

9.8 Lighting Up The Knuckles Range – Sri Lanka. *A case study on rural village lighting with solid state lighting*

G. Doluweera and D. Irvine-Halliday
Light Up The World Foundation
Dept. of Electrical & Computer Engineering
Schulich School of Engineering
University of Calgary
2500 University Drive NW, Calgary, AB Canada T2N 1N4

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Case Study: Sri Lanka

9.8 Lighting Up The Knuckles Range – Sri Lanka

By Ganesh Doluweera, BSc(Eng), MIEE, Dave Irvine-Halliday, MSM, PhD, PEng Light Up The World Foundation, University of Calgary, Canada (www.lutw.org).

Light Up The World Foundation (LUTW) is a humanitarian organization affiliated with the University of Calgary, Canada. It is the pioneer and world leader in utilizing solid state lighting technologies to enhance the quality of life of the rural communities in the developing world. LUTW uses highly efficient, durable and environmentally friendly lamps made of white light emitting diodes (WLED) powered by renewable energy systems to provide safe and economical home lighting systems for the developing world. Since its inception in 1997, LUTW and its partners have illuminated over 5000 house holds all around the world, plus an additional 3000 for Sri Lankan Tsunami refugee camps.

LUTW started its operations in Sri Lanka in 2001. The main target area is the Knuckles Range in the central part of the country.

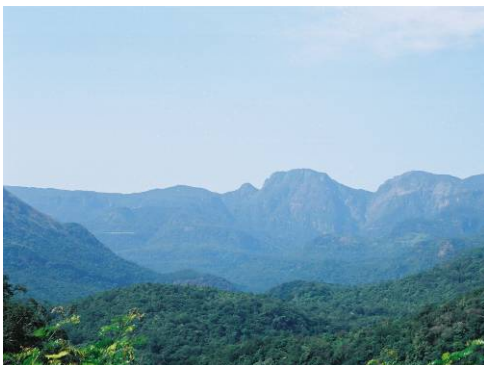
9.8.1 Background

The Knuckles Range is a mountainous forest reserve in the central province, Matale district of Sri Lanka (Figure 9.8.1). The area has a very rich biodiversity with unique fauna and flora and the watershed value of the reserve is an invaluable asset to Sri Lanka. This ecologically sensitive area is a national nature reserve and a proposed UNESCO world heritage site.

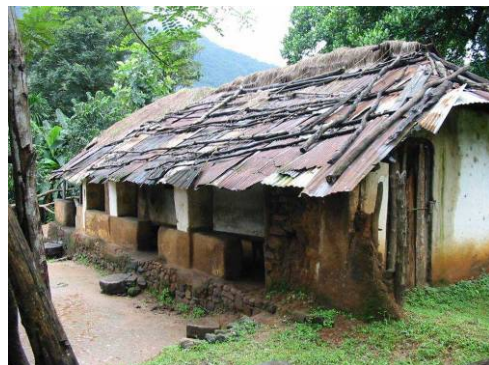
There are about 25 isolated villages in the buffer zone deep inside the Knuckles reserve and the inhabitants are mainly small plot farmers. The cost associated with the grid extension and also the environmental constrains prevents these villages being connected to any form of utility grid in the foreseeable future. The villagers rely mainly on kerosene lamps for home illumination. The price escalation of kerosene imposes a huge burden on their annual income and some cases the villagers have to walk long distances to procure kerosene if it is available. These flame based lamps cause severe health hazards from heat fracture and respiratory ailments.

Starting from April 2003 LUTW has illuminated about 300 houses in 8 villages in the Knuckles Range using solid state lighting. The project was carried out in two phases with the help of a group of alumni and student volunteers from University of Moratuwa, Sri Lanka [1].

Figure 9.8.1 a) Knuckles Range



b) A house in Rambukoluwa



Source: LUTW

9.8.2 Lighting System

The home lighting system comprised of three main components (Figure 9.8.2).

- **Modular White LED Lamp**

The standard unit is a 1 Watt device containing a single Luxeon Star® high brightness WLED from Lumileds Corporation, USA. A home lighting system contains two lamps each consisting of a single diode and additional driver circuitry. The driver circuit has the low voltage cut off feature and the lamp switches off when the battery voltage is down to 12.2V, ie after consuming about 25% of the battery capacity. This will prevent the battery being over discharged and ensures longer battery life.

- **Photovoltaic Module**

Photovoltaic (PV) modules are used to generate energy for the WLED lamps. In the first phase two central solar charging stations were placed at strategic points in each village to charge the batteries. A Charging Station consists of a 75W solar panel and a charge controller. In the second phase each house was given a 5W PV module and was therefore completely independent.

- **Battery**

The PV energy is stored in a 12V, 7Ah sealed lead acid battery, which are maintenance free. The villagers are trained to handle the battery safely and are advised not to over drain the battery. It is expected to replace the battery once in every 3 to 5 years.

9.8.2 LUTW home lighting system



Source: LUTW

9.8.3 Phase I

In the first phase 87 houses in two villages Rambukoluwa and Dammantenna, were illuminated using solid state lighting systems. In both villages the houses lie in about a 1.5km radius area. Considering the cost constrains a centralized solar battery charging system is used for energy generation. Two battery charging stations were installed in each village. Each station comprised of a 75W PV module and a charge controller which is capable of charging twelve 12V, 7Ah sealed lead acid batteries at a time.

Two WLED lamps were installed such a way that the lamp position can be easily adjusted. For example when the lamp is needed for reading the lamp can be lowered to get a higher light intensity

(Figure 9.8.3). Each family has to take their battery every other day to the charging station to get it topped up. The women and children usually do this as it gives them a chance to socialise with friends.

One draw back of the system is on rainy days the batteries tend not to charge up to the full capacity. However the villages adjust them selves to mitigate this and use the lamps for lesser amount of hours on rainy days. The system was installed in April 2003 and has been in operation successfully ever since.

9.8.4 Phase II

The second phase was launched in July 2004 and two hundred houses in 8 villages in the Knuckles Range were provided with solid state lighting systems (Table 9.8.1). These second phase houses were given a 5W PV module (Kyocera) to charge the 12V 7Ah battery, hence each house has a totally independent and complete lighting system.

Table 9.8.1 Number of houses and type of energy generation in each village

Village	Number of houses	Type of power generation						
Rambukoluwa	42	Central PV battery charging station						
Dammantenna	45	Central PV battery charging station						
Walpolamulla	6	5W PV module at each house						
Gangahenwala	24	5W PV module at each house						
Rawanagama	30	5W PV module at each house						
Imaduwa	49	5W PV module at each house						
Kattadeniya	55	5W PV module at each house						
Poththatawala	7	5W PV module at each house </tr <tr> <td>Divulgaspatana</td> <td>29</td> <td>5W PV module at each house</td> </tr> <tr> <td>Total</td> <td>287</td> <td></td> </tr>	Divulgaspatana	29	5W PV module at each house	Total	287	
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Total	287							

Source: LUTW

Figure 9.8.3 WLED lamps in houses of the Knuckles range



Source: LUTW

9.8.5 Maintenance and Governance of Village Lighting Systems

In each village two persons were trained to do any maintenance or troubleshooting necessary and they were also provided with basic tools such as screw drivers, pliers and multimeters. Village co-operative societies have also been formed for the governance of the lighting system. All the villagers are members of this society and the executives are elected annually. The members pay a monthly membership fee which is deposited in the society's bank account and it is usually in a local financial institution. The main responsibility of the society is to ensure the interrupt free running of the lighting system. In case of centralized battery charging system the society oversees the charging schedule. The other objectives of the society are promoting micro enterprise, community development and to promote literacy and education. Monthly meetings are held in the village hall or temple.

9.8.6 Observations and Feedback

In all the villages the lighting systems were greeted with much enthusiasm and received 100% user satisfaction. Users quickly achieved the competency to handle the home lighting systems and maintain it properly. The primary benefits as reported by the inhabitants are improved quality of life due to cleaner and safer lighting systems and significant economic benefits due to savings of kerosene expenditure. WLED lamps provided an adequate amount of lighting for the children to study and read in the night without the ill consequences of flame based kerosene lamps. The women of the villages reported that the systems provided them more time and flexibility in the night for the household activities such as meal preparation and house cleaning. The safety of the lighting systems was highly commended by all the users. Personal injuries and property damages due to overturned kerosene lamps were quite frequent in these villages prior to the SSL system installation. The portable nature of the lamps allowed the villagers to use them to illuminate the social events in the villages such as religious festivals and sermons. Further some even lend their systems to a needy neighbour in occasions such as a wedding or a funeral.

The main economic benefit as reported by the villagers is the money saved from kerosene expenditure. It was observed that irrespective of the income levels, all the households spend virtually equal amounts on kerosene and on average it represents about 3.7% of the monthly spending. However this is about 10% for the low income families. (Table 9.8.2) This was significantly reduced (about 80%) after the system installation. The main purpose of post installation kerosene purchase is to use it to start cooking fires. However a significant number of households reported a 100% reduction of kerosene usage [2].

Table 9.8.2 Kerosene expenditure per household (pre and post installation)

Income Group	Average monthly spending US\$/month	Average spending on kerosene per month (pre installation) US\$/month	Average spending on kerosene per month (post installation) US\$/month	Kerosene expenditure as a % of monthly spending (Pre installation)	Kerosene expenditure as a % of monthly spending (post installation)
Low	15.73	1.50	0.30	9.5%	1.9%
Medium	34.56	1.50	0.30	4.3%	0.9%
High	72.91	1.60	0.40	2.2%	0.5%
Average	41.07	1.53	0.33	3.7%	0.8%

Source: LUTW

The other economic benefit is an increase in family income due to longer working hours in the evening. Most people found the lighting systems as a boost for the cottage industries such as dress making, weaving of mats out of palm leaves and making dairy products (Figure 9.8.4). An increase in this extra income was reported due to longer working hours in the night with WLED lamps. Earlier this was not cost effective due to use of kerosene lamps.

Figure 9.8.4 Use of solid-state lighting sources for cottage industry



Source: LUTW

9.8.6 Conclusion

The suitability of solid state lighting to illuminate remote off grid villages was proven conclusively in the Knuckles Range. A rural household could be illuminated to an adequate level consuming only 2W of electrical power. The social and economic benefits of efficient, clean and safe lighting system were observed. LUTW is presently expanding the lighting projects in the Knuckles Range to illuminate all the off-grid households in the area.

9.8.7 References and Resources

Reports

1. Doluweera, G., Fernando, S.N., Madanayake, A. “Illuminating Lives – Knuckles Project 2003”, Light Up The World Foundation
2. Leon, S., Graham, S., “Village Lighting in Sri Lanka: Socio-Economic Impact Evaluation of LUTW Solid State Lighting (SSL) Technology”, Light Up The World Foundation

Internet Web Sites

Light Up The World Foundation

www.lutw.org