



AN INNOVATION OF



## **Pilot Baseline Study – Report**

### ***Market Presence of Off-Grid Lighting Products in the Kenyan Towns of Kericho, Brooke, and Talek***

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#### **About Lighting Africa**

Lighting Africa, a joint World Bank and IFC program, seeks to accelerate the development of markets for modern off-grid lighting products in Sub-Saharan Africa where an estimated 10 to 30 percent of household incomes is spent on hazardous and low quality fuel-based lighting products. The goal is to mobilize and provide support to the private sector to supply quality, affordable, clean and safe lighting to 2.5 million people by facilitating the sale of 500,000 off-grid lighting units by 2012 while, at the same time, creating a sustainable commercial platform that will realize the vision of providing 250 million people with modern off-grid lighting products by 2030. This platform will provide an avenue for social, health and economic development, especially for households and small businesses that will realize significant cost savings and increases in productivity.

*Lighting Africa is implemented in partnership with: the Global Environment Facility (GEF), the Energy Sector Management Assistance (ESMAP), The UK Department for International Development (DFID), Good Energies Inc., Luxemburg, The Netherlands, The Norwegian Ministry of Foreign Affairs, The Public-Private Infrastructure Advisory Facility (PPIAF), The Renewable Energy & Energy Efficiency Partnership (REEEP), and the Asia Sustainable and Alternative Energy Program (ASTAE). For more information: [www.lightingafrica.org](http://www.lightingafrica.org)*

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## Overview

One focus of Lighting Africa is providing off-grid lighting market intelligence. LED-based lighting technologies are beginning to be available to African consumers, and it is a critical time in terms of market preservation. The quality and price of the first wave of LED products will drive consumer expectations – if the first impression of improved efficiency lighting technologies is negative it may be difficult to affect widespread adoption due to market spoiling. This Pilot Baseline Study Report provides a snapshot of an African lighting market in transition as Lighting Africa’s programs ramp up to combat market spoiling and improve consumer access to affordable, efficient off-grid lighting.

The market for off-grid lighting products in Sub-Saharan Africa currently includes both fuel-based and electric products. This report focuses on characterizing the availability and price of *electric* off-grid lighting products in Kenya based on a survey of retail vendors in selected geographic areas. We designed and deployed the survey and field observation study in June 2009 in the Kenyan towns of Kericho, Brooke, and Talek. Included in the study are all the products that have electric light sources, are available as a unit, are used for illumination, and do not require a connection to grid electricity. The products included range from dry cell incandescent torches (i.e., flashlights) to solar lanterns and preconfigured mini solar home systems. We did not include full sized solar home systems in the study.

### The Pilot Study Sites

Kericho is a large town (~100,000 pop.) in the prosperous tea growing region in the highlands of southwest Kenya. Brooke is a small town that is close by (~5 km). Talek is a small market center that is far from any large towns and is off the grid.

## Summary Results

A summary of our key findings is provided below.

- The off-grid lighting product market consists primarily of torches (flashlights), with very few task or ambient lights currently available for purchase. The few lamps identified that included task and ambient lighting features that were available were primarily part of a “combination” light (e.g., a torch that has an ambient gooseneck feature or an array of LEDs on the side).
- The products that are most widely available are very low cost, with a median retail price of 110-150 Kenyan Shillings (Ksh; this is equal to approximately \$US 1.50-2.00) in the towns we surveyed. Very few were priced above 300 Ksh.
- A large number of products and brands of off-grid lighting products are available in the market; in the town of Kericho, for example, we observed 115 distinct products for sale. Nearly all of these products had a torch form factor.
- We estimate that the market size for low cost off-grid lighting products in Kericho is 30,000 to 40,000 units annually. We estimate the national market exceeds one million units per year.
- We observed numerous quality problems among the ubiquitous low cost LED torches available in the market. Sellers of the products indicated that many customers are dissatisfied with LED product quality. Moreover, field observations indicate that LED torches provide the only experience that most end-users have had with LED products. This suggests that market spoiling for LED-based lighting products is almost certainly already occurring on a significant scale. Commonly cited product failures included LED failure after impacts (from dropping), early battery failure, and general durability issues.
- We recommend that the baseline study be carried out in other towns and villages in Kenya to identify the geographic variability of the market, with minor modifications reflecting our experience with the pilot study.

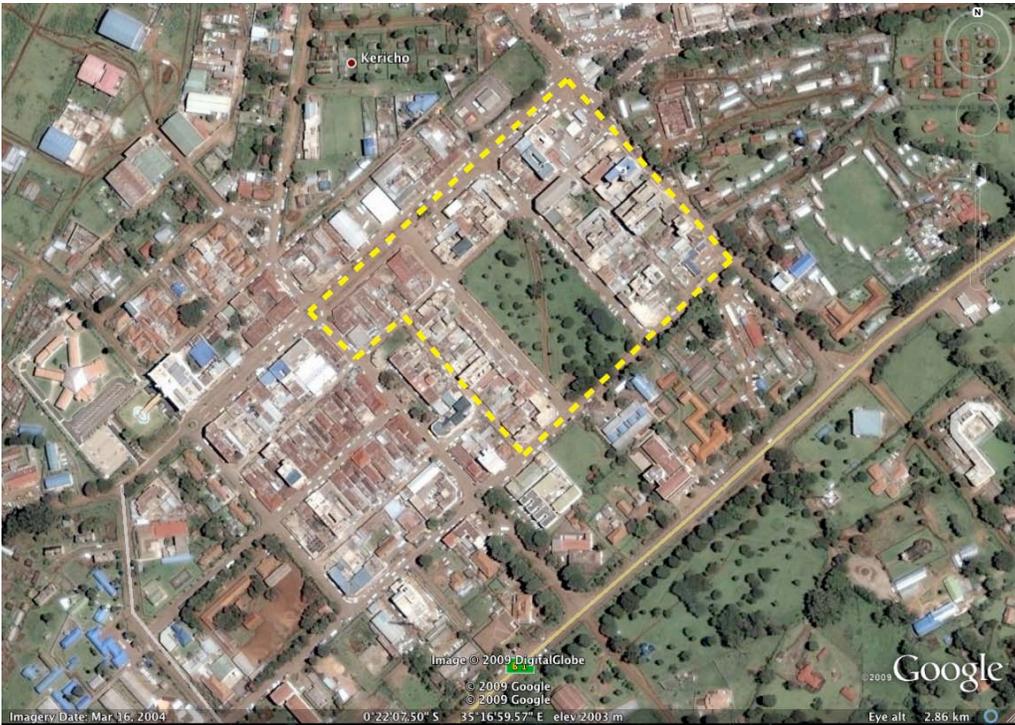
# 1 Introduction

In June 2009, Lighting Africa (LA) team members<sup>1</sup> undertook a market presence survey in the towns of Kericho, Brooke, and Talek. All three towns are located in Kenya’s Rift Valley Province. The purpose of the survey was to establish the availability, price, and other characteristics of off-grid electric lighting products (hereby known as “products”) in each town. In this document we present background information about the towns and the method we used to collect data. Next, we present analyses of the data that we collected, including quantitative survey results as well as a number of additional field observations. In the final sections, we include descriptions of the baseline market in each town.

## 1.1 Geographic Background Information

### **Kericho (S 0.369 E 35.284)**

Kericho is a large town in a tea growing region, with approximately 100,000 residents. Multinational corporations (Unilever Tea Kenya Limited and James Finlay (Kenya) Limited are the two largest producers) and small holders grow and process tea in the surrounding area, and the town center is the commercial hub of the area. In town there is widespread electricity access for those who can afford a grid connection. The center of Kericho town and the surrounding tea areas are shown in Figure 1. Our survey covered an area near the town center, where electronic goods stores are concentrated. The boundary of our study area is noted on Figure 1. Figure 2 shows a typical scene on the street in central Kericho.



*Figure 1: Aerial image of central Kericho, with the boundary of the baseline market study indicated (yellow dashed line).*

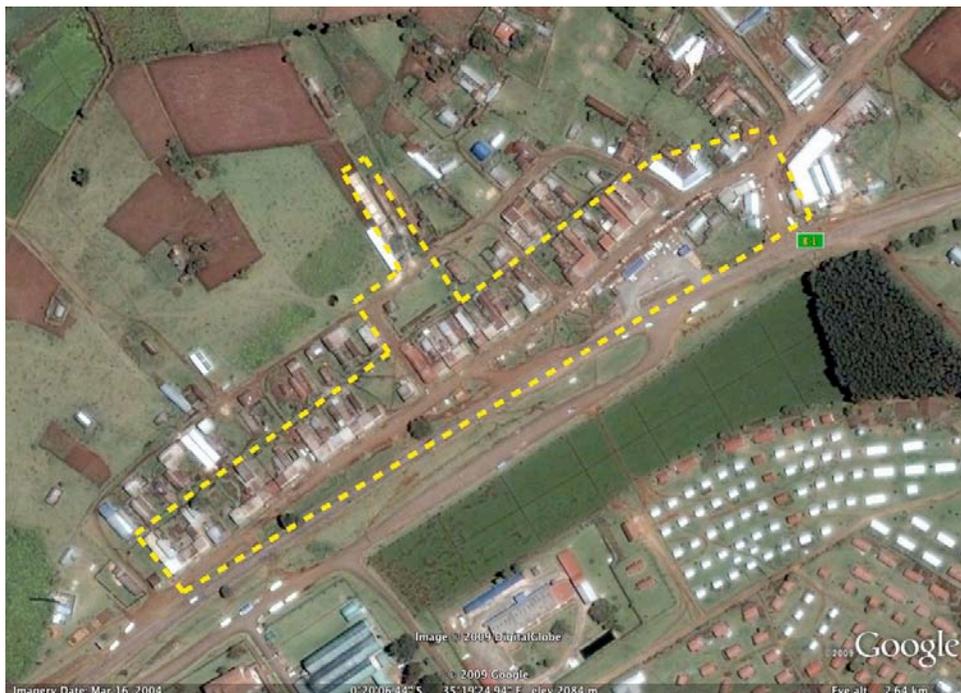
<sup>1</sup> Arne Jacobson, Peter Johnstone, Maina Mumbi, Jenny Tracy



*Figure 2: Street scene in Kericho*

**Brooke (S 0.336 E 35.323)**

Brooke (also known as Kapkugerwet), is a small market center outside of Kericho town. It is adjacent to the main offices of Unilever Tea Kenya Limited (previously the Brooke Bond Tea Company). There is electricity access for those who can afford a grid connection. Our survey covered the commercial area, as noted on Figure 3. Figure 4 shows a typical street scene from Brooke.



*Figure 3: Aerial image of Brooke with the boundary of the baseline study indicated (yellow dashed line).*



*Figure 4: Street scene in Brooke (Kapkugerwet)*

**Talek (S 1.442 E 35.215)**

Talek is a small town in southern Rift Valley Province, located near one of the entrances to Maasai Mara National Park. There are several lodges and hotels in the area for tourists who are visiting the park, and support of tourism is a large part of Talek's economic base. Additionally, people raise livestock and farm in the area. The electric grid does not extend to Talek, although mobile telecommunications are now available there. Our survey covered the commercial area. There is no map indicating the study area due to a lack of good aerial imagery from Talek. Figure 5 shows a street scene in Talek.



*Figure 5: Street scene in Talek at dusk*

## 2 Methods

We developed a set of sampling, survey, and observation methods to achieve the data collection goals for the study. In this section, those methods are outlined.

With the goal of accurately capturing the baseline presence of off-grid lighting products in the market, we established the following definition for “off-grid electric lighting products” to define the scope of our survey:

- Has energy storage incorporated into the product (or uses dry cell batteries).
- Has an LED, fluorescent, incandescent, and/or other electric lighting source.

The definition was intentionally broad to ensure that we captured the full range of products, including “traditional” dry cell incandescent torches.

In each town, our first task was establishing the geographic scope of our study, according to the guidelines listed below:

- Center the study area to achieve the highest commercial density possible.
- Create a study boundary that is sensible (based on blocks and streets), and is a relatively normal polygon (we sought to avoid irregular shapes).
- Limit the size of the study area based on the available time for surveying.

In practice, we began our survey without a fixed boundary and established the boundary as we learned how quickly we could cover areas.

The general practice during a surveying day was to systematically administer the survey (Appendix 1) on a shop-by-shop basis. Figure 6 shows LA personnel searching the back streets of Kericho for shops that peddle off-grid lighting products. The survey included questions about the interviewee, the shop, the off-grid lighting products sold in the shop, and the shop’s customers. After completing the survey, we used a handheld GPS device to mark the location of the shop. Later, after completing the paper surveys, the data were entered into a database spreadsheet for each town.

A key to the process was convincing shop owners that our effort would not harm their interests (e.g., we are not from the Kenya Revenue Authority or representing a competitor). Once we established rapport with a shop owner, the interview commenced. Figure 7 shows Maina Mumbi conducting an interview with a shop owner in Kericho.



*Figure 6: Study team members searching the survey area in Kericho for off-grid lighting products.*



*Figure 7: Maina Mumbi (foreground) interviews a woman about the availability of off-grid lighting products at her shop, in Kericho.*

## 3 Findings

In this section we present the study results. We begin by summarizing product availability and diversity in each town. This is followed by sections on product pricing, supply chain structure, and the geographic distribution of shops in the towns. Next is a section focused on key market sellers of off-grid lighting products, ranging from wholesale dealers to street vendors. We close with an estimate of market size and a discussion of product quality and the potential for market spoilage.

### 3.1 Availability and Diversity of Lighting Products

The markets for electric off-grid lighting products in Kericho, Brooke, and Talek offer varying ranges of products. As reported above, we observed 115 distinct products for sale in Kericho, 35 in Brooke and 16 in Talek. Some of the popular products were carried in multiple shops in each town, leading to our observation of 240 total products in Kericho, 54 in Brooke, and 25 in Talek. As expected, the large town of Kericho offered the greatest number and widest variety of products, followed by Brooke then Talek.

Figure 8 is a summary of physical characteristics of all the observed products in each town. In each market, the dominant form factor was torches (flashlights), accounting for ~90% of the available products in Kericho and Brooke and all of the products in Talek. There were a number of hybrid form factor products available in Kericho and Brooke that incorporated task light and, to a lesser extent, ambient light features into a product that served primarily as a torch. An example of a typical torch-task light combination is pictured in Figure 9. It is a light that was shown to us by a staff member of the guesthouse where we lodged in Kericho. Ambient-torch combinations were less common. An example of one that we observed at a shop in Kericho is pictured in Figure 10.

LEDs dominated the market in terms of light source for the products we observed. Anecdotal observations in Kenya by one team member over a number of years indicates that LEDs were emerging as a significant lighting technology by 2007, but at that time they had not yet eclipsed the “traditional” incandescent bulb in torches. However, it is apparent that LEDs are now the clear technology of choice for these products. Incandescent products, however, are still available in each town. In fact, the most common product in Brooke was the “Kaida 2D”, a metal-bodied, dry cell, incandescent torch. However, only one shopkeeper estimated that it was their best seller, indicating that the wide availability may be due largely to languishing dead stock.

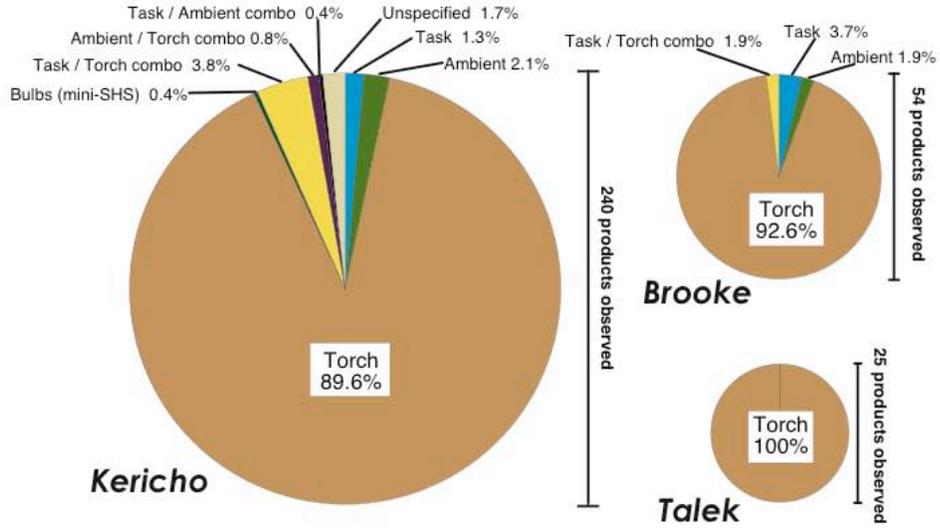
Perhaps the most interesting variability between the markets was in the available energy sources for the products we observed. In Kericho, a majority (56.3%) of products contained rechargeable batteries with integrated grid charging systems. The next most frequent energy source was dry cell batteries (39.2%), the “traditional” off-grid energy source, followed by a very small number (0.8%) of solar-recharged products. In Brooke, dry cell products (57.4%) were more widely available than grid charged products (42.6%), which may have been due to a relative lack of access to grid electricity for people who shop in that town. In Talek, which is far from the grid, dry cell products (80%) dominated the market.

For people who lack free access to grid electricity, fee based battery charging services were available in each town we surveyed. The fee in grid-connected Kenyan towns (like Kericho and Brooke) is typically 20 Ksh/charge for products with small batteries (e.g., mobile phones, torches). Charging services were also available in Talek (an off-grid town) at shops with small solar electric systems. The fee in Talek was also 20 KSh/charge, despite the higher cost to provide the service in the absence of grid electricity. A detailed treatment of the economics of off-grid lighting is available in Radecky et al. (2008)<sup>2</sup>

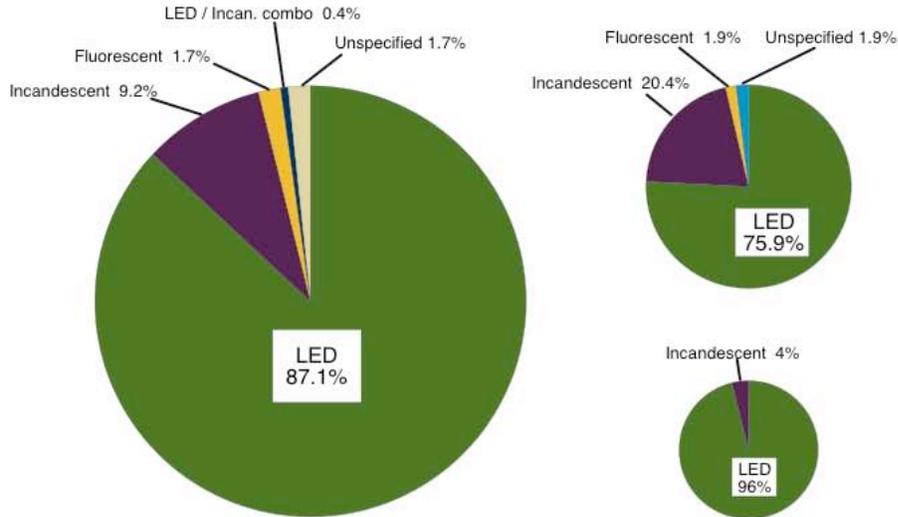
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<sup>2</sup> Radecky, K., P. Johnstone, A. Jacobson, and E. Mills "Solid-State Lighting on a Shoestring Budget: The Economics of Off-Grid Lighting for Small Businesses in Kenya," Lumina Project Technical Report #3, <http://light.lbl.gov/pubs/tr/lumina-tr3.pdf>

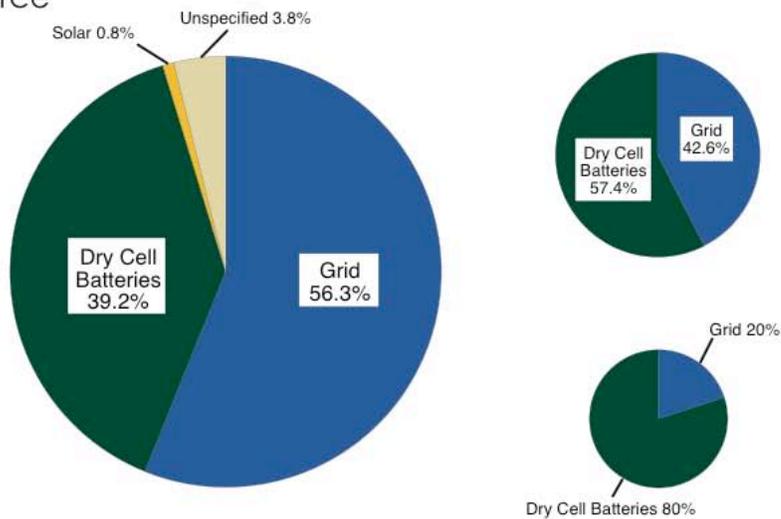
## Form Factor



## Light Source



## Energy Source



**Figure 8:** Characteristics of observed off-grid lighting products



*Figure 9: A torch / task light hybrid product, being shown to us by a worker at a Unilever guesthouse near Kericho. It is currently being charged using AC grid electricity. He is extending a task light head from its cradle in the handle of a torch. It is a common product that can be found in town. Note that there is no feature preventing the lamp from being switched on during charging.*



*Figure 10: A torch / ambient light hybrid product, available in Kericho. The ambient lighting is achieved by a conical mirror (visible on top) which scatters the light of upward-facing LEDs.*



Figure 11: A combination torch / task / ambient light that we observed in Kericho with an unusual design; it has an LED "spotlight", a fold out array of LEDs, for task lighting, and an incandescent bulb on top for ambient lighting. The light is powered by a somewhat large 12 V sealed lead acid battery that includes an indicator gauge for the voltage (state of charge).

### 3.2 Prices of Available Off-Grid Lighting Products

Low-cost LED torches dominate the market in each town we surveyed. A statistical summary of the prices we observed in each town’s market is presented in Table 1. The median price in each is at or below 150 Ksh, approximately \$2 US, an order of magnitude smaller than some of the emerging products (particularly solar charged products) that are currently being developed for markets in developing countries. An inspection of the full distribution of prices (Figure 12) shows that the available products are currently concentrated below 300 Ksh, with few products priced above that level. It is notable also that there does not appear to be appreciable price inflation in the smaller towns of Brooke and Talek compared to Kericho, a large town with a diverse and large market for off-grid lighting products.

Table 1: Statistical summary of off-grid lighting product prices in Kericho, Brooke, and Talek.

Metric		Kericho (n=239) <sup>3</sup>	Brooke (n=54)	Talek (n=25)
Mean price	(Ksh)	162.28	120.96	153.20
Median price	(Ksh)	130	110	150
Std. Deviation of price	(Ksh)	183.85	87.48	65.81

Of the 115 distinct products available in Kericho, there are six “most commonly available” ones that comprise 70 instances of 240 total lighting products we observed for sale. That is, these six, which made up 5% of the available product models, account for 29% of the market presence in Kericho. Table 2 summarizes our observations related to them: the number of observed shops that carry each, the median price, and a quartile box plot of the prices we observed. For reference, the table also includes the median price and a quartile box plot for the entire Kericho market. The Casibao CA 199 and Jinge JG 6170 are essentially identical in design (3x 5mm LED Torch with grid-charged SLA) and were ubiquitous in Kericho. Conversations with shop owners confirm that these products are among the top selling units.

<sup>3</sup> An outlier in the Kericho dataset was disregarded for this statistical analysis: a 15,000 Ksh mini-solar home system.

The next most commonly seen products were small, disposable keychain LED lights (one or two 5mm LEDs with integrated button-cell batteries and a switch). Following those were two torches that are LED-based and require 2 dry cell “D” batteries (like “traditional” torches), the Lion Head and Diamond brand torches. Torches like those comprise the majority of the market in Talek. The final product on the “most commonly available in Kericho” list is the Jinge JG 6162. It is a grid-rechargeable LED product similar to the CA 199 and JG 6170 with more LEDs (five vs. three) and a battery that is advertised to be larger. There are no tables of this type included for Brooke or Talek because the markets are smaller and do not lend themselves to a similar analysis.

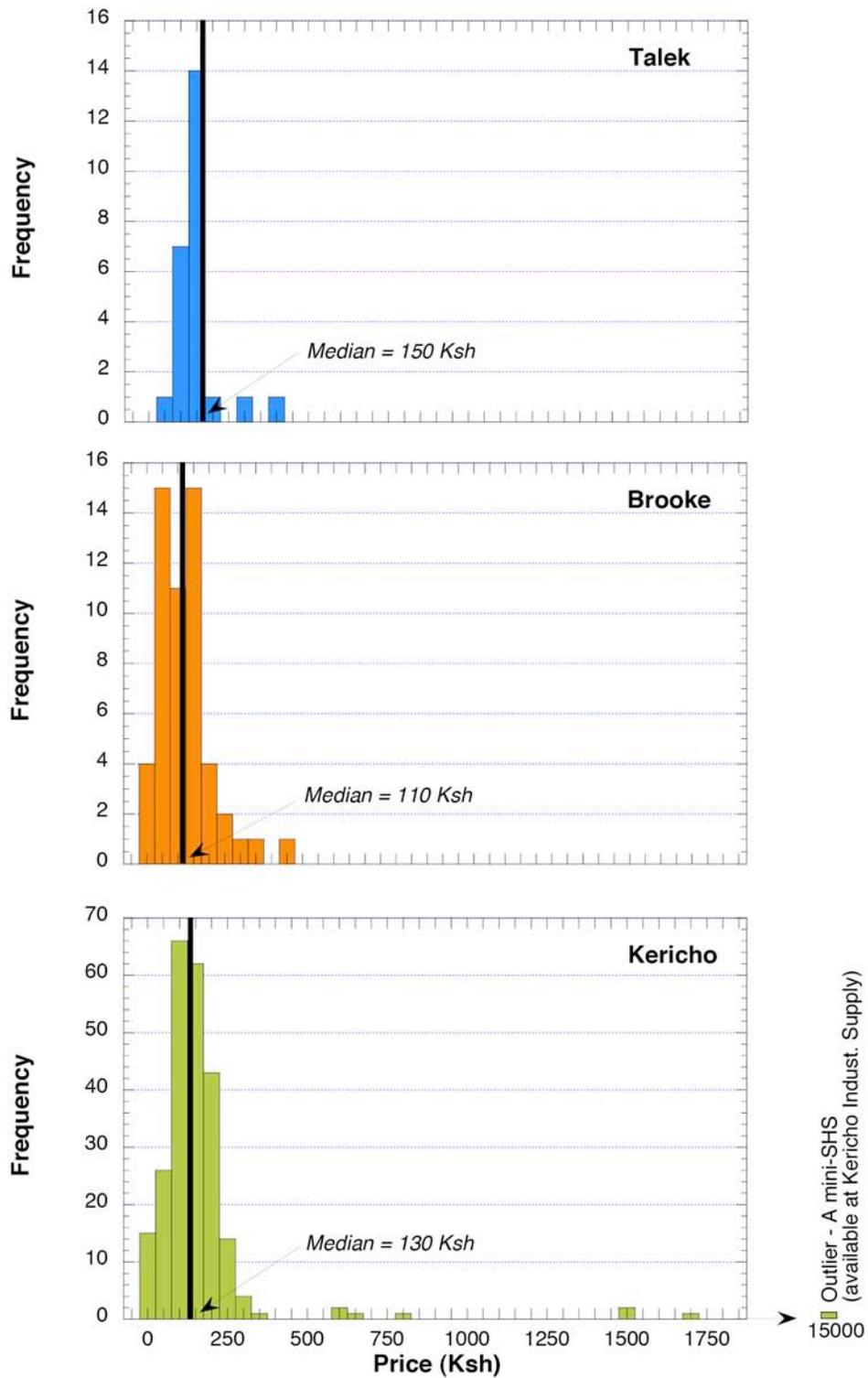


Figure 12: Histogram of the observed prices for all the available products in Kericho ( $n=240$ ), Brooke ( $n=54$ ), and Talek ( $n=25$ ). The median price in each town is also noted, along with an outlier in Kericho. Note that the y-axis (frequency) is scaled differently for the Kericho data because the sample size is larger.

**Table 2: Summary of the most commonly available products in Kericho**

Product	Incidence (#)	Median Price (Ksh)	Box Plot - Price Quartiles
All Products in Kericho town	n/a	130	<p style="text-align: center;"><b>Price (Ksh)</b></p> <p>0 50 100 150 200 250 300 350 400</p>
Casibao CA199	19	130	
Jinge JG6170	14	135	
Mini-keychain	12	20	
Lion Head LED	9	80	
Diamond	8	110	
Jinge JG6162	8	163	

### 3.3 The End of the Off-grid Lighting Supply Chain

The general stores, street hawkers, supermarkets, electronics wholesalers, and other shops we surveyed provide a snapshot of the end of the supply chain for off-grid electric lighting products. The shops in Kericho generally carried a greater selection of products (6.5 products/shop average) compared to Brooke (3.4 products/shop) and Talek (3.6 products/shop). Figure 13 is a probability plot showing the likelihood that a shop carries at least a given number of electric off-grid lighting products.

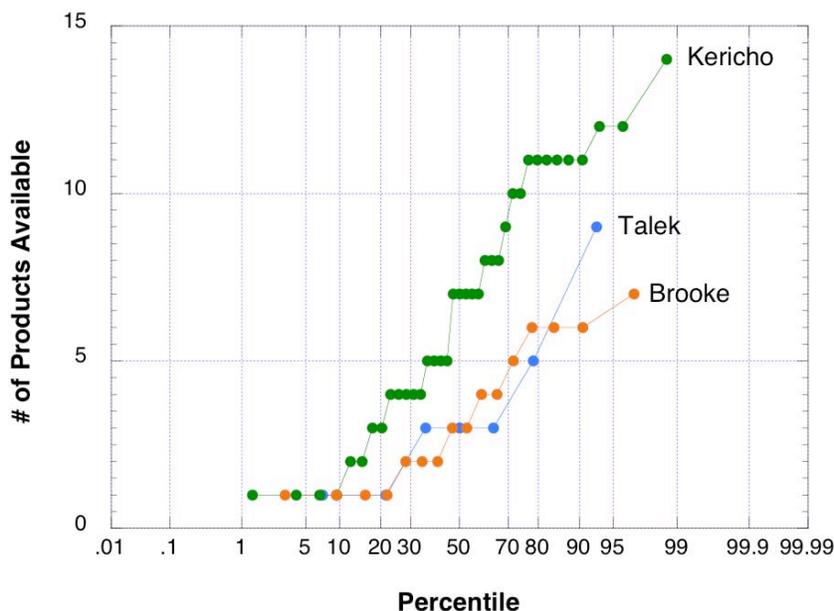


Figure 13: Probability plot of number of products available in a shop for Kericho, Brooke, and Talek.

Appendix 3 contains summary data on each shop we surveyed: the shop name, location, product availability and price information. Table 3 summarizes the key results of the short survey we administered to shopkeepers. The survey form is in Appendix 1. The highlights from Table 3 are:

- While most shop keepers that we interviewed were men, a significant fraction were women
- In Kericho there was a wide range of shop types that offer lighting products. Specialty electronics shops (41%) were the most common shop carrying off-grid lighting products. A vibrant outdoor market served by hawkers and people with temporary displays (23%) were also centrally important in the off-grid lighting product supply chain.
- In Brooke and Talek, general shops were the most common vendor of off-grid lighting products (63% and 86% respectively), although both towns also had one or more electronics shops. Lighting products are not generally available in either town from hawkers or vendors with temporary displays.
- The shops that sell lighting products in each town are predominantly small operations, with a majority having 1-2 employees. Kericho also has several larger shops (i.e., > 3 employees). There is one larger shop in Brooke.
- Lighting products were available on a strictly retail basis in Brooke and Talek, while there was a mix of retail and wholesale vendors in Kericho. Only 58% of sellers in Kericho were strictly retail shops; the others did some or all of their business on a wholesale basis.
- In each town, some shops were offering LED and/or fluorescent off-grid lighting products for the first time during the 3 months previous to our survey. Others had offered such products for longer periods. In Kericho, LED and fluorescent products had been available for over 3 years, in Brooke for about the last 3 years, and in Talek for about 2 years.

**Table 3: Shop survey summary results**

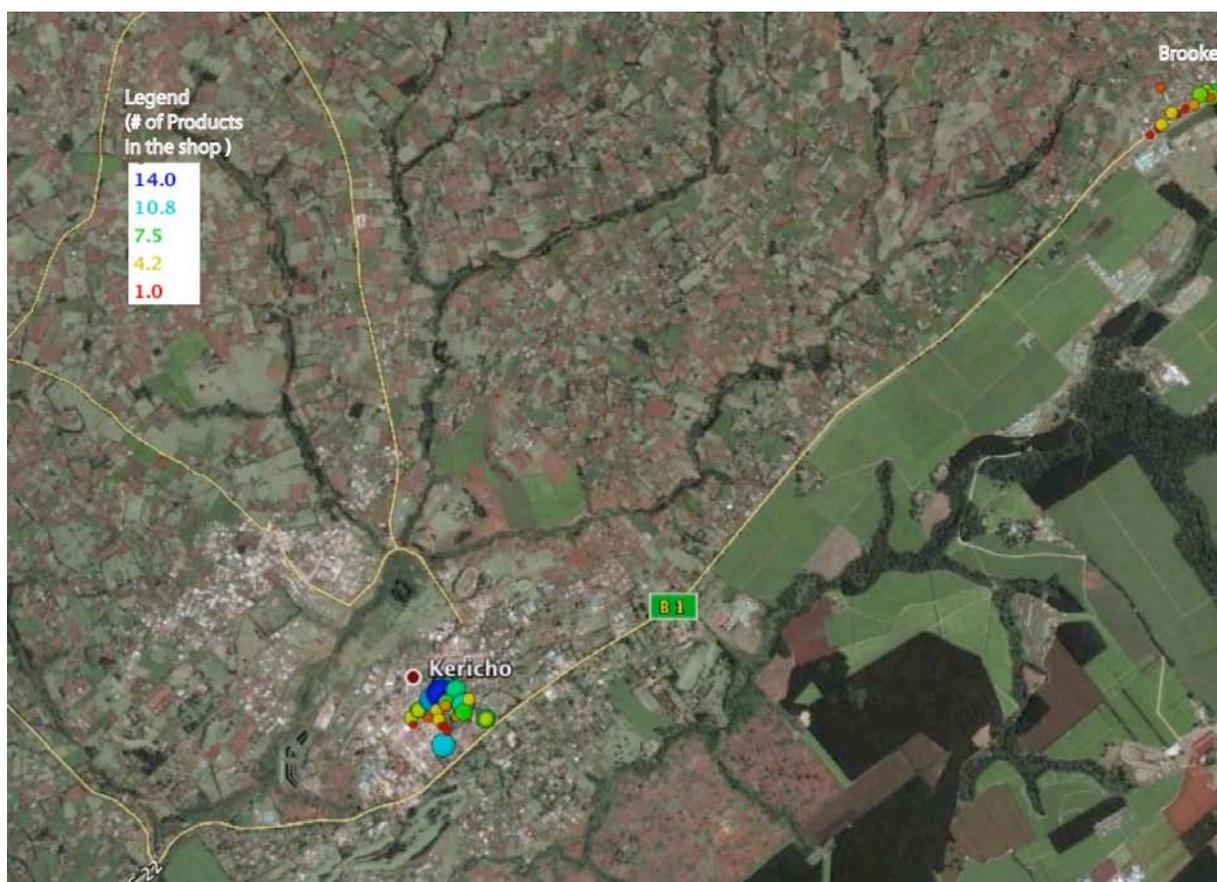
<b>Information</b>	<b>Kericho (n=37)</b>	<b>Brooke (n=16)</b>	<b>Talek (n=7)</b>
Gender of Interviewee			
<i>Male</i>	73%	63%	29%
<i>Female</i>	27%	31%	71%
<i>Unspecified</i>	0%	6%	0%
Shop Type			
<i>Electrical and Electronics</i>	41%	13%	14%
<i>General Shop</i>	27%	63%	86%
<i>Super Market</i>	3%	6%	0%
<i>Hardware</i>	3%	0%	0%
<i>Solar Specialty Shop</i>	0%	0%	0%
<i>Kiosk</i>	0%	0%	0%
<i>Market Stall</i>	0%	13%	0%
<i>Blanket / Street Hawker</i>	24%	0%	0%
<i>Unspecified</i>	3%	6%	0%
Number of Employees <sup>4</sup>			
<i>1-2</i>	68%	88%	100%
<i>3-5</i>	22%	0%	0%
<i>6-10</i>	0%	6%	0%
<i>11+</i>	8%	0%	0%
<i>Unspecified</i>	3%	6%	0%
Sales Type			
<i>Retail</i>	58%	100%	86%
<i>Wholesale</i>	12%	0%	0%
<i>Retail + Wholesale</i>	27%	0%	0%
<i>Unspecified</i>	3%	0%	14%
Length of time they have offered LED or fluorescent lighting products			
<i>3 mo.</i>	14%	13%	14%
<i>6 mo.</i>	22%	0%	14%
<i>1 yr.</i>	22%	6%	29%
<i>1.5 yr.</i>	3%	6%	14%
<i>2 yr.</i>	22%	6%	14%
<i>3 yr.</i>	3%	6%	0%
<i>3+ yr.</i>	8%	0%	0%
<i>Not yet</i>	0%	6%	0%
<i>Unspecified</i>	6%	56% <sup>5</sup>	14%

<sup>4</sup> The total number of people present at the shop in a customer service role.

<sup>5</sup> The reason so many Brooke shopkeepers did not answer this question is unknown.

### 3.4 Physical Geography of Off-grid Lighting Shops

The geographic position data (latitude, longitude) we collected for each shop enables analyses of the data in a geographic context; they also will be helpful for finding shops during any follow up survey(s). In the maps in this section, each shop we surveyed is represented by a dot that is proportional in size (and color) to the number of products available at the shop. The base maps are copyrighted and from Google Earth. In some cases, the precision of the GPS receiver ( $\pm \geq 10\text{m}$ ) combined with inaccuracy in the satellite photos leads to the dots being shifted away from the true shop location. However, they are approximately in the correct place relative to each other and the base maps. Figure 14 shows the shops we surveyed in Kericho and Brooke on the same map. The towns are close by, and there is some overlap between the markets (i.e., residents from one market may buy in the other). Many Brooke residents likely do some business in Kericho, and to a lesser extent vice versa.



**Figure 14:** Map of Kericho and nearby Brooke, with dots indicating shops that offer electric off-grid lighting products. The relatively uniformly green lands at the bottom right of the image are large tea plantations, while most of the remainder of the non-town land shown in the figure is farmed by smallholder farmers (top and top left). The legend indicates the color “temperature” of the dots, a function of the number of products available at each shop. There are fractions indicated on the legend because it is evenly spaced over the color-space.

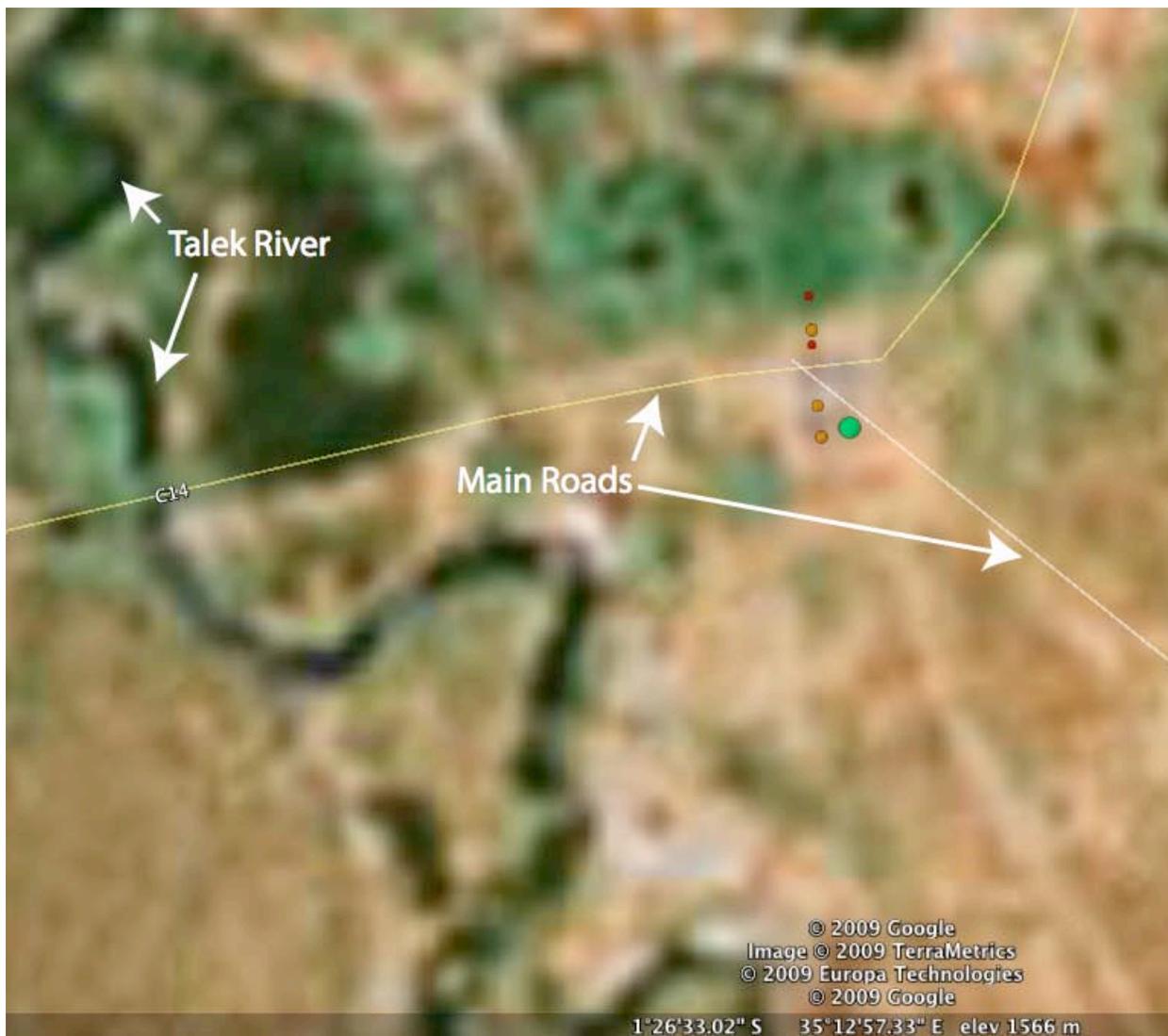
In addition to shops in nearby Kericho, people who live or work near Brooke have access to a number of lighting products from shops in Brooke. Figure 15 shows a more detailed map of Brooke. There is a cluster of shops with high numbers of products on the NE (top right) end of town. They include sellers that operate market stalls and small shops close to the largest shop in town, Kipchimchim Wholesale. This shop offers the widest selection of lighting products in town; seven products are available at an average price of 130 Ksh. Despite the reference to wholesale sales in the business name, the shop does not appear to supply lighting products on a wholesale basis to other shops in town. Based on our survey,

60% of shopkeepers in Brooke procure their products in Kericho. The rest, including Kipchimchim Wholesale, procure them from shops or agents in Nairobi. Twelve of the thirteen vendors who told us how they procure their products go to their source to pick them up. Only one has regular deliveries (from Kericho in their case).



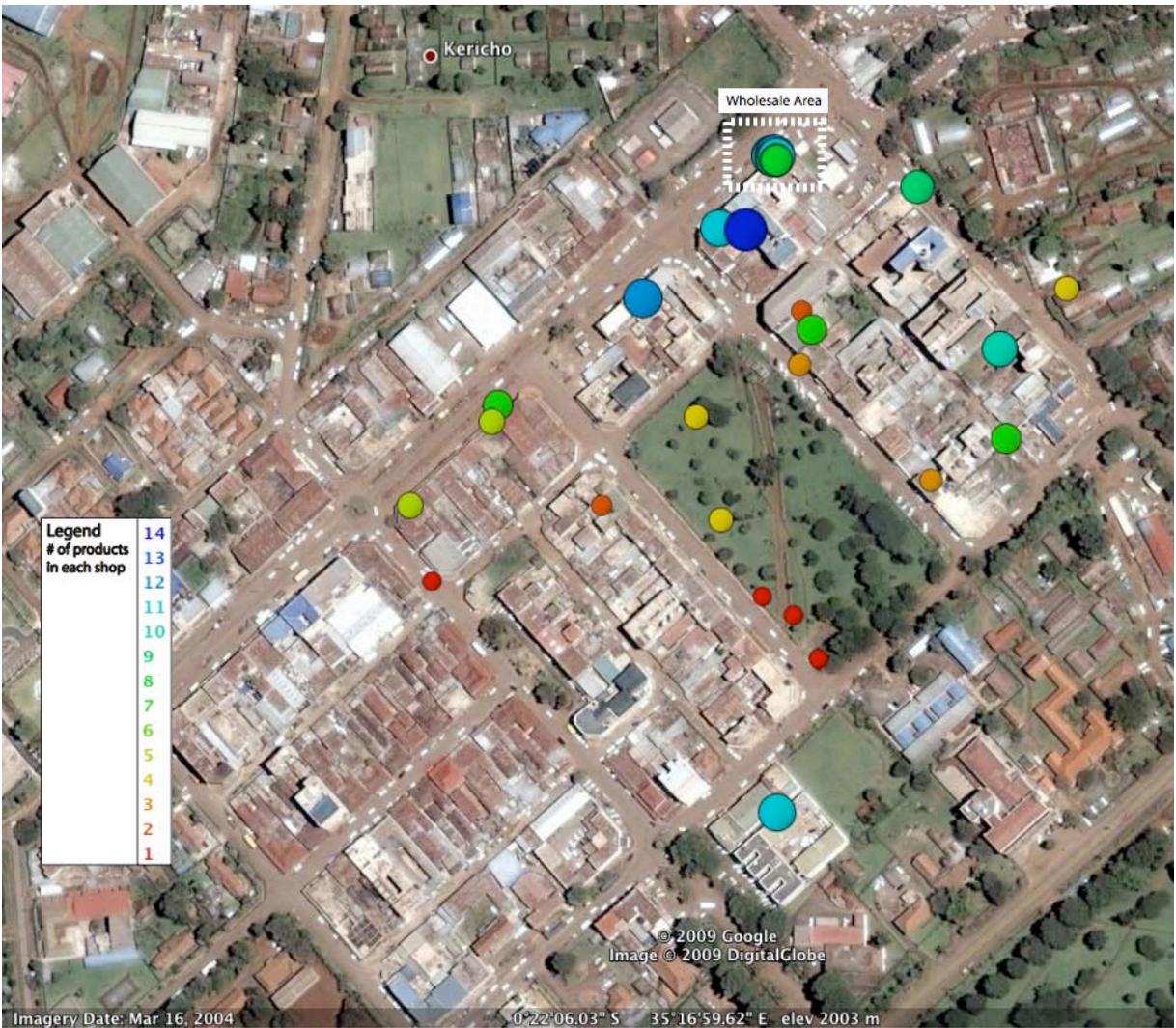
*Figure 15: Map of Brooke with dots indicating the location and number of products available at shops. Note that some of the points appear to be in the middle of roads; this is due to the precision of handheld GPS devices and potentially to base map inaccuracy*

Unlike Brooke, the town of Talek is not near a large town or city. Figure 16 is a map of Talek and the shops we surveyed there. The shops do not have a wide selection, as was shown by the lack of product options in Figure 8. Our survey area included the main “center” of the town, which is situated at a crossroads near an entrance gate to Maasai Mara National Park. The park boundary in the area is the Talek River. The shopkeepers in Talek procure their stock from markets in Nairobi (60%), Nakuru (20%), and Narok (20%). Those who buy from Nairobi go there to pick up new stock, while those who purchase from the medium sized cities of Nakuru and Narok have their products delivered, likely via matatu (private minibus).

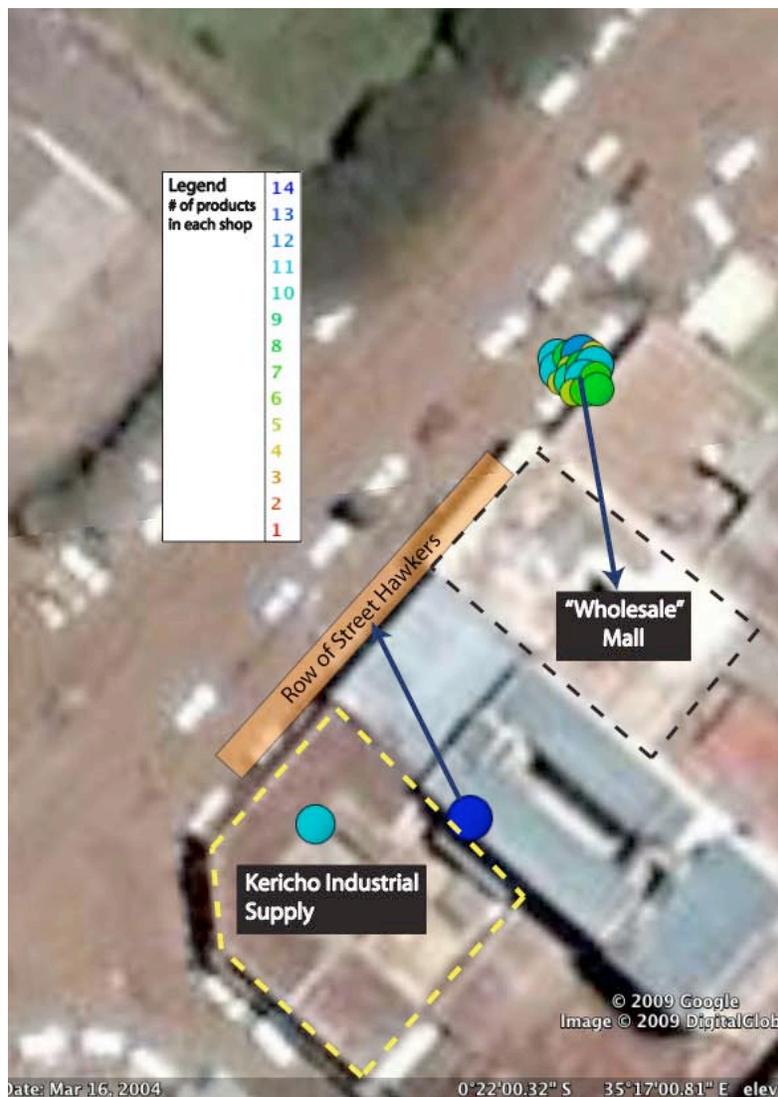


*Figure 16: Map of shops in Talek, with surroundings labeled for clarity.*

Off-grid lighting products are widely available across central Kericho, as shown on the map in Figure 17. Of the 240 available products we observed in 37 shops, 122 (51%) were in 15 shops that are housed in a multi-storey shopping center called the “Embassy Building” (labeled “wholesale area” on the map). A zoomed-in map of the Embassy Building and its neighborhood is shown in Figure 18. The shops inside include electronics and general shops that generally do a retail and wholesale business. It was clear to us that the shopping center was a hub of activity for the off-grid lighting market for both consumers and shopkeepers (e.g., those from Brooke who say they purchase stock in Kericho likely purchase here). Outside the shopping center, there is a long row of street hawkers who set up shop on the sidewalk that links the Embassy Building with Kericho Industrial Supply (a mainstay in the Kericho electronics goods market, open since 1978). The hawkers on that section of sidewalk as a whole provide the widest selection of products that we observed in Kericho (or any town), 14 in all. Their position is indicated by a large, dark blue dot on the Kericho maps (Figure 17 and Figure 18). The businesses of the street hawkers and electrical wholesalers in Kericho are two important and very different links in the supply chain for off-grid lighting products. They are pictured and described in more detail in a section that follows.



*Figure 17: Map of shops that offer off-grid lighting products in Kericho. A multi-level mall that contained a cluster of wholesale electronics shops is labeled.*



**Figure 18:** A zoomed view of the Kericho map. The cluster of shops in the "wholesale" mall is included, along with the nearby row of hawkers (larger dark blue dot) and Kericho Industrial Supply, a large store on the corner.

Thirty-six of 37 shopkeepers in Kericho shared information about where they procure their stock. Most of them (78%) get stock from Nairobi at least some of the time. Some (6%) go directly to China and/or Dubai to procure the latest products, skipping links in the typical supply chain. Five shopkeepers (14%) procure their stock locally in Kericho. A few others (6%) purchase from dealers in other medium sized towns (Nakuru and Nandi). Of those who told us the mechanism for product delivery (22 of 37 respondents), 77% go to fetch the goods themselves every time. An additional 14% have a regular delivery. The rest (9%) use both mechanisms.

### 3.5 Key Players in the Kericho Market – Hawkers and Electronics Shops

The street hawkers in central Kericho, particularly those near the Embassy Building, are an important set of players in the lighting products market and merit special attention. In addition to offering the largest selection of lighting products (14), they also offer belts, radios, shavers, music (CDs, etc.), toys, and other goods. Figure 19, Figure 20, and Figure 21 are pictures of their businesses.

The hawkers in the row near the Embassy Building operate as a pseudo-collective; they each have their own goods that are segregated from the rest (by boundaries that are not immediately apparent in some cases). Each hawker keeps an eye on the whole row (presumably to prevent thievery) and has a working knowledge of the goods available from the others. There does not appear to be significant price competition between the hawkers.

Because hawkers set up outside in the hot sun (“jua kali”), their products are subjected to high temperatures and dust intrusion (i.e., degradation). Some of them use cardboard to shield their wares when customers are not in the immediate vicinity, but the visible impact of direct sunlight on the products was apparent (e.g., the plastic casing of a number of products was faded). It is important to note here that the sealed lead acid batteries that commonly are included in rechargeable LED torches can be damaged by long exposure to high temperatures.

Lacking the structure of a standing shop, the hawkers report that they are subject to extraordinary verbal abuse and threats from customers who are angry that their products failed prematurely or otherwise do not function as they expected. The hawkers offered multiple anecdotes of customers who accosted them, demanding refunds and threatening physical violence. Because they do not have a physically defined shop from which to eject angry customers or a large staff, they feel they are more prone to customer recriminations than traditional stores and shops. Also, they lack legal standing and indicated that they cannot depend on the police to enforce their safety and livelihood.

Due to their mode of operation, the hawkers are impacted very negatively by low quality products and are on the front line of market spoiling. They have a strong incentive to learn which products are well made and can be trusted. Of all the shopkeepers we interviewed, the hawkers had the most detailed knowledge of their lighting products. For example, they pointed out a small set of holes in the case of the Casibao CA 199 (the most widely available product in the market) that were previously unrecognized by us. Apparently, early versions of the CA 199 included an adapter cord that allowed a user to power a small radio with the torch, a popular feature. The newer versions do not include that function but retain the holes, which led to some customer dissatisfaction. Their concerns about product quality cut across their entire offering; in addition to the lighting products they offer, they are also unsure of the quality of shavers, radios, and other goods. However, they said that they have “no choice” but to accept the assurances of their distributor about product quality when they arrive from Nairobi with new goods for sale.



*Figure 19: Torches, along with other goods, available from hawkers on the street in central Kericho.*



*Figure 20: A hawker in central Kericho arranging his goods.*



*Figure 21: A street hawker with a table of goods for sale.*

Near the hawkers, but operating under very different circumstances, are the well-established retail and wholesale shops in the Embassy Building. The interior of the multi-storey Embassy Building is pictured in Figure 22. A typical wholesaler there offers lighting products along side electronics and/or other general goods. Figure 23 is a photo of the shelves in a wholesale shop. The cluster of wholesalers in Kericho provides a place where other vendors (like hawkers and shopkeepers from the surrounding towns and market centers) can comparison shop for their products.

One of the shopkeepers in the Embassy Building allowed us to photograph their pricing book, which gives data on the markup they apply to products in their shop. Their markup ranges from 40-60%, depending on the product.



*Figure 22: The multi-level shopping center in central Kericho where several electronics wholesalers do business.*



*Figure 23: The shelves in a wholesale shop; central Kericho.*

### 3.6 Market Size

We asked the shopkeepers a series of questions about their best-selling product and how many of that product they sold in the last month. Unfortunately, their interpretation of the question varied: in hindsight some shopkeepers seemed to estimate how many *total* products they sold, others estimated the number of the best selling product(s), in some cases including more than one. Also, estimating monthly sales volume was a difficult task for many of them. We noted that several based their estimate on a line of thought such as, "...well I sell 5 or 6 on a good day, and there are 30 days in a month, so I sell 150". So, many of the estimates we received were likely inflated (or deflated because they only considered their best selling products).

With the uncertainty in our estimates in mind, Table 4 reports the aggregate estimates for market volume in each town. Based on the multiple difficulties that shopkeepers had answering the question, we assume that the estimates they made are representative of the whole market, not just their best sellers. Because the market is dominated by a small number of high-selling products and their tendency to overestimate the volume, this assumption may be reasonable.

Based on our estimates, the yearly sales volume in Kericho is on the order of 30,000 to 40,000 units, which corresponds to about one product for every three residents of the town. While many of the products that are purchased in Kericho likely leave the city, it also is notable that the low quality (and cost) of many products we observed leads them to be disposable commodities rather than durable goods. Some residents, such as night watchmen, may purchase new products every month.<sup>6</sup>

*Table 4: Estimated monthly sales volume of off-grid electric lighting products in the towns we surveyed.*

	<b>Kericho</b>	<b>Brooke</b>	<b>Talek</b>
Monthly Sales (units)	3,100	210	90
Monthly Sales (Ksh, \$) <sup>7</sup>	Ksh 403,000 \$US 5,400	Ksh 23,200 \$US 310	Ksh 13,500 \$US 180

### 3.7 Product Quality issues and Market Spoilage

The sentiment of the street hawkers – that the products available in the market are of variable quality and many customers are dissatisfied – was also borne out in the responses of vendors in our wider survey. One set of questions we asked the vendors dealt with the “main problems” customers reported to them or they observed with the products. Of the 60 shops we surveyed, 41 (68%) of them reported problems with product quality. LED failure and durability in general were cited as a problem 22 times each (37% each). Failures related to the rechargeable batteries were cited 21 times (35%). Four vendors (7%) mentioned switch failure and two (3%) reported that dry cell batteries leak inside torches. However, the perception of low quality was not universal. Nineteen vendors (32%) did not have an answer for our question, many of whom were completely satisfied with the quality of available products. Some of the statements from vendors about product quality are summarized below. In most cases, the statements are translated from Swahili by our research team.

*“Most torches fail or do not work at all after purchase.”*

<sup>6</sup> See Tracy, J., A. Jacobson, and E. Mills (2009), "Quality and Performance of LED Flashlights in Kenya: Common End User Preferences and Complaints." Lumina Project Research Note #4, <http://light.lbl.gov/pubs/rn/lumina-rn4-torches.pdf>

<sup>7</sup> Based on the median price of products in each market, as reported in Table 1, and an exchange rate of 75 Ksh/\$US

*“Very few complications...”*

*“[There are bad] switches, [LED] heads failing, dropping down makes it fail. Some do not charge.”*

*“When you switch on the torch while charging it fails completely.”*

*“[There are] not many complaints for LEDs but the batteries don’t last long.”*

*“Complaints are rare...”*

*“Many customers come back to complain. When LEDs stop working, they are not repairable.”*

*“Charging mechanism failure is the main problem.”*

*“Sometimes the battery fails even before we sell it. The LEDs also fail sometimes.”*

*“If people leave it charging for a long time the battery fails...”*

*“The torches fail very [often] after a few days, and spare [parts] are not available.”*

The main quality issues stem from poorly constructed LED assemblies, shelf life issues, and the overall durability of the products’ design. The fine wires and solder joints that are endemic to LED sources seem to be particularly prone to failure in the products that are currently available. Because many of the products are torches, people tend to carry them around and they end up dropping them from time to time. Failures of the LED assembly or cracked cases after dropping are common complaints. The sealed lead acid batteries used in many rechargeable torches degrade during long periods of storage, and are not well protected by the products’ integrated charging circuits.

Some rechargeable LED torches have stickers on them indicating the date of manufacture. Although recording the information was not standardized in our survey, in June 2009 we observed date of manufacture stickers on eight products in Kericho in an opportunistic manner. They ranged between October 2007 and August 2008. In other words, most of these products were shipped and stored for at least a year before the batteries were recharged. Common practice for sealed lead acid batteries recommends recharging every three months at a minimum. In light of our observations, the customer complaints about battery failure “out of the box” are not unexpected. Compounding the issue is the fact that some products are switched on (e.g., for testing their functionality) at some time before their purchase and are not switched off. This leads to the battery being fully discharged, which damages the battery cells if they are not recharged soon afterward. The shelf life of rechargeable batteries is a critical aspect of product quality that may be difficult to manage in the complex supply chains that these products move through.

## 4 Conclusions

In June 2009 Lighting Africa undertook a baseline market presence study for off-grid electric lighting products in the towns of Kericho, Brooke, and Talek. Our research team administered a survey to shopkeepers located inside a distinct geographic boundary in each town.

In Kericho we identified 37 shops, offering 240 total products (115 distinct products). The median price was 130 Ksh, and most products fell between 10 and 300 Ksh. About 90% of the available products were torches, with a diverse range of form factors comprising the other 10%. LEDs are ubiquitous, and are the primary light source in 87% of products. The energy for the products comes mainly from grid-rechargeable (generally sealed lead acid) batteries or dry cell batteries. We only saw two solar-charged products that were available for sale.

In Brooke, we identified 16 shops, offering 54 total products with a median price of 110 Ksh. In Talek, we identified 7 shops, offering 25 total products with a median price of 150 Ksh. The products in Brooke and Talek were less diverse than those in Kericho, but followed similar trends in the availability of form factors and light sources. Talek is an off-grid town, so the majority (80%) of products available there use dry cell batteries as an energy source.

The products we identified generally were serving the segment of the off-grid lighting market that has been met with low cost incandescent torches in the past. Although some incorporate an integrated task or ambient light, we did not see a substantial presence of *improved* LED based lighting explicitly designed for task or ambient applications. Because end-users of off-grid lighting products are being heavily exposed to low cost and *low quality* LED technology, there is considerable risk of market spoiling for emerging LED products that may be of higher quality. If people learn to associate LEDs with inexpensive disposable torches that seem to be less durable than “traditional” incandescent lights, they may see little incentive to risk the relatively high initial cost of non-torch LED products. It may not matter if emerging products are more durable and economical if people think they are fragile like the cheap LED torches while being overpriced in comparison.

Our key findings about the market for lighting products are:

- LEDs are ubiquitous as an available light source and are primarily found in low cost (~150 Ksh / \$US 2) torches. LED products now dominate the market for torches (80-90% share), and very few incandescent torches are available in comparison.
- The sellers of lighting products include a diverse set of individuals and businesses. They range from street hawkers to large electronics wholesalers who travel to Dubai to procure their goods. The sellers of these goods are on the front lines of quality assurance issues, and relayed poignant anecdotes to us regarding customer dissatisfaction with the quality of low cost LED torches.
- The market for electric off-grid lighting products is large (~30,000-40,000 units per year in Kericho) and growing (many shops are just starting to offer them). Kericho is in a relatively prosperous region of Kenya, but is reasonably representative of many large towns in the country. We estimate the total Kenyan market likely exceeds one million units per year (based on an assumption that the population weighted consumption in Kericho may be 500% of the typical level).
- There is a significant risk of market spoiling for emerging high quality LED products by the low cost, low quality LED products that are currently in the market. The street hawkers note that customers are dissatisfied with the quality of the available products, and that there is not a reliable source of information about product quality. LED products are sufficiently available so that most people who shop for a new torch will consider purchasing one.
- Off-grid task and ambient lighting is available on a limited basis, and remains a specialty type of product that is only available in larger towns.