban population	16.4	15.2	29.9
% of population with primary education	72.3	70.9	66.6
% of population with secondary education	9.9	11.0	12.7
% of households with access to electricity	6.0	5.6	22.7
% of paved roads	4.9	4.9	9.4

Figure 2² Despite living in a rural area with relatively poor infrastructure, the population in Busia and Kakamega counties enjoys relatively good access to primary education.

¹ Source: Google maps, <http://kenya.usaid.gov/kenya-map-west>, accessed 14/6/2013

² Source: <http://kenya.usaid.gov>, accessed 14/6/2013 (Note: the data is from 2009.)

The 30 households (HH) that were interviewed encompass the diverse demographics of the people who bought a d.light through the project. Due to the up-front cost of the solar lanterns, the customers tended to be middle class families who live in or not too far from the municipalities, or retired professionals who relocated to the countryside. This explains the education background of respondents, which is higher than the local and national average (c.f. Figures 2 and 3): more than half of them have completed secondary school or beyond.

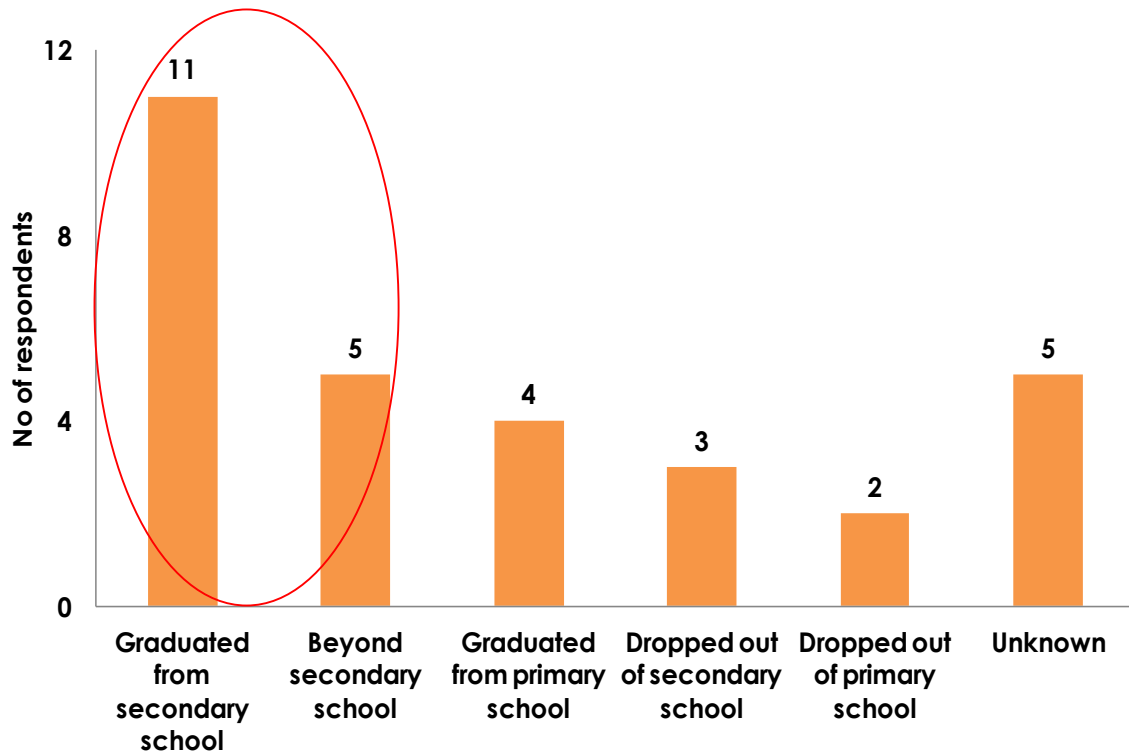


Figure 3 53% of respondents completed secondary school or above. This is higher than the % of the population with secondary education in the counties of Busia (10%), Kakamega (11%) and the county average (13%) (c.f. figure 2).

An average household consists of seven people, including three children. The median monthly income is 15,000 KES³ (US\$176). Only 35 out of the 102 adults in the surveyed households (34%) engage in salaried employment (mostly teachers). 57% of households are involved in farming.

³ 1 USD= 85 KES, source: www.xe.com, accessed 12 /6/2013

	Min	Max	Average
Size of household	4	12	6.8
Of which children (under 18)	0	8	3.4
Monthly HH income (KES)	3,000	150,000	15,000 (Median)
Total no. of buildings in household compound	1	8	3.2

Figure 4 Households in western Kenya tend to have a large number of children.

Common Practices Relating to Technology

Mains electricity, while available in parts of Busia and Kakamega, is highly unstable. Blackouts and unanticipated power rationing are frequent. During the rainy seasons⁴, power outages can occur several times per week. As a result, all 30 surveyed households, living in both urbanised (and electrified) municipalities and rural areas, burn kerosene for light. 80% of respondents use kerosene as their principal light source (due to the unavailability of electricity in rural homes), while the rest have access to electricity and use kerosene as a back-up during frequent power cuts.

However, the use of kerosene comes with numerous disadvantages:

- The fumes released from burning kerosene can irritate eyes and cause breathing issues;
- Kerosene lanterns and lights leave an unpleasant residual smell inside the house even after the flame is extinguished;
- The rising cost of kerosene is a significant financial burden for many, causing households to limit their activities after dark in order to reduce their expenditure;
- Due to the limited availability of kerosene in rural areas, some households go without light or go to bed early in the evenings when they have run out of kerosene and cannot immediately go into town to buy more.

Consequently, our respondents tend to keep a repertoire of light sources, such as kerosene lanterns, kerosene lamps, candles and torches in order to optimise their budgets and ensure that they have a back-up light source should they run out of kerosene. Further, our survey revealed that reducing the use of kerosene (and the subsequent expense) is the most cited reason for purchasing a d.light solar lantern:

⁴ The months of March/April to May/June constitute the "long rains" whereas October to November/December, the "short rains". (Source: <https://en.wikipedia.org/wiki/Kenya>, accessed 14/6/2013)

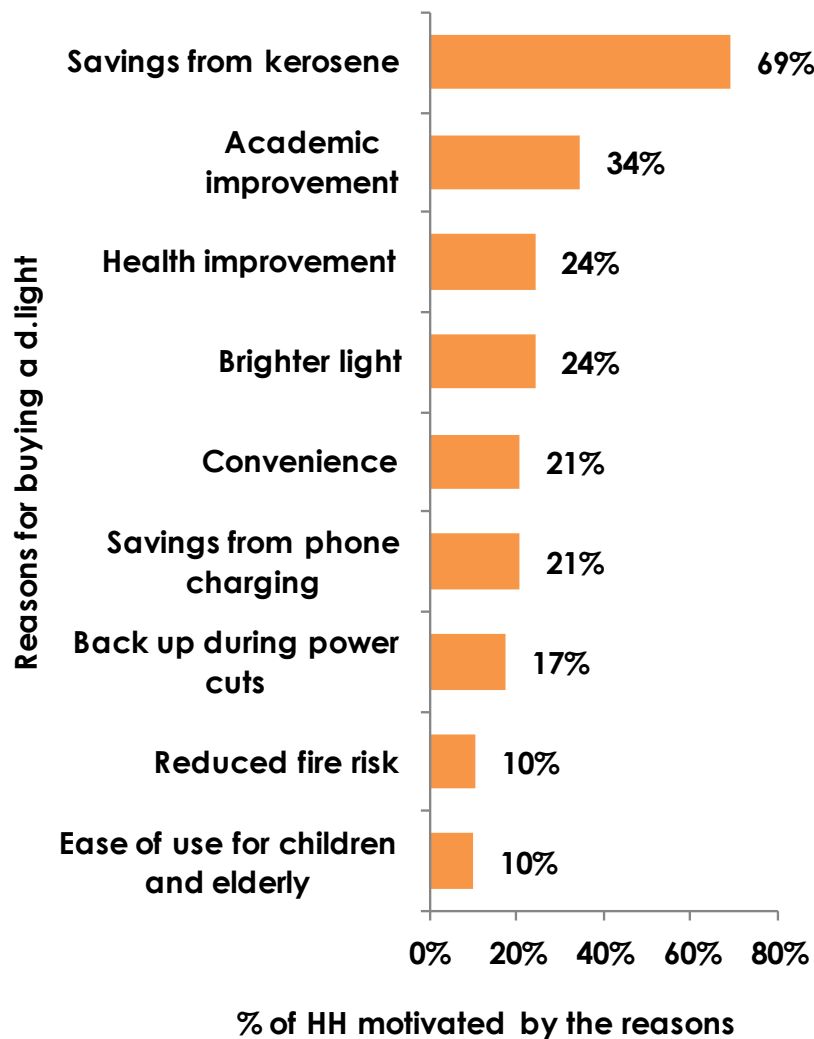


Figure 5 The most frequently cited reason for buying a solar lantern is to save money on fuel

Our Local Partner: Action for Child Development Trust

Kopernik’s local partner is Action for Child Development Trust (ACDT)⁵.

ACDT was established in 2007 in Kenya’s Western Province with a mission “to facilitate communities to enhance the life of children and families by increasing their capacity to protect, educate and advocate for promotion of children’s rights through quality education, better health and sustainable livelihood.”

⁵ Official website: <http://acdt.webs.com>, accessed 7/5/2013

ACDT aims to contribute to the creation of the productive, progressive country envisaged in Kenya Vision 2030⁶ by encouraging community participation and world citizenship. Their goal is to improve conditions for the children of Busia and Kakamega.

The ACDT team consists of four full time staff, three volunteers and one intern, who visit schools to educate children about their rights and responsibilities in order to help them become “healthy, responsible members” of the community who are capable of “lift[ing] themselves out of poverty and becom[ing] driving forces in a functioning economy”.

ACDT conduct the following programmes in schools and community groups:

Programme	Target Audience	Objective
Aflatoun	6 - 14 year olds	Social and financial educational programme that aims to empower children to become agents of change in their own lives through games, activities, stories and the thrill of doing “grown-up” things like starting their own bank accounts.
Aflateen	15 – 18 year olds	Programme to explore participants’ identities, values and beliefs and discuss socio-cultural, environmental and financial issues around them. The programme is supported by social media and a website, through which participants can communicate and share ideas with other teenagers all over the world.
The World Starts With Me	12 – 19 year olds	Interactive, computer-based programme which teaches participants about sexual and reproductive health and rights, helping them make a safe transition from adolescence to adulthood.
Lighting Up Rural Kenyan Households and Schools	Households in Busia and Kakamega	Project to provide portable solar-powered lanterns to rural families and schools in order to encourage children to pursue education while simultaneously helping households save money for other essentials.

Figure 6 ACDT runs several programmes to empower children.

⁶ Kenya Vision 2030 is a development programme launched in 2008 by President Kibaki with an objective to transform Kenya, over the period of 2008-2030, into an industrialised, middle-income country.

ACDT submitted a proposal to Kopernik for d.light S250 solar lanterns in 2010. Kopernik decided to partner with ACDT because of their focus on education, environment and improving community health.

The project was crowdfunded on the Kopernik website. More than 60 donors from Australia, Canada, Germany, Poland, Indonesia, Japan, Sierra Leone, South Korea, the United Kingdom and the United States of America donated to the project.

Kopernik sent the d.lights to ACDT in early November 2011, after fully funding the project. As ACDT distributed the lights, Kopernik provided advice on different pricing schemes and helped connect ACDT with a local d.light distributor to replace broken products under warranty.





Project Implementation

The Technology

The d.light S250 solar lantern is a white LED light equipped with an external solar panel that can also charge mobile phones. It has four brightness settings and can provide from eight to 100 hours of light after each full charge, depending on the brightness required. The product description from the manufacturer indicates that the lantern has a lifetime of five years or more when handled properly.

ACDT markets the solar lanterns to customers as offering the following benefits:

- They eliminate the many drawbacks of using kerosene;
- They provide a better study environment for children, both in terms of the quality of the light and the amount of time during which light is available;
- They save money for other household needs.

Light source	 d.light S250 Solar lantern	 Kerosene lantern	 Kerosene lamp ("Koroboi" in Swahili)	 Candle
Cost of hardware	1,800 KES (ACDT price) 3,500 – 4,500 KES (market price)	800 KES	30 KES	Nil
Cost of fuel	Nil	50 KES/ evening	20 KES/ evening	<5 KES/ evening
Disadvantages	- Availability of light is dependent on weather - Prohibitively expensive in the absence of	- Fumes irritate eyes and cause breathing issues and coughing	- Naked flame poses a fire risk - Disadvantages related to	- Naked flame poses a fire risk - Dim light

	subsidies/installment plan	<ul style="list-style-type: none"> - Unpleasant smell - Glass casing is fragile - Expensive 	<ul style="list-style-type: none"> - burning kerosene - Dim, localised light
Remarks	Very sought after in the project site due to positive reviews from all users	Used as the main light source in rural households, in particular in the sitting room	<ul style="list-style-type: none"> - More affordable alternative to the kerosene lantern (with the same drawbacks) - Used in particular in kitchens, even in households that own solar lanterns - Affordable - Usually used by households to complement kerosene or electricity, for instance when they have run out of kerosene or during blackouts

Figure 7 The table above shows some common light sources used in the project site. Kerosene-based lamps and lanterns are the most frequently used light sources despite the long list of disadvantages. Note that 1 USD= 85 KES at the time of writing.

Distribution Mechanism, Pricing, and Payment

ACDT distributed 205⁷ d.light S250 solar lanterns in the counties of Busia and Kakamega over 10 months from November 2011 to August 2012. ACDT marketed the lanterns mostly in schools during their youth empowerment programme visits. Other means of publicity included the local administration and ACDT’s own network of community groups. The lanterns were distributed on a first come, first served basis. The majority of lanterns were sold at 1,800 KES, which is below the local market price of around 3,500 KES, in order to make them more affordable to the rural population. 72 lanterns were sold at a higher price of 3,000 KES to local groups, who resold them to their members.

The people reached through this project can be divided into three groups, each with their own pricing and payment plan:

Client segment	Price	Remarks
Individuals/ households	1,800 KES	This segment learnt about the solar lanterns via schools and purchased one or more lanterns each by a one-off cash payment.
Community groups	3,000 KES	72 solar lanterns were sold to local community groups for 3,000 KES, who then sold them to villagers for 3,000 KES-4,500 KES using a three-month instalment plan.
School	1,800 KES	A school bought four solar lanterns to use in classrooms, replacing kerosene lanterns and eliminating recurrent fuel expenses (c.f. section V.3 Case Studies).

Figure 8 While the majority of the lanterns were distributed to individuals, community groups proved to be an effective distribution channel. Note that 1 USD= 85 KES at the time of writing.

ACDT repaid 4,054 USD to Kopernik from the sales revenue of the first phase of this project. This has enabled Kopernik to fund a second phase of the project, sending 71 d.light S300s and 258 d.light S2s to ACDT for distribution in western Kenya. (c.f. Annex for the distribution strategy of Phase 2).

⁷ Of the 230 units of d.light S250 ACDT received, 25 were defective and had to be sent away for repair. They were not yet distributed at the time of writing.

Impact Assessment

Process and Methodology

Due to (i) the fact that the vast majority of solar lanterns (191/205) were distributed in Kakamega county and (ii) the long distance between Busia county and the ACDT office, we decided to conduct the impact assessment in Kakamega county only. Solar light owners were grouped according to their location (Kakamega municipality, Butere, Esumeyia, Lusumu) and random samples were drawn from each group.

Over the course of three weeks (17 April 2013-6 May 2013), 30 interviews were conducted in order to gauge the impact of the solar lanterns, which had been for around six months at that stage. As the interview period coincided with school holidays, many parents were accompanied by their children and it was possible to get both adults' and children's opinions.

Our survey sample of 30 households included 13 women, 16 men and one couple.

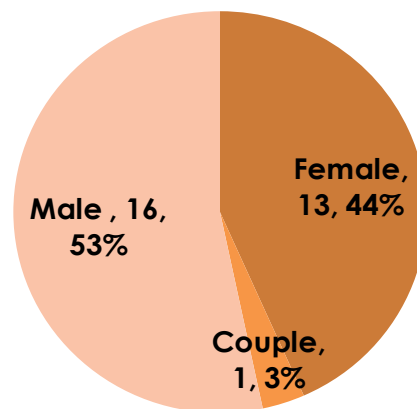


Figure 9 Both male and female users were represented in our survey

A questionnaire was used to guide the interview. This questionnaire was designed in collaboration with ACDT staff in order to investigate (i) the changes the d.light solar lanterns have brought about in the lives of the respondents, (ii) the respondents' opinions on the solar lanterns and (iii) other appropriate technology the respondents are looking to purchase. The questionnaire was then field tested on three households and adapted accordingly.

These face-to-face interviews lasted from 30 minutes to one hour, and were followed by an inspection of the solar lantern in order to detect any abnormal wear and tear and customisations. At least one member of the ACDT staff was present at all of the interviews. In the instances where people preferred to be interviewed in Swahili, the interviews were conducted in Swahili and the answers recorded in English by ACDT staff.

Results of the Impact Assessment

Socio-economic Impact

Almost half of the respondents eliminated the use of kerosene. All but one candle user have stopped using candles.

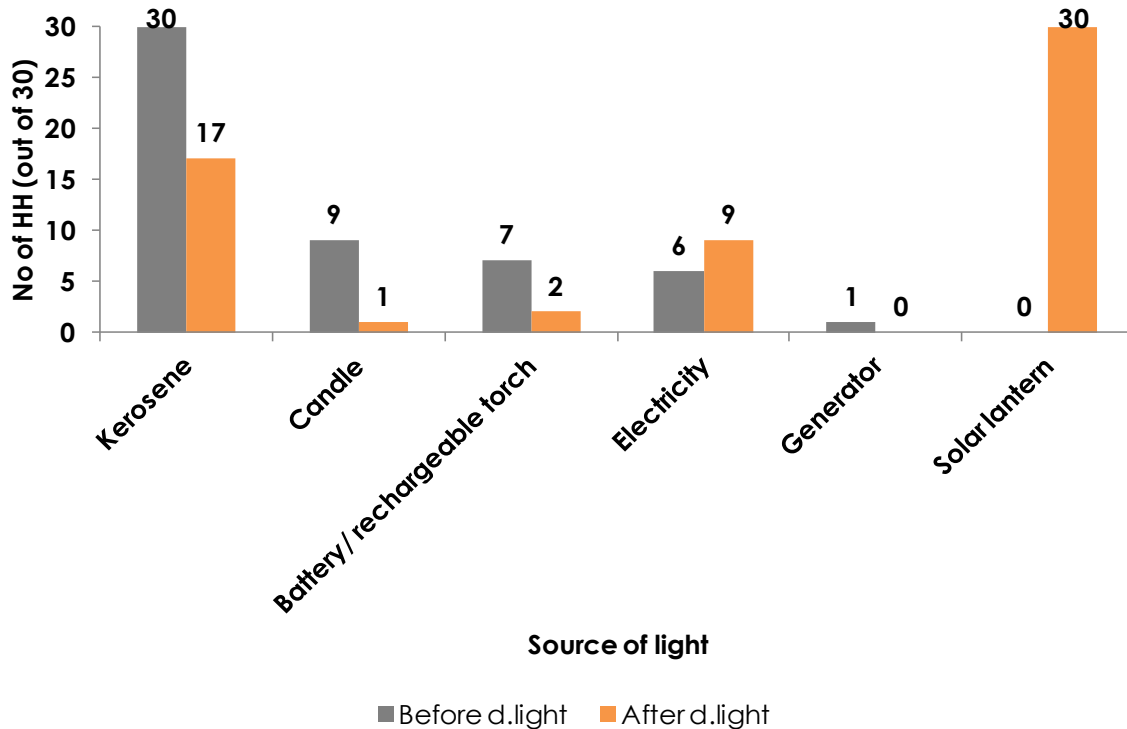


Figure 10 The introduction of the d.light solar lanterns have drastically reduced households' usage of kerosene, candles and torches. It is worth noting that some households have adopted electricity at some point after buying solar lanterns.

The solar lanterns have greatly reduced the use of kerosene (and consequently its disadvantages) among the surveyed households, and they have simplified the portfolio of light sources. Respondents now maintain at maximum only two extra light sources in addition to the d.light (ie three sources in total, as opposed to four).

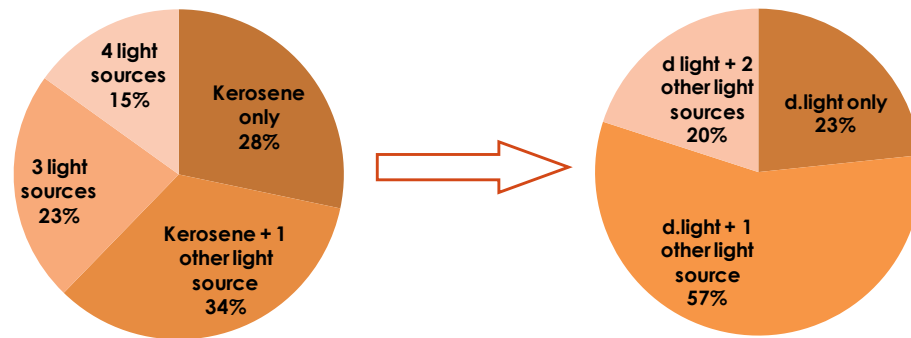


Figure 11 The % of households that use two or fewer light sources has increased from 62% to 80%.

In line with the expectations of users, the d.light solar lanterns have made an economic impact on the vast majority of surveyed households, mainly by creating savings but also by enabling income generation.

97% of households, ie 29 out of 30, reported saving money since using the solar lanterns. On average, a household saves 776 KES per month, principally from not buying kerosene, followed by charging their mobile phones for free at home with the d.light. (Note that the respondents' household income ranges between 3,000 KES and 150,000 KES, with a median of 15,000 KES.)

27% of households engage in income-generating activities using the d.light solar lanterns, such as tending to livestock and crops in the evenings. The reduction of kerosene use has led to health improvements in the majority of households. the majority of households (87%) reported health improvements, mostly related to eye issues caused by the fumes of burning kerosene, followed by coughing and breathing-related issues.

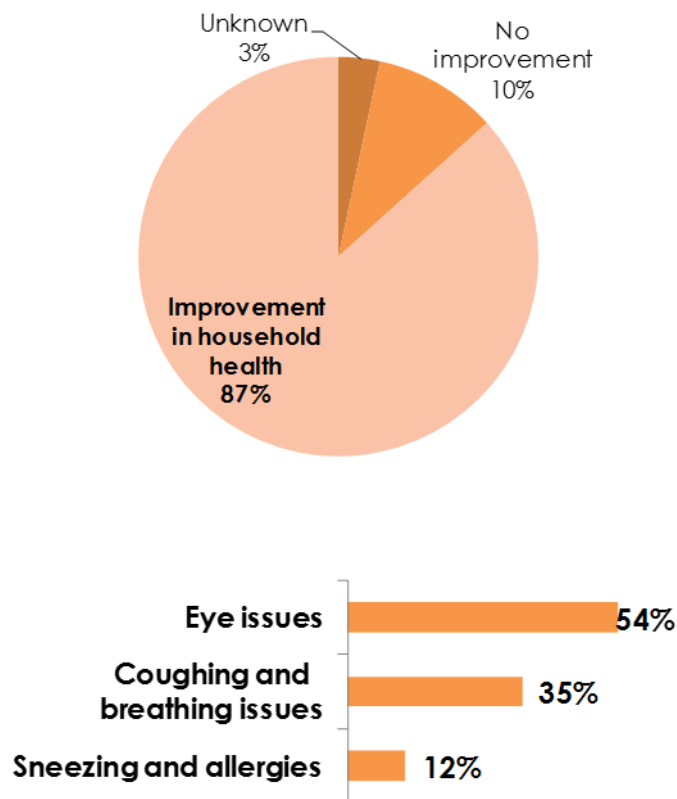


Figure 12 The majority of respondents reported that their eye and breathing issues subsided since replacing kerosene with their solar lanterns

Households are enjoying three more light-hours per day on average, which they spend on activities that improve their quality of life.

An overwhelming majority (97%) of households said that they have gained extra light-hours at no cost. In particular, many households enjoy being productive in the early mornings, which was not possible before they had access to the d.light solar lanterns due to economic considerations.

Furthermore, 86% experienced an increase in social activity (especially during the evenings) since owning a d.light solar lantern.

Last but not least, of the 26 households that have school-aged children, 77% reported increased study time from an average of 2.2 hours per evening to 3.6 hours. This is possible as longer study hours no longer require more fuel. Moreover, 88% of these households have seen the grades of their children improve.



Figure 13 Children demonstrate how they hang up the solar lantern during their evening study sessions.

User Satisfaction

100% of people surveyed reported an overall positive experience with their d.light solar lanterns. In order to gauge the lanterns' performance in more detail, the d.light users were asked to rate its different aspects on a scale of one (poor) to five (excellent). They rated their overall experience with the d.light solar lantern as overwhelmingly positive (4.6/5). They were particularly impressed by the durability of the d.lights, giving it an average rating of 4.4/5 (exceeds expectations). Core features of the d.lights, namely brightness and quality of light, are rated 4.3/5, also exceeding expectations.

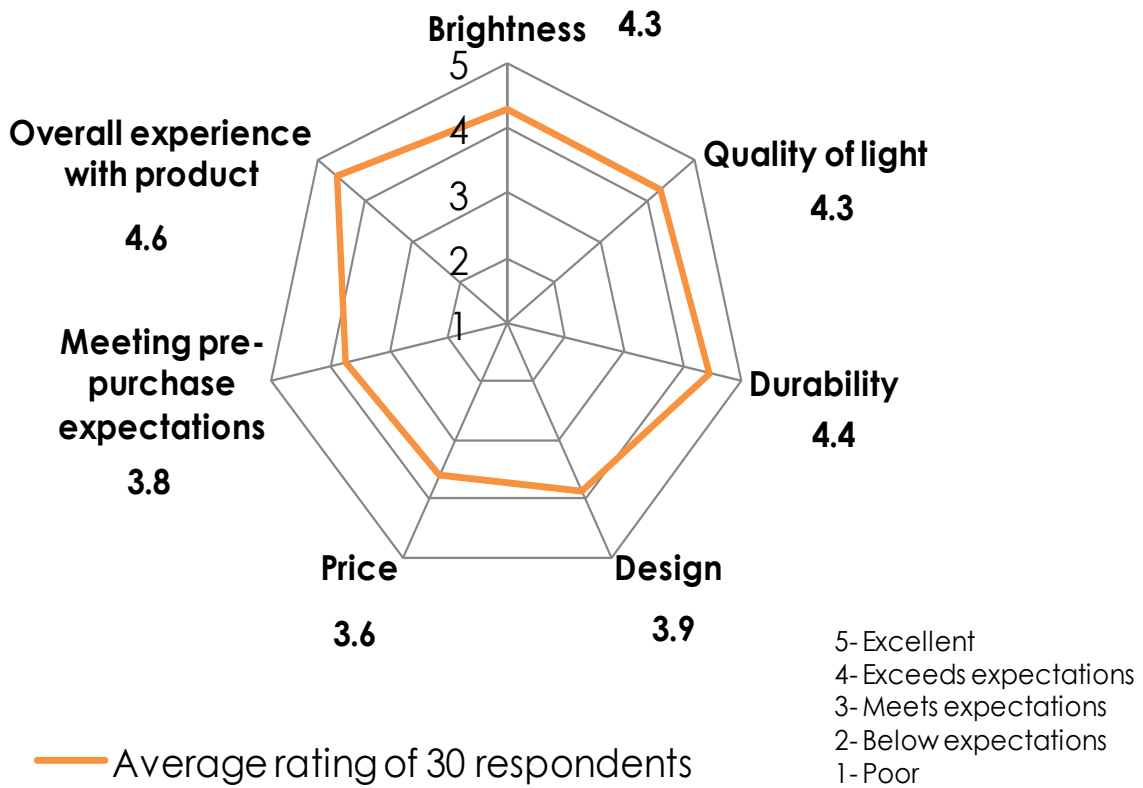
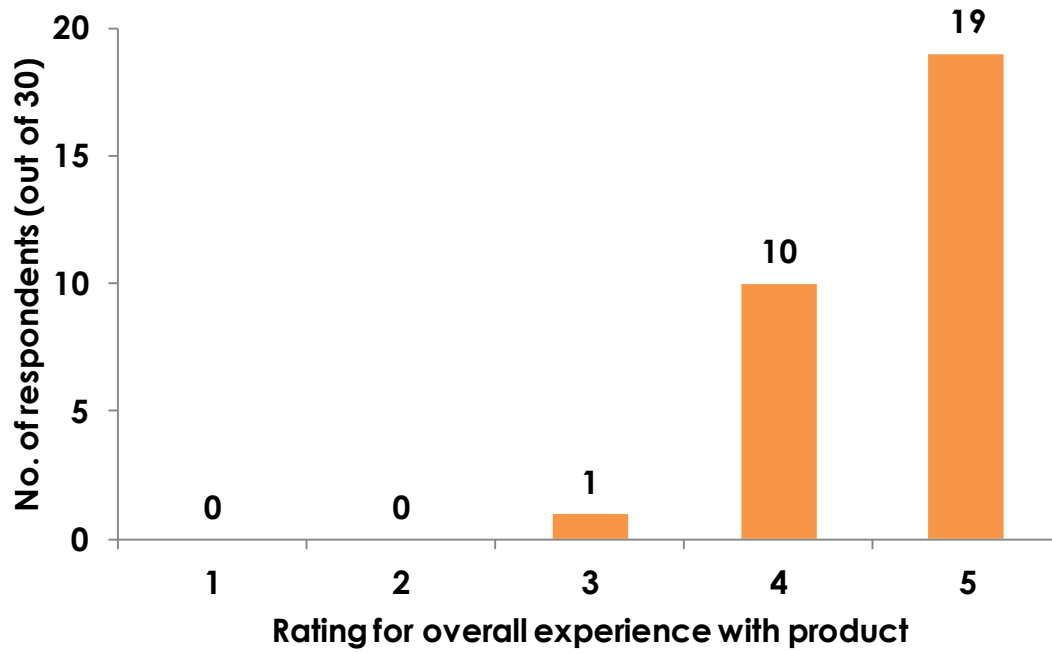


Figure 14 On average, the overall d.light experience has exceeded expectations

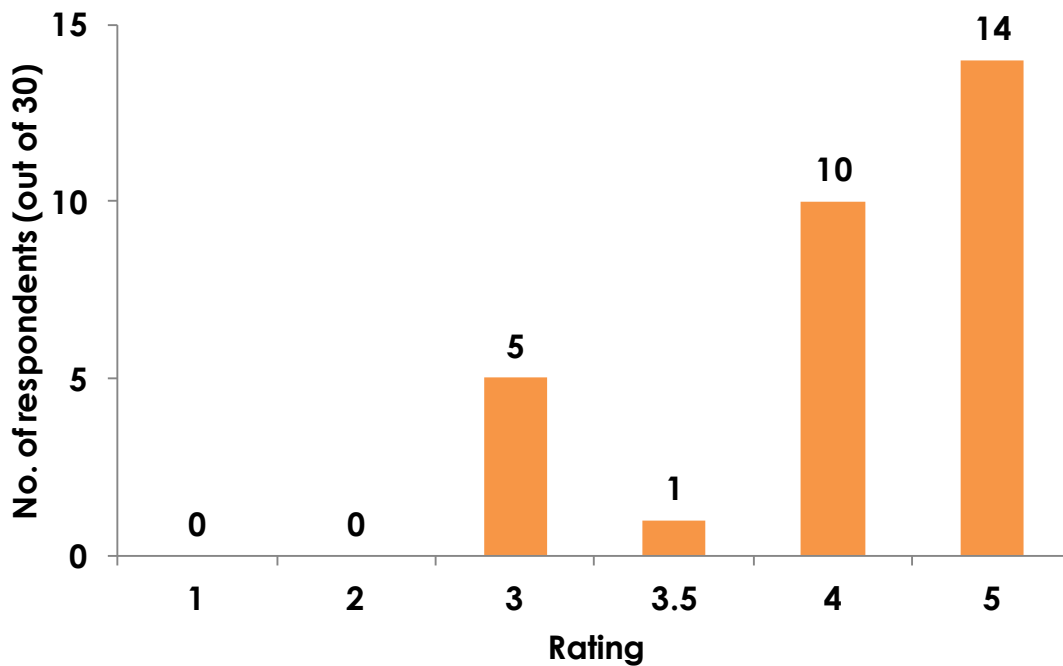


1- Poor 2- Below expectations 3- Meets expectations 4- Exceeds expectations 5- Excellent

Figure 15 A breakdown of the users' ratings of their overall experience with their solar lantern reveals that all people surveyed think that the d.light solar lanterns have at least met their expectations.

A detailed breakdown of the ratings of the different aspects of the d.light solar lantern is as follows:

The vast majority of respondents find that the brightness of their d.light solar lanterns exceeds their expectations.

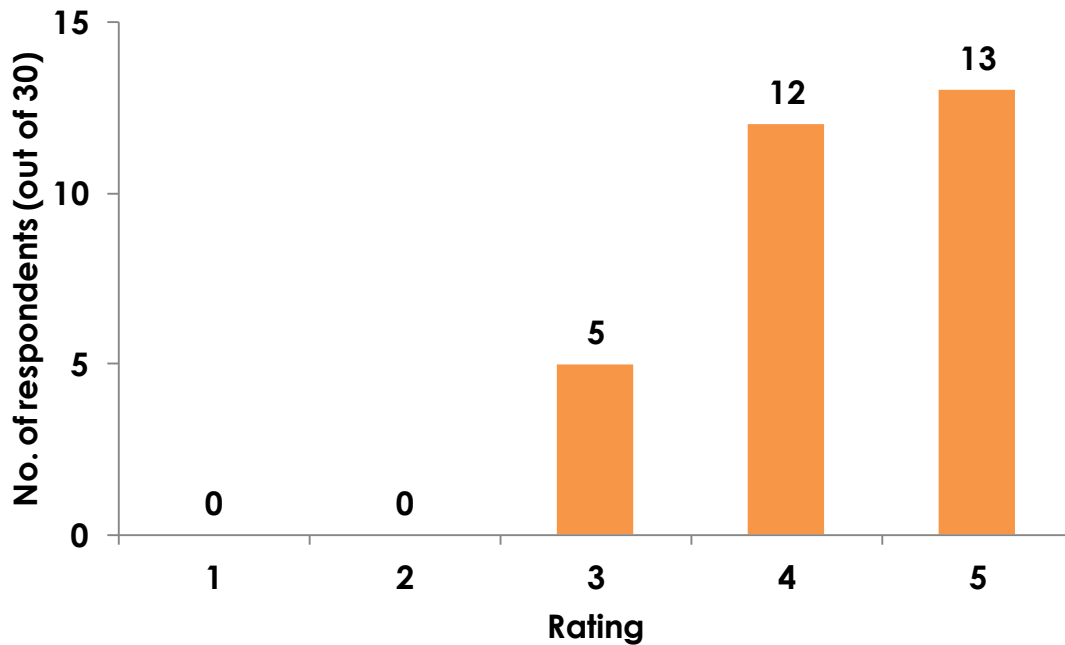


1-Poor 2-Below expectations 3-Meets expectations 4- Exceeds expectations 5- Excellent

Figure 16 The average rating of d.light S250's brightness is 4.3/5.

Users reported that the d.light is brighter than previous light sources, such as kerosene lanterns, kerosene lights and candles. Moreover, users are very familiar with the four different brightness settings, which they adjust in order to optimise the lantern's battery life and brightness for the task at hand.

100% of respondents find their solar lantern's quality of light to be satisfactory or above.

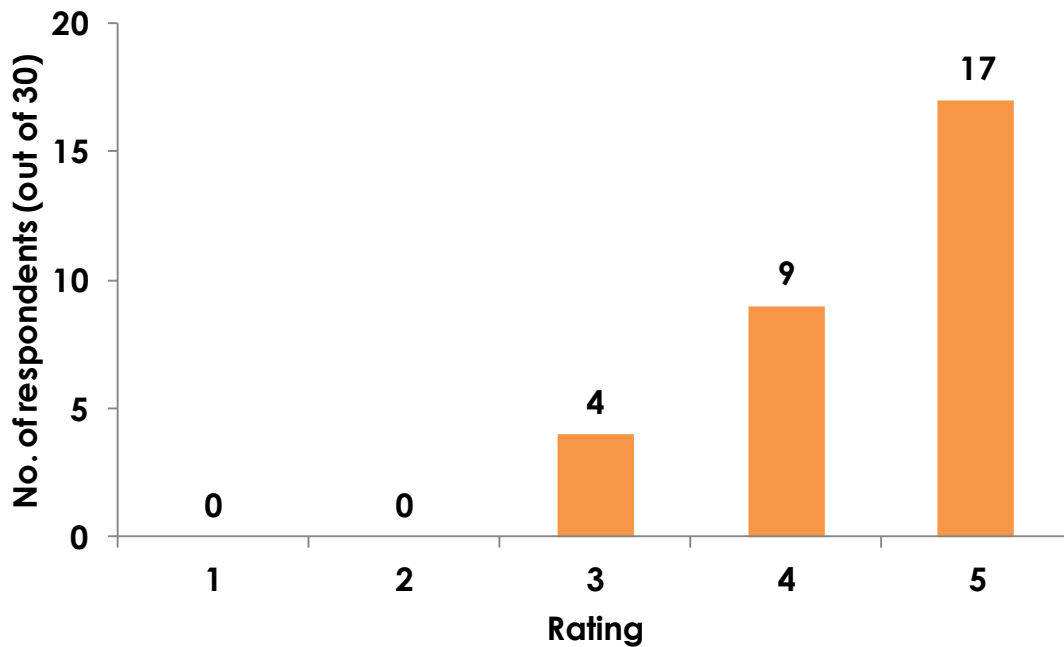


1 - Poor 2- Below expectations 3- Meets expectations 4- Exceeds expectations 5- Excellent

Figure 17 average rating of the quality of light is 4.3/5.

According to users, unlike flames, d.light's LED is steady and projects over a large area, making it an excellent light source for reading and for social events alike. The solar lanterns are commonly used to light the entire sitting room at home and to provide lighting for church, funerals and weddings.

More than half of the respondents rate the d.light as excellent in terms of durability.



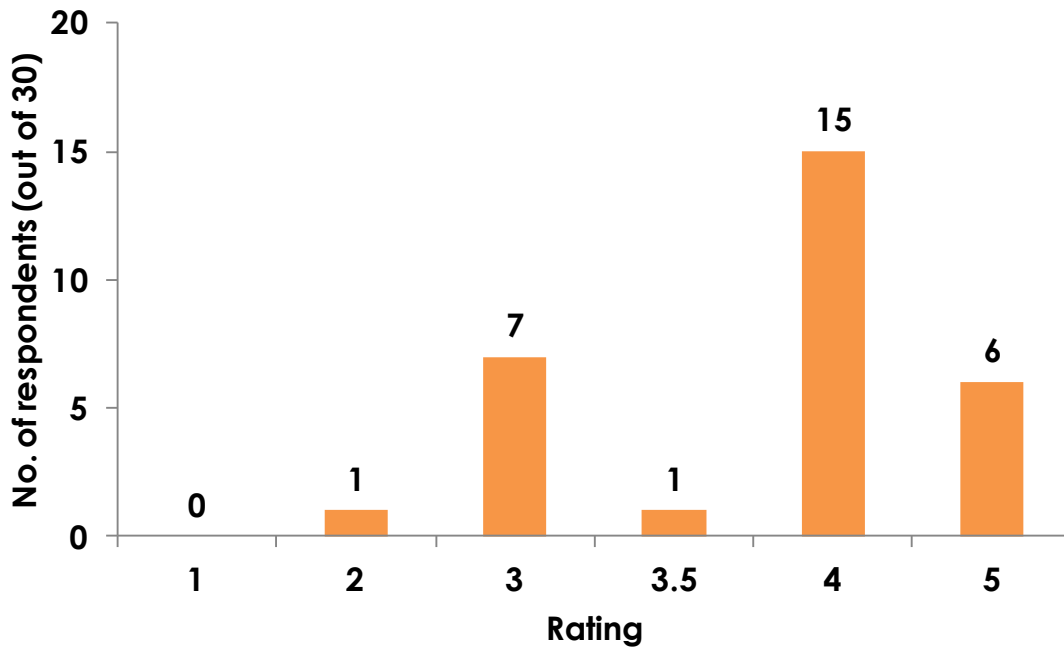
1-Poor 2-Below expectations 3- Meets expectations 4- Exceeds expectations 5- Excellent

Figure 18 The average rating of d.light S250's durability is 4.4/5.

Some users mentioned that their lanterns have sustained some occasional falls with no adverse effect. A small number of surveyed users who own other types of solar lanterns said that d.light solar lanterns and solar panels are more robust.

However, some households have experienced problems with the charging wire (c.f. section The d.light in the Context of Western Kenya).

Respondents are generally happy with the design of d.light.



1- Poor 2- Below expectations 3- Meets expectations 4- Exceeds expectations 5- Excellent

Figure 19 The average rating of d.light S250's design is 3.9/5.

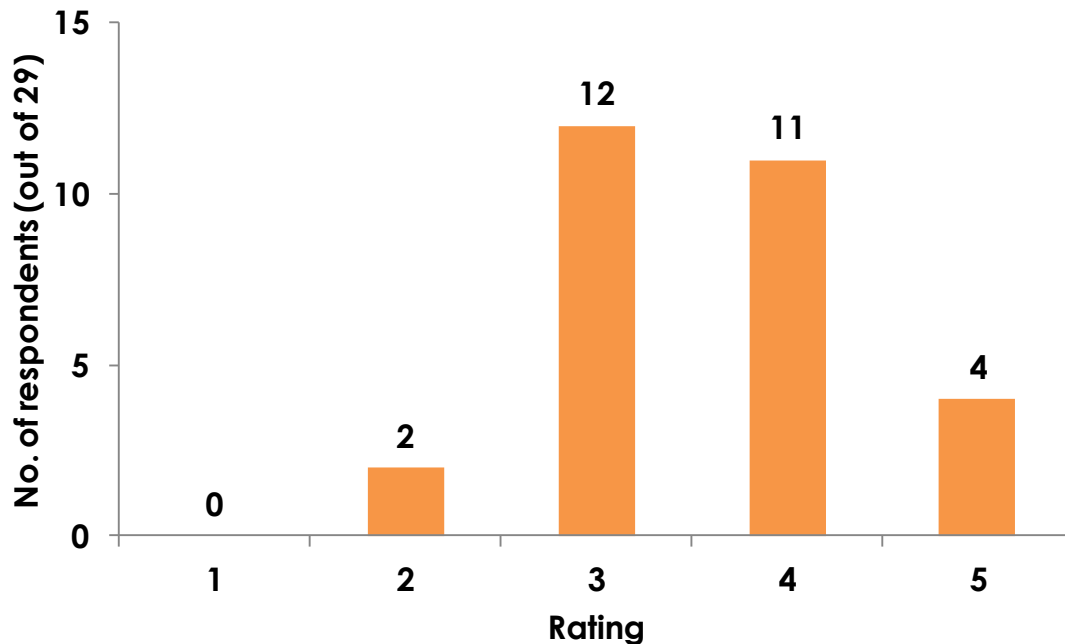
Many users report that the solar lanterns are “convenient” and “easy to use”, even for children and the elderly. Users appreciate the versatility of the lanterns, using it as a torch in the outdoors, hung from the sitting room ceiling as a main light, or just placed on top of a cupboard as a reading lamp.

Some users suggested ideas for improvement, such as incorporating a built-in hook and/or an adjustable stand.



Figure 20 Even a small child can safely handle a d.light solar lantern.

More than 90% of respondents find the price charged by ACDT to be competitive.



1- Poor 2- Below expectations 3- Meets expectations 4- Exceeds expectations 5- Excellent

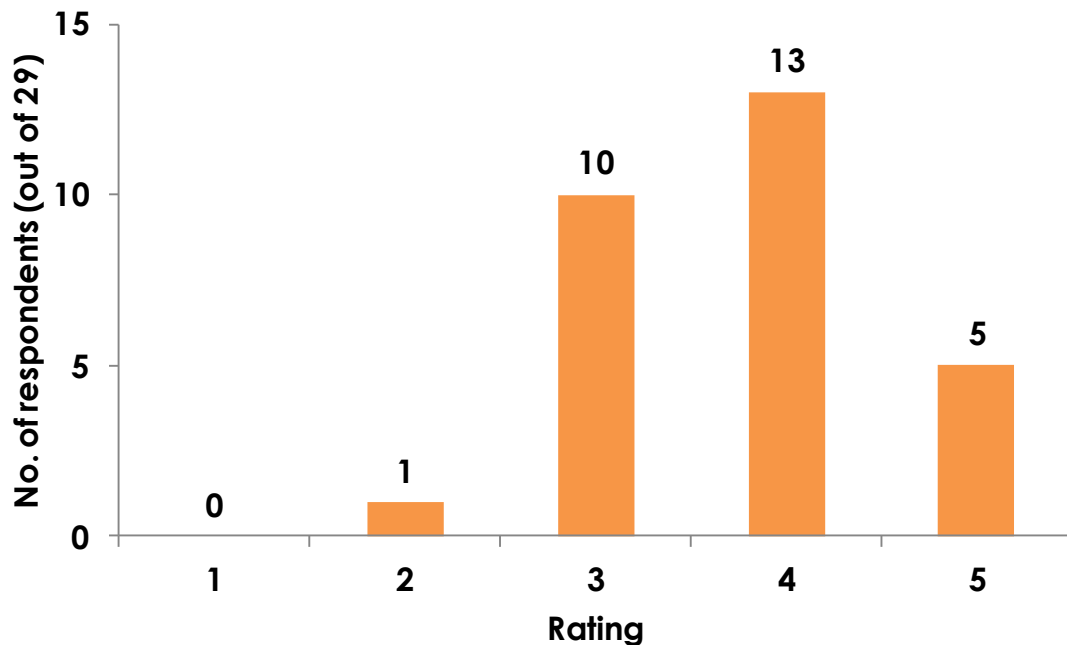
Figure 21 The average rating of the price is 3.6/5

Many users are delighted to report that the lantern pays for itself in only a few months due to the significant fuel savings from substituting kerosene, candles, mains electricity, etc. Furthermore, some commented that they have seen the same d.light S250 solar lantern, for which the majority paid 1,800 KES (21 USD), in shops for as high as 4,500 KES (53 USD).

Of the seven sampled households that paid between 3,000 KES and 4,500 KES, as opposed to the subsidised price of 1,800 KES, for their solar lanterns, the vast majority (six out of seven households), who paid 3,500 KES-4,500 KES via their community group's instalment plan, find the price to be acceptable (ratings between 3-5). The remaining household, who paid 3,000 KES, deemed the price to be too high and rated it 2/5. This indicates room for more aggressive pricing provided that an instalment plan is available.

It is worth noting that d.light products can be found in western Kenya in a small number of stores and petrol stations. In particular, S250 and S2 solar lanterns are available in Kakamega town for 4,500 KES and 1,050 KES respectively in shops such as *Solar Lighting Solutions* and *Total*.

The majority of users report that the lanterns have met or exceeded their expectations, indicating adequate sensitisation efforts by ACDT.



1-Poor 2- Below expectations 3- Meets expectations 4- Exceeds expectations 5- Excellent

Figure 22 The average rating in terms of meeting pre-purchase expectations is 3.8/5.

Many parents bought the lanterns via teachers or schools in order to help their children to study. They have been pleasantly surprised by the additional benefits beyond education, particularly the lantern’s phone charging capability and the consequent savings.



Figure 24 Charging a mobile phone by directly connecting the phone to the solar panel.



Figure 23 Charging a mobile phone using the S250 solar lantern.

This positive experience with d.light solar lanterns and ACDT has fostered among the d.light users a strong appreciation for appropriate technology. When asked what other technologies they would like to try, solar cooker is the most popular answer.

The d.light in the Context of Western Kenya

The solar lanterns prove to be robust under daily use even in rural areas: 100% of solar lanterns we inspected are still operational on all of their light settings.

The most common issue (affecting 30% of surveyed users) concerns the wear and tear of the charging wire. This is usually fixed at home by users using a replacement wire and/ or duct tape.

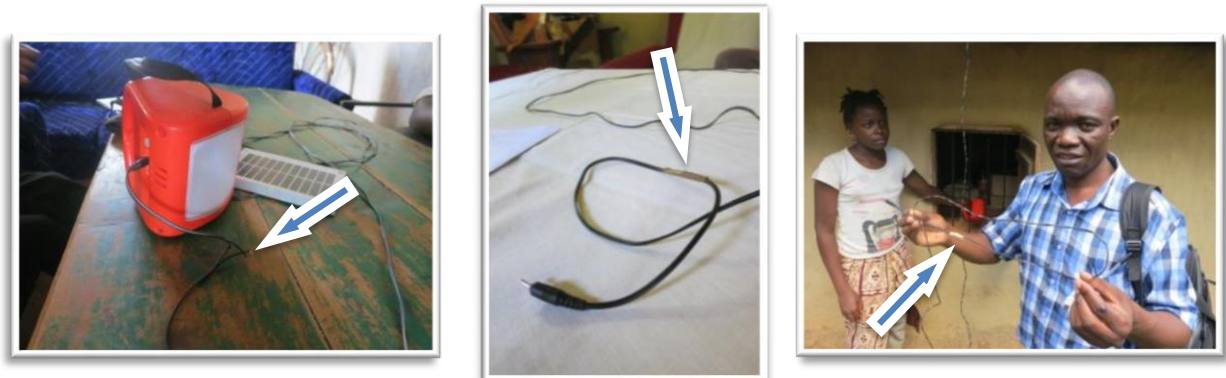


Figure 25 The wires are mended by users using duct tape.

There was one instance of the phone charging port not working.

Theft is another concern worth noting. Among the 30 surveyed households, there was one instance of theft of the solar panel when it was charging under the sun, outside the house, while attached to the S250 lantern, which was inside the house. Furthermore, there have been two cases of theft of S250 lanterns at social events (funerals).



Figure 27 Two households permanently leave the solar panel of the S250 on the roof, which not only increases the risk of theft, but also that of damage.



Figure 26 A S20 lantern and the solar panel of the S250 charging unsupervised just outside the house.

Conclusions

This impact assessment revealed that the d.light solar lanterns have made a tangible, positive impact on the daily lives of the users. In particular:

Almost half of the respondents (13/30) eliminated the use of kerosene and consequently its disadvantages and cost:

- 87% of households reported health improvements, mostly in terms of eye issues caused by fumes, followed by coughing and breathing-related issues;
- 97% of households reported savings (on average 776 KES or 9 USD per month) from no longer having to buy kerosene and from charging mobile phones for free with the d.light.

97% of households are enjoying three more light-hours per day on average:

- 86% of respondents experienced an increase in social activity (especially during the evenings);
- 27% of the households engage in income-generating activities using their solar lanterns, such as tending to livestock and crops in the evenings;
- 77% of households with school-aged children reported an increased study time from an average of 2.2 hours per evening to 3.6 hours. 88% of these households have seen the grades of their children improve.

All in all, 100% of respondents declared that they enjoy an overall positive experience with their solar lanterns. People are particularly impressed by the durability of the solar lanterns, exceeding their expectations. Core features of the lanterns, namely brightness and quality of light, are also rated highly.

In order to ensure the success of the second phase of the Light Up Rural Kenyan Households and Schools project, the following recommendations, inspired by a SWOT analysis of the first phase of the project, are put forward:

	Findings	Recommendations
Strengths	ACDT's extensive marketing efforts and positive reviews from existing users have created a strong awareness and buoyant demand for d.light solar lanterns.	ACDT can leverage the communities' strong recognition to pilot a solar lantern rental scheme in conjunction with community partners in order to reach more users (including "bottom of pyramid" users- c.f. Annex).
Weaknesses	Theft and poor handling of solar lanterns in a small number of households.	ACDT can educate users on how to handle the lanterns and solar panels in order to maximise their useful lives, eg

		advise against permanently installing the solar panels on the roof.
Opportunities	Households that bought the S250 solar lanterns by instalment at 3,500 KES via local groups find the price to be acceptable.	ACDT can engage in more aggressive pricing by introducing an instalment plan.
Threats	Competition is intensifying as d.light solar lanterns are becoming more readily available to individual consumers in regular shops.	<p>ACDT should be aware of the competition and ensure that their prices are appropriate and competitive.</p> <p>ACDT can raise profit margin by:</p> <ul style="list-style-type: none"> - differentiating product offering, eg bundle marketing & operational support, instalment plan, etc. into their value proposition to community groups; - diversifying customer base, eg distribute in bulk to local groups, NGOs and schools.

Developing a Distribution Strategy for Light Up Rural Kenyan Households and Schools (Phase 2)

After studying the outcomes of Phase 1 of the project, a new distribution strategy is proposed for Phase 2 of the project in order to (i) widen access to solar lanterns by lower income groups and (ii) facilitate project sustainability and scalability.

This strategy is characterised by a diversification of the customer base, which enables cross-subsidisation among different client segments. Moreover, this model generates an income stream to ensure sustainability of the project.

The three-tiered model is as follows:

Immediate purchase by individuals/ groups by one-off cash payment at market price

Purchase by individuals at market price plus a small premium paying in **instalments** over a fixed number of months

In collaboration with community groups, establish **social enterprises** that operate **short term rental** of solar lanterns at a price that is comparable to using a kerosene lantern

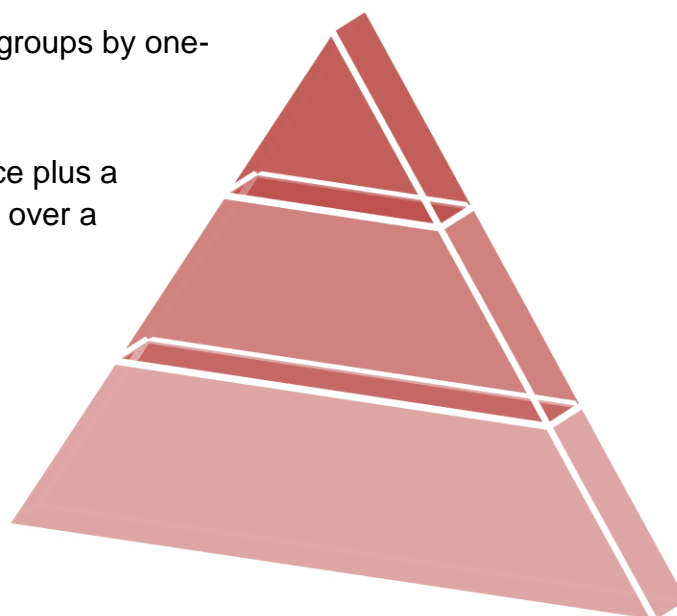


Figure 28 A three-tiered distribution strategy is proposed for Phase 2 of the project.

The social enterprise model is designed to widen access to solar lanterns by the 'bottom of the pyramid -- the low income households who cannot afford solar lanterns, despite their profound need for one.

The main difficulties in operating a rental scheme are the risk of damage and theft⁸ of the solar lanterns, followed by finding the resources necessary, namely the labour to maintain the lights and the day to day operations of a social enterprise. In light of these obstacles, it is proposed that ACDT outsources the operation of the social enterprises to community partners, such as youth groups or women's groups. Firstly, these local groups have a deep knowledge of the locality and its inhabitants, which allows them to assess risk accurately and work with reliable clients. For instance, some survey respondents suggested avoiding renters (who might abandon their house and take the solar lantern with them) and families with domestic abuse and drinking issues (who might damage the solar lantern). Secondly, ACDT will not need to take on new staff to maintain and expand the social enterprises. Instead, ACDT will provide one-off assistance during the set up of the enterprises and simple support during the day to day operations. In return, ACDT will receive payment (by instalment) for the lanterns and a small proportion of earnings for the first few months.

⁸ In some communities, for-profit businesses recharge car batteries and rent them out to inhabitants. The risks that these businesses face are very similar to the social enterprise model mentioned here. It is thus recommended that ACDT research their practices, in particular in areas such as customer initiation and mitigation of damage and theft.

By outsourcing the day to day rental operations, this scheme allows ACDT to distribute solar lanterns quickly and over a wide area despite human resource constraints. The modest profit will ensure the sustainability and scalability of the scheme.

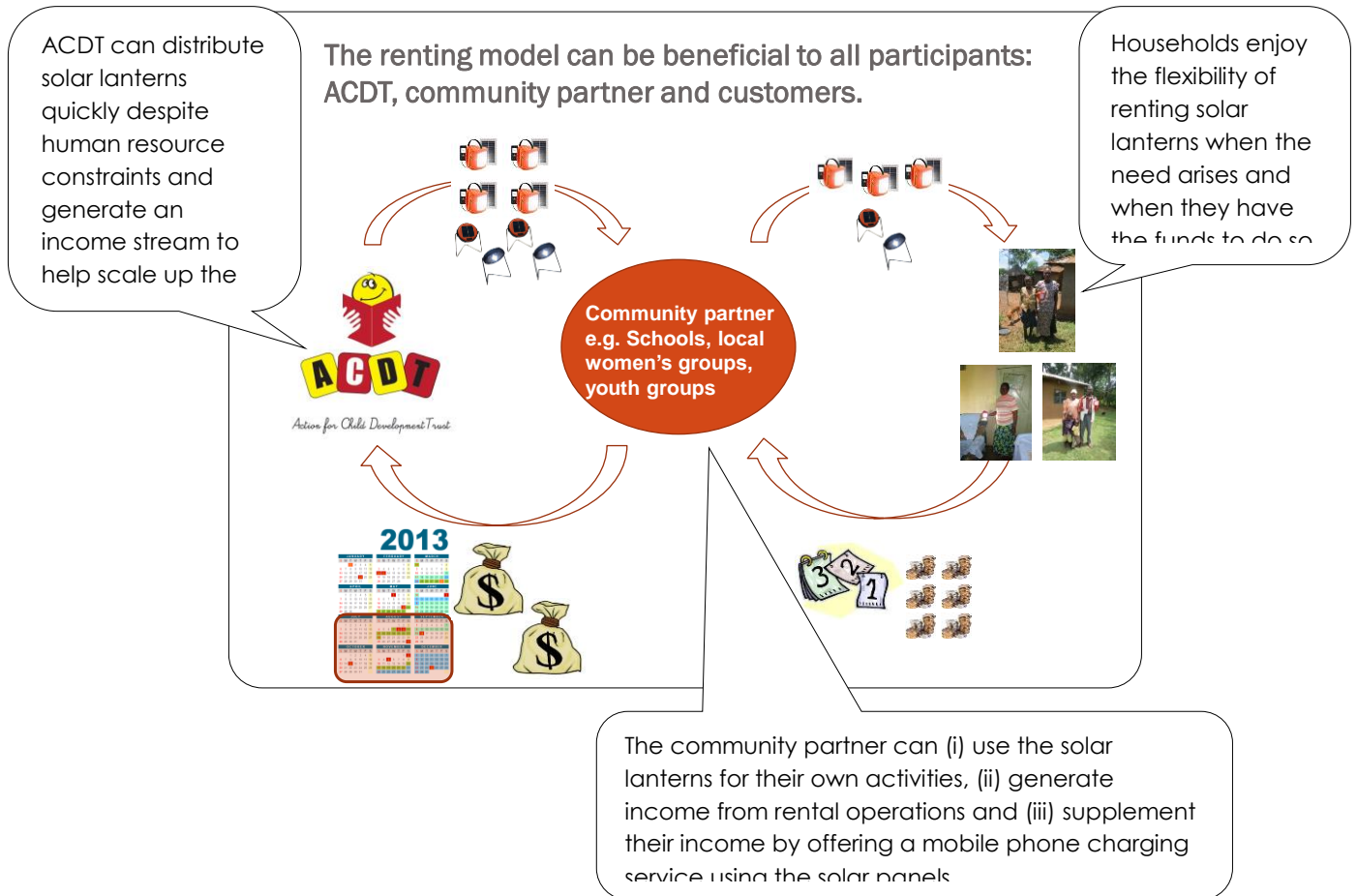


Figure 29 With this model, even the poorest households can access the solar lanterns.

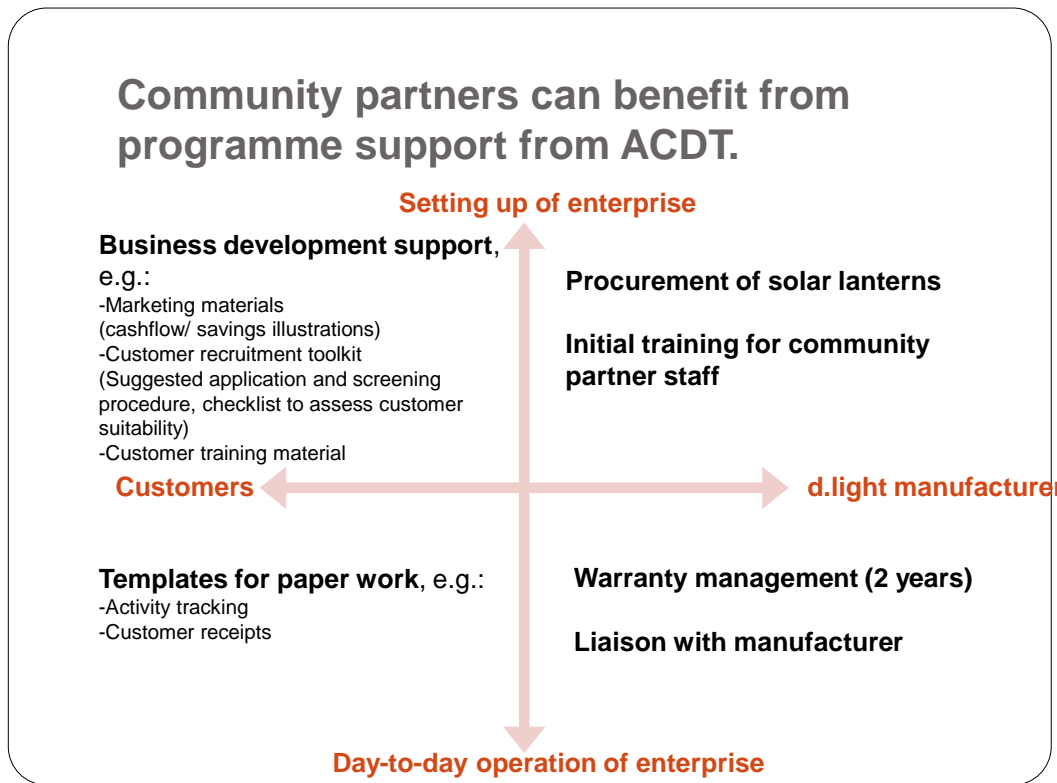


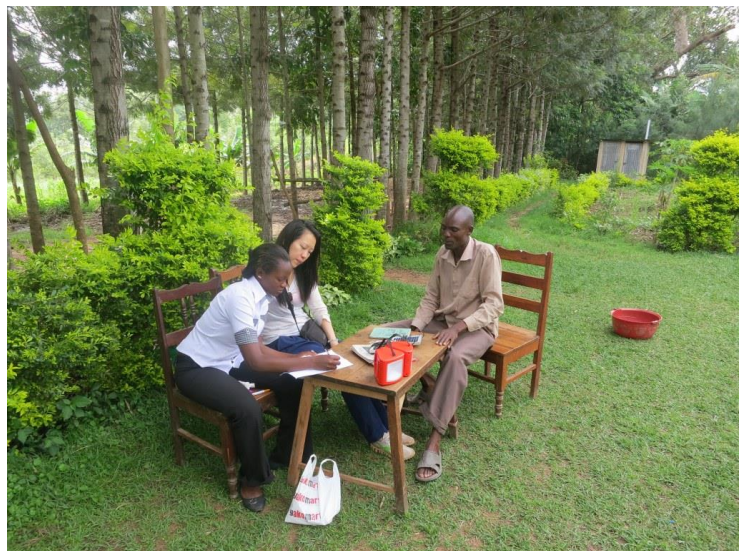
Figure 30 ACDT will justify the premium paid by community partners by supporting the establishment and day-to-day operations of the social enterprise. Note that most of these require only a one-off effort and minimal upkeep.

Annex

Case Studies

Cassim

Cassim's passion for projects manifests itself in his immaculately manicured garden. As a teacher, he really appreciates the extra light-hours that his solar lantern brings him. They allow him to prepare his lessons and grade his students' homework not just in the evening but also in the early mornings. When asked what his plans were with regards to the savings, he enthused, "I try to motivate my children in their academic pursuits by offering them presents when they meet certain goals. My daughter, Brenda, is really looking forward to getting a new dress."





Mustafa, also a teacher, is a father to two energetic boys. Not only did he give us a very positive and enthusiastic review of the d.light solar lantern, he couldn't wait to show us where he has planned to build a chicken enclosure with the savings, which will allow him to keep more chickens and use it as a side business to supplement his household income. Mustafa then added, while beaming ear to ear, "After completing the chicken enclosure, I am going to open a bank account for my firstborn!"



Even though ACDT's target customers in the context of the d.light project are individuals, one primary school decided to purchase d.lights to use during class.

For a site visit, we arrive at the school at 6:30pm. The sun is starting to set and the pupils are gathered in their classroom for evening prep, their last activity before school finishes at around 7pm. As the students work on their maths homework, we talk with Moses, the class teacher. He tells us that the school used to collect, sometimes with difficulty, money from pupils every term in order to purchase kerosene for the lantern that was used in the evenings and early mornings. Fortunately when the school suggested purchasing d.light solar lanterns, the parents were very receptive. With just a one-off payment to fund the purchase they would eliminate the recurrent fuel fees required to maintain the kerosene lanterns.

It turns out that the kerosene lantern, being fragile and flammable, caused an accident a year ago when some pupils arrived at school early and tried to set it up themselves. "With the solar lantern," Moses adds, "the children now enjoy more autonomy and can start their morning prep sessions as soon as they arrive at school, even if the teachers are not there yet."

Despite using four d.lights in each classroom, the d.light is not optimised for use in a spacious classroom setting after all, and the light is not evenly spread. The school has applied for electricity and is looking forward to having it installed, although no date is set yet. Moses concludes, "In the meantime, the solar lanterns are a good interim solution."

Sample Survey

ACDT Light Up Kenya Project Phase 1 Impact Assessment Questionnaire

1. General information:

- 1.1. Name of respondent
- 1.2. Age
- 1.3. Postal Address
- 1.4. Name of village Sub location
- 1.5. Name of Location Division
- 1.6. Name of sub county County
- 1.7. Mobile No.
- 1.8. Role within the household
- 1.9. What is the highest level of Education you attained?
- 1.10. Name the sources of household income
- 1.11. On average, what is your household monthly income?
- 1.12. What is your household size?
- 1.12.1. How many children (under 18) are in the HH?

Sex (M/F)	Age	Schooling? (Y/ N)	If not schooling, why?

- 1.12.2. How many adults are in the HH? (Specify if they perform salaried work.)

Role in HH father, mother, son, etc.)	Age	Work	Salaried (Y/N)

- 1.13. Number of huts/ buildings in the household (excluding the latrine)
 - (a) Temporary
 - (b) Semi permanent
 - (c) Permanent

1.14. Ownership of other appropriate technologies: (specify examples, eg water filter, solar cooker, other solar lights, etc.)

2. Initiation

2.1. Initiation to ACDT (approached by staff, recommendation from friends and family, etc.)

2.2. Were you a beneficiary of ACDT before the d.light project? (Y/N)

2.3. What other ACDT programmes are you participating in?

2.4. How did you hear about the d.light? (from ACDT, from other users, etc.)

2.5. Do you know about the partnership between Kopernik and ACDT?(Y/N)

2.6. What information did you receive before you made the decision to buy the d.light? (physical product, demonstration, pictures, oral description, etc.)

2.7. Why did you want to buy the d.light? (What expectations did you have?)

2.8. What support did you ask for and receive after your purchase? (repairs, replacement, demonstrations, questions, etc.)

2.9. Who made the decision to buy the d.light. How many d.lights did you get? (specify replacements, if any)

2.10. Which models?

2.11. At what price?

2.12. What was the payment system? (cash, subsidy, instalment, etc.)

2.13. If you paid in instalments, how many instalments? How much was each payment?

3. Social and Economic Impact

Please specify the following for both before and after the purchase of the d.light:

3.1. Sources of lighting: (electricity, kerosene light, candle, generator, d.light, etc.)

Before

Source electricity, kerosene light, candle, generator, d.light etc	No of hours	Spending (KSH/week)	Purpose	Health problems	Any other problem/ comments

After

Source electricity, kerosene light, candle, generator, d.light etc	No of hours	Spending (KSH/week)	Purpose	Health problems	Any other problem/ comments

3.2. On average, how many hours do your children spend on studying at night?
 (a) Before the d.light
 (b) After the d.light

Regarding the changes brought about by the d.light:

3.3. Do you think you are enjoying more hours of light per day? (Y/N)

3.3.1. If yes, how many more?

3.4. What do you use the extra hours of light on? (Use the following prompts if necessary.)

3.4.1. Economic activity

3.4.1.1. How much more money do you earn?

3.4.1.2. How much money are you saving with the d.light?

3.4.1.3. What are you spending this money on?

3.4.2. Social activity (Charging phone for neighbours, lending d.light for special occasions, visiting friends, etc.)

3.4.3. Education (any improvement in grades?)

3.4.4. Household chores, etc

3.4.5. If you own the d.light S250, how often do you use the mobile charging capability?

3.5. (If previous sources of lighting are still used after the purchase of the d.light, ask why.)

3.6. Please describe any changes on your household health situation since you used the solar light.

3.7. Please describe any other changes since you used the solar light (e.g. risk of fire, dirt from the smoke etc).

4. Questions for children

4.1. Do you use the d.light? (Y/N)

4.2. If yes:

Purpose	No. of hours	Previous light source	Comments

4.3. What do you like best about the d.light?

4.4. What do you like least about the d.light?

4.5. How can it be improved?

If the child uses it for studying

4.6. Can you describe how you use the d.light? (e.g. Put it on table, hang it up on the ceiling,ec.)

4.7. Are you studying more because of the d.light?

4.8. How much more? (h)

4.9. Have your grades improved? Give examples.

If not:

4.10. Why are you not using the d.light for studying?

4.11. What light sources do you use for studying?

Source	No. of hours	Problems	Other comments

5. Rating

Please rate and comment on the following aspects of the d.light on a scale of 1 to 5:

(1- very poor, 2- below expectations, 3- average/meets expectations, 4- exceeds expectations, 5-excellent)

5.1. Brightness

5.2. Steadiness of the light

5.3. Durability

5.4. Size

5.5. Price (specify how much you think the price should be)

5.6. Ability to meet your expectations in general

5.7. Overall quality of product

6. Problems and suggestions

6.1. Regarding the use of the d.light:

6.1.1. How often do you charge the d.light?

6.1.2. For how many hours each time?

6.1.3. How many hours of good quality light do you get from each charge?

6.2. What do you like most about the d.light?

6.3. Any problems you encounter when using the d.light?

7. Distribution strategy

7.1. Did you pay in a oneoff payment? (Y/N)_____ If not, what was the arrangement?

7.1.1. If by instalment, are you happy with the instalment plan?

7.1.2. Did you have difficulties meeting the payments?

7.1.3. What changes would you like to see in order to make the instalment plan more appropriate for you?

7.2. Would you prefer a different business model? Instead of buying a d.light for your household, would you rather: pay per use, lease, share with neighbour, etc.

7.3. At X KSH (appropriate price as per user), how many d.lights would you buy for your household?

8. Visual check

8.1. The number of d.lights in the household

8.2. How is it set up when being used? (eg. Hung up in the living room, placed on table, etc.)

8.3. Where is the solar panel kept?

8.4. Look for areas of uneven and excess wear and tear

8.5. Check the following parts are functioning

Part	Comments
Casing of d.light	
All 4 light settings	
Phone charging port on light	
Solar panel	
Wires	

8.6. Is it serving any purpose other than what is intended?

8.7. Look for modifications and customisations

9. Feedback on different d.light models- show respondents the S2 and the 250 and note their reactions, concerns and interest

10. Other questions

10.1. Any other feedback

10.2. In what other domains in life would you like to receive assistance? (Eg: lighting, cooking, healthcare, etc.)

10.3. What other appropriate technologies would you be interested in buying?

Any other observations/ comments

