Socio-Economic Impact of Solar Lamp Lighting in Kibera Slum, Kenya.

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Abstract

Globally, it has been documented that people living in informal settlements are exposed to socio-economic risks due to the constant daily pressure on space, social relationships, healthcare, education, infrastructure and governance. Water and light energy crises among the residents in informal settlements such as Kibera, experience increased social risks due to the growing demand over limited resources. Poor lighting facilities in the households of Kibera, has a negative impact on businesses, security , environment, health and education of school going children because they rely on the dangerous dim smoky paraffin lamps to carry out their activities. The study aimed at evaluating the socio-economic impact of using solar lamps lighting in Kibera. The research adopted a descriptive survey design .The study area was purposively chosen and a sample size of 330 households also drawn purposively from a sampling frame of 1050 households who had directly benefitted directly from Mwangaza Kenya. Data was collected during home visitations in households who had used solar lamp lights for at least 8 months prior to the study using structured questionnaires and pre- filled d.light passbooks. The data was keyed into a spreadsheet and analyzed to quantify the social-economic changes brought about by use of solar lighting. Data was presented using tables and graphs. The study showed a major socio economic impact of the project i.e. the elimination of health hazards associated with paraffin lamps, increased sense of security, saving and income from additional income due to extended business time in the evening and improved quality of light used by school going children leading to increase in study time hence improved academic performance. This resulted to high level of resilience among the inhabitants of Kibera.

Keywords*:* *Solar lamps, education performance, socio-economic, paraffin*

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Introduction

Kenya's big four agenda is to transform the country into an industrialized country by 2030 with an internationally competitive and thriving economy. To achieve this vision, energy was envisaged as one of the foundations and enablers of the socio-economic transformation. To ensure that every Kenyan has access to electricity, the government prioritized connectivity even to the rural areas by subsidizing the cost of installation through the rural electrification program. However, not everyone has access to electricity in their homes or businesses due to high cost of tariffs in relation to their

limited household incomes. This has led to the use of improvised electricity wiring and dangerous illegal connections especially in the informal settlements. Majority of Kenyan use paraffin (kerosene) lamps for lighting and batteries to keep their TVs, phones and radios charged (Energy Digest, (2014). It is recognized that transition to the use of an innovation or technology takes time. According to Balshemet, Christensen, Tuepker & Kansagara (2011), there are real and perceived risk factors that one has to contend with before adopting new innovations such as relative advantage, compatibility, complexity, observability and triability. Solar lamps lighting is such new innovation that is expected to be an alternative source of lighting in Africa which might face slow diffusion. Kibera Slum faces a myriad of problems resulting from the low socioeconomic status of its population. Just like other informal settlements, poor lighting is identified as one of the major issues affecting the livelihood of the households (Gongera, & Gicheru, (2016). Kibera started as a settlement scheme for Nubian soldiers returning from the First World War, in the outcast of Nairobi forest. Other ethnic groups started moving to the area in large numbers putting a big strain on resources such as education facilities and other social amenities (United Nations Development programme [UNDP], 2009).

Kibera slum covers approximately 2.5 square kilometers and has approximately 1.2 million residents (UNDP, 2009) where young person's 18yrs and below constitute the greatest majority. Kibera slum is characterized by overcrowded rooms with little to no access to electricity, poverty, contagious infectious diseases, periodic violence, and corruption. Among these education in both primary and secondary schools, security and economic activities in the evening is the most affected. Those of school going age lack adequate basic facilities such as food, ideal accommodation, transport to school and proper lighting system to do their evening studies and home work. Business hours are shortened due to lack of lighting in the evening which would earn households extra income. Households rely on unhealthy sources of light such as smoky paraffin lamps, candles which predispose them to respiratory and eye diseases. This creates a number of problems especially, for those households with school-age children: The poor light quality hinders the ability to study and carry out household and business activities. Paraffin is expensive and may run out during the evening's study period, noxious fumes produced by paraffin lamps are a health hazard and pose risk of fire breakout. This situation has adverse effects on their business, academic performance and ultimate productivity.

The cost of mainstream electricity installation and maintenance in Kibera has denied many residents access to reliable power supply in spite of government efforts. Use of unhealthy sources of lighting such as paraffin lamps and batteries to run their TV sets, radios, mobiles etc. is a common phenomenon. A project by Mwangaza Kenya was carried out, where a business model to distribute d.light solar systems was used in Kibera. The beneficiaries were supplied with a solar kit including a lamp, battery and mobile phone charging system as shown in the picture below.

The model was kept simple by having two terms of payment and focusing on a single product (d.light s250). Beneficiaries of the project would pay an affordable deposit and after that complete the payment in equal weekly installments.

The installments were set only at Kshs. 150.00. Households who paid all their installments without default had their last two installments written off in the form of a loyalty discount. In the alternative, those who could afford were allowed to purchase the lamps on cash at a discounted price. It is for this reason therefore that the study was carried out to evaluate the socio-economic impact of solar lighting system in Kibera Slum among households who had benefitted from the solar lighting for eight months prior. The Social Return on Investment Framework and The Best of Practice Impact Assessment Framework was used to contextualize the study. Slight changes was made to the framework to ensure it measured what was intended to in the study.

Materials and Methods

The research adopted a descriptive survey design. The study area was purposively chosen and a sample size of 330 households purposively sampled out from a sampling frame of 1050 households who had directly benefitted from Mwangaza Kenya. Data was collected from households who had used solar lamps for at least 8 months prior to the study using structured questionnaires and d.light passbooks. The pass books were daily logs where users recorded; how the solar lamps were used, challenges experienced using the solar lamps as well as repayments for the lamps. Data was collected during home visitations from respondents who were head of the households whether men or women. The data was keyed into a spreadsheet and analyzed to quantify the social-economic changes brought about by use of solar lamps. Based on the Social Return on Investment Framework (Moody, Page & Paydar, 2015), analysis isolated changes through the outcome map that depicted relationships between inputs (lamps/funding) activities (beneficiary recruitments/ trainings/evaluations) outputs (use of solar lamps, skills acquisitions, change of attitudes) outcomes (more hours of study, more savings) and the goal (improved academic performance, improved livelihoods). The analysis was based on the impact value chain depicted below:

Results and Discussion

Three hundred and twenty two (322) respondents were interviewed out of which 82% were women. Sixty percent (60%) of the respondents had used a solar lamp for at-least eight months prior to the study. The majority (90%) of the beneficiaries using the lamps were either self-employed or unemployed. They ran small businesses within the slum while others engaged in casual labor around the neighboring estates. Their average income was Kshs. 150.00 per day.

Use of an alternative source of lighting

Out of the category of the respondents who had no access to electricity, 100% of them had completely replaced the use of paraffin with solar lamps for lighting. Respondents living in houses with electricity used the solar lamps 65% of the time in a month when there was no power, or unstable supply. Other sources of lighting used included candles and battery powered torches. The figure below illustrates the source of lighting they used before acquiring the solar lamps.

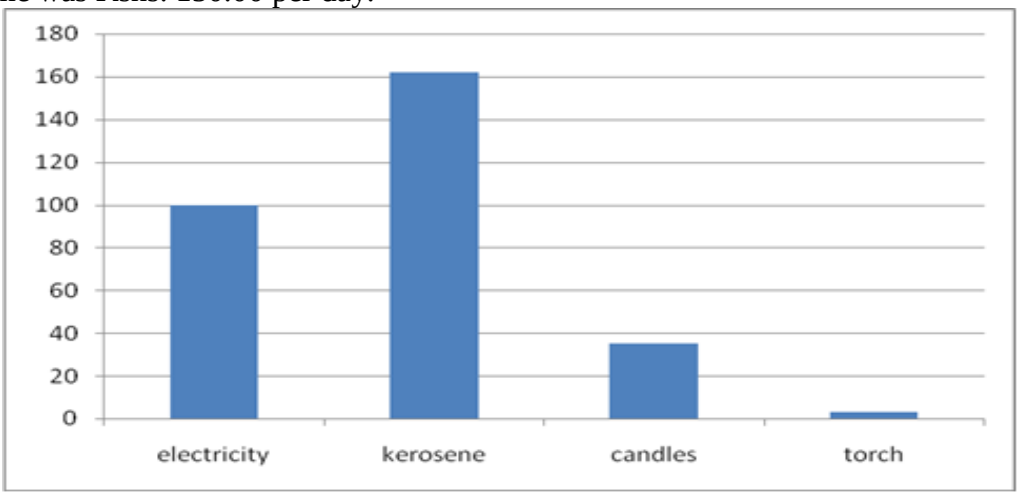

Figure 1: Source of lighting they used before acquiring the solar lamps

After the introduction of the solar lamps, the scenario changed as shown in the figure 2 below.

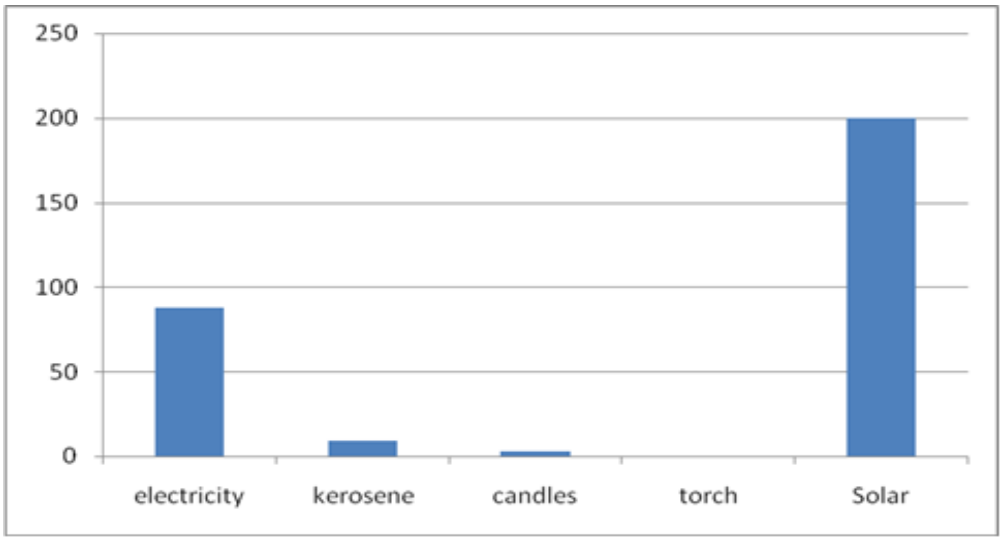

Figure 2: Usage of lighting sources

Majority of the beneficiaries were motivated to purchase the lamps due to the savings they made and the quality of solar lamp light compared to paraffin lamps. Respondents who had no access to electricity reported savings of up to Ksh 25 per day which would have been used on paraffin. This translated to about Kshs 9,000.00 per annum. Additionally, more savings accrued from improved health of the households. For instance: a particular respondent whose entire household had been put on daily medication due to respiratory allergies explained that from the third month after replacing the use of paraffin with solar, the household did not purchase medication again. The daily tablets had costed Kshs 40.00 per day. This implied that with a healthier environment respondents made savings of Kshs. 1,200.00 every month.

Reasons for Purchase of Solar Lamps

Respondents' passbooks indicated that the lamps were used for an average of four hours every day. The passbooks also indicated varying hours of lamp charging ranging from one to three hours daily. The figure 1 below shows the key reasons the respondents gave as to why they purchased the solar lamps.

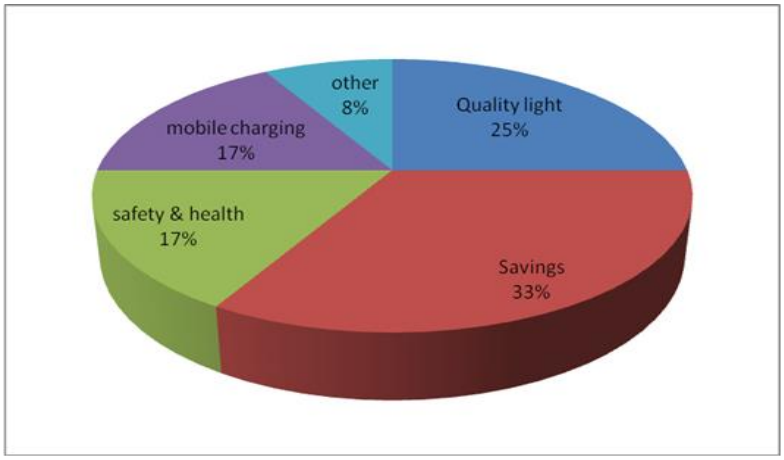

Figure 3: **Reasons for Purchase of Solar Lamps**

There was 99% shift from electricity to solar lamps in charging mobile phones, this was also replicated among respondents who previously did not have electricity in their houses. Some of the respondents did not use the solar lamps for charging phones, largely because they had cell phones whose charging system were not part of the lamp packaging.

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Savings and Income

The results showed savings from use of solar lighting as compared to other sources of lighting and extra income from business activities as a result of using the solar lamps as shown in Table 1.

Table 1: Average amount of monthly savings by replacing different sources of lighting.

Source of lighting	Average amount of saving per month
Kerosene	9,000
Electricity	500
candles	300
Torch Batteries	112
Mobile phone charging	80

A youth from Kibera used both the solar panel and the lamp to charge neighbors' phones at a fee. He charged Kshs 5.00 per phone and reported an average five customers per day. Additionally, other respondents who engaged in business activities in the evenings reported additional income averaging at Kshs 150.00 per day. Women used lighting to extend hours of family businesses like tailoring and selling at the grocery late into the evening. The main impact was linked to the extended business hours in the evening and security which enabled them to transact and which therefore earned them more revenue. Households involved in businesses and who used the solar lamps reported to have managed to augment their income at least, by 15-20%. Men used lighting in their retail shops in the slum, getting extra hours of sales. Increased hours available for study by children and elders enhanced the household's long-term social and economic health.

Effect on Health and Security

The survey revealed that the solar lamps had eliminated smoke and fumes emission from paraffin tin lamps. As a consequence, there was a significant reduction in indoor air pollution which would eventually impact positively on the environment and health. There were additional savings on medication cost in some of the households that had cases of respiratory complications resulting from kerosene fumes. The solar lamps eliminated the health hazard associated with paraffin tin lamps to those who used them. According to a number of respondents, women felt a sense of security when they used solar lamps at night. The risk of exposure to open fire from wick lantern was also eliminated.

Effect on Education

The effect of solar lighting was assessed based on three indicators namely: Children motivation, hours of study and academic performance. When the performance of children from those households that had benefited from the project and those that had not yet benefitted within the period of one year was compared, improvement in academic performance was noted. Children performance was traced through termly as well as mid-term academic reports. The latter could however not be fully isolated and linked to the use of solar lamps since it depended on many other intervening variables. From the households studied, 97% of the parents thought their children were more motivated to read and learn since they studied using a solar lamps. This implied that the quality of light used by school children for reading was far much better.

The studying time per child, particularly at home in the evening, increased by 75% implying that each child had increased their study time by 3 hours per day based on logs and resulted in improved academic performance. Additionally, elders admitted reading either books, magazines and newspapers. This had a significant change in their day to day lives due to availability of quality light.

Conclusion

Solar lighting among the households which had benefited from Mwangaza Kenya demonstrated improvement of income through saving and business proceeds, health, security and academic performance. People living in informal settlements that are exposed to socio-economic risks can benefit from solar lighting because of its affordability and flexibility in payment. Kenya has a constant supply of solar energy since most areas experience sunny periods through-out the year.

Recommendations

The National and County governments should ensure equitable distribution of resources by investing in lighting households both in informal and formal settlements which unable to access or use electricity due to its high cost. This is because Kenya has a constant supply of solar energy as it experiences extended sunny periods most of the year.

There is a need for more awareness on the benefits of solar lighting across the country and also scale up of solar lamp distribution through public private partnership with companies like Mwangaza Kenya.

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