Introducing Solar LED Lanterns to Rural Kenya: Sustainability Assessment of Environmental, Economic, and Social Impacts

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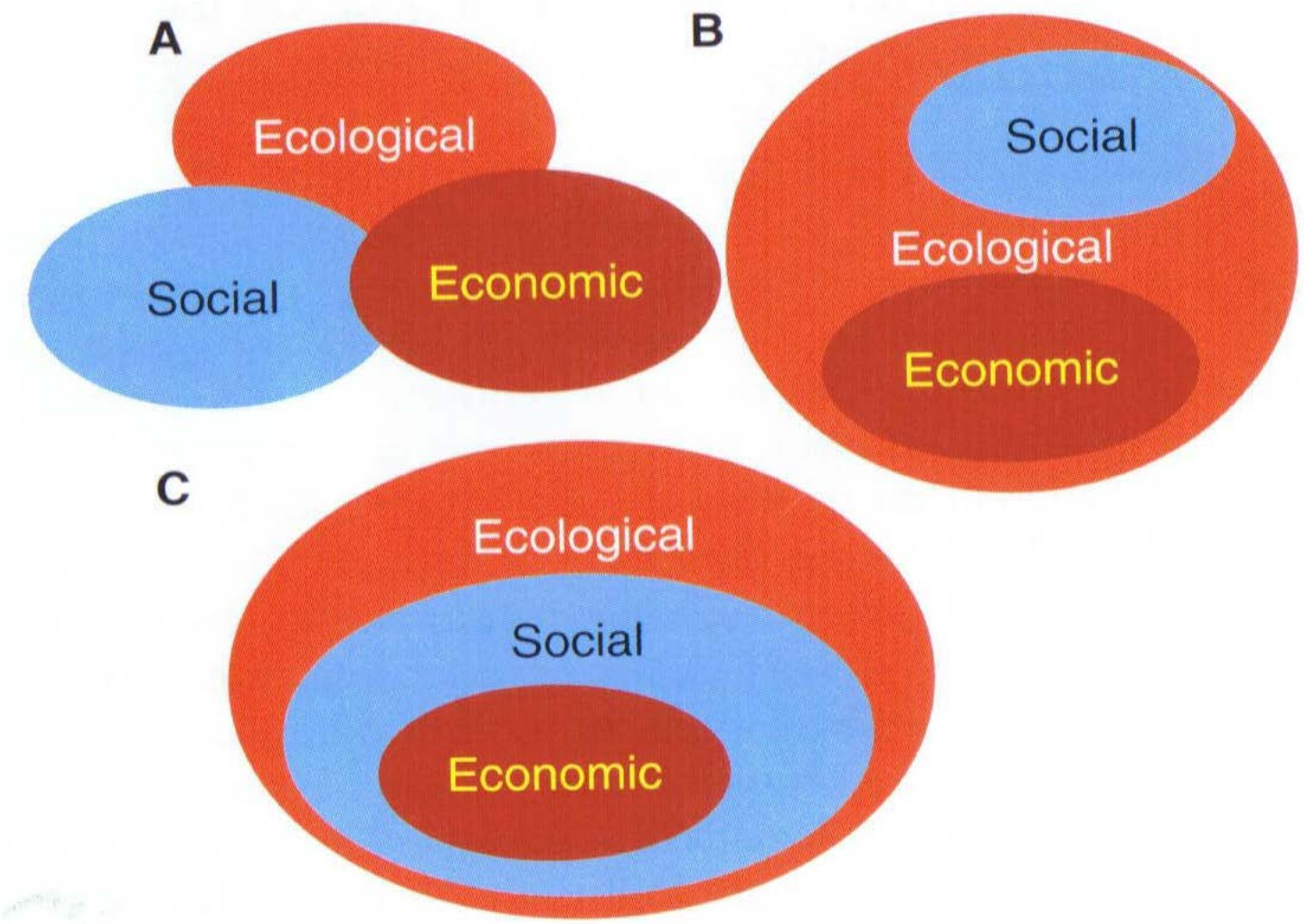
Micro Perspectives for Decentralized Energy Supply
April 23-25, 2015, Bangalore, India

Background

- While previous attempts have been made by small-scale enterprises and organizations to introduce solar lanterns that are relatively inexpensive and easy to use, recently multinational electronic companies have also started to enter into this business.
- Sanyo Electric, which has later been merged to Panasonic, is one of the largest electronics companies in Japan, with production and sales operations worldwide.
- With core business activities on photovoltaics and batteries, the company has developed various types of pro-poor products targeted to the African market, including long-lasting and chargeable solar LED lanterns.
- As one of the leading manufacturers of electronic products, the company has been struggling to establish a robust business model of supplying relatively high-quality solar LED lanterns that would provide safe, clean, and convenient lighting.

Ecological, Economic, and Social Dimensions of Sustainability



Voinov (2008)[3]

Creating Values for Sustainability with Solar Lanterns

- Environmental
  - Reducing CO_2 emissions by replacing fuels (e.g. kerosene) used for lighting
  - Reducing emissions of harmful substances such as soot and carbon monoxide for improvement in health conditions
- Economic
  - Reducing expenditures for buying fuels (kerosene), instead using that part of income for other purposes (e.g. food, education for children)
  - Providing opportunities to local entrepreneurs for starting new business activities
- Social
  - Enabling children to study in the evening
  - Enabling women to perform routine household work during power outages

Yarime (2011)

Research Objectives

- In this paper, we attempt to make a comprehensive assessment of the sustainability of solar LED lanterns provided by a large electronic manufacturer to people without access to electricity in a rural area in Kenya.
- A field survey was conducted to examine what impacts solar LED lanterns made on households with regard to environmental, economic, and social aspects.
- Then we explore the possibilities and challenges in promoting a broader dissemination of solar LED lanterns in rural areas in developing countries.

First Generation Solar Lantern

Sanyo Electric

Assessment of Impacts

- A household survey was conducted to assess the environmental, economic, and social impacts of the solar LED lanterns produced by Sanyo Electric.
- For environmental impacts, the amount of CO2 emissions reduced by replacing fuels (e.g. kerosene) used for lighting was examined.
- For economic impacts, it was examined how much amount of the expenditures which had been spent for buying fuels (kerosene) was reduced by using the solar LED lanterns.
- For social impacts, we examined how much time the children in the households which have received solar LED lanterns increased the time they spend for study in the evening.

Methodology

- Solar lanterns were donated by Sanyo Electric through the local non-governmental organization (NGO) African Children Education Fund (ACEF) in Embu to promote education in the area.
- The study involved a survey conducted for a total of 209 households. Over half of the households sampled, 105, had received a solar lantern per household for free from ACEF.
- Another 26 households had bought their lanterns, either from ACEF or independent salespeople.
- There were 78 households without solar lanterns. This is the group that acted as a control group in the survey, given that it was not possible to conduct a baseline study prior to the introduction of the solar lanterns in the community.

Amount of kerosene used before and after the introduction of lanterns

Kerosene used by household in liters/week	Before introduction of lanterns		After introduction of lanterns	
	N	%	N	%
0-1.0	56	47.9	87	76.3
1.1-2.0	33	28.2	17	14.9
2.1-3.0	9	7.7	2	1.8
3.1-4.0	7	6.0	5	4.4
4.1-5.0	4	3.4	1.0	0.9
5.1-	8	6.8	2	1.8
Total	117	100	114	100

Reduction in Kerosene Consumption and CO_2 Emissions

- The average amount of kerosene consumed per household dropped from 2.1 L to 1.4 L per household per week after the acquisition of a solar lantern.
- The use of the solar lantern helped households cut the consumption of kerosene for lighting by 0.7 L per week, which translates to a saving of 3.0 L per month and 36.5 L per year per household.
- This contributes to reducing emissions of carbon dioxide (CO2), as well as reducing household expenditures by about 300 Kenyan shillings per month, which means an annual saving of 3,650 Kenyan shillings, almost equivalent to 40 US dollars.
- The households would be able to recover the cost of one solar lantern within the first year from the savings on kerosene alone.

Effects of Tin Lamps on Coughing in Households with and without Solar Lanterns

Children	Without		With		Mother	Without		With	
	N	%	N	%		N	%	N	%
Yes	33	54	24	40	Yes	24	40	27	28
No	28	46	36	60	No	36	60	68	72
Total	61	100	60	100	Total	60	100	95	100

Time Children Spend on Homework in Households

Time children spend on homework per day	Without lanterns		With lanterns	
	N	%	N	%
Less than 1 hour	3	4.5	1	0.9
1 hour	11	16.4	3	2.8
2 hours	23	34.3	33	30.8
3 hours	21	31.3	35	32.7
4 hours	5	7.5	21	19.6
5 hours	3	4.5	13	12.1
6 hours	1	1.5	1	0.9
Total	67	100	107	100

Findings

- This paper examined the impacts of the introduction of solar LED lanterns on in rural Kenya on environmental, economic, and social dimensions of sustainability.
- A survey was conducted on the use of the solar lanterns in households, compared with these households without solar lanterns.
- The solar lanterns had made some positive impacts with regard to reducing kerosene consumptions, thereby expenditures for purchasing it and CO_2 emissions, improving health conditions, and increasing time for doing homework for children at home, therefore contributing to moving towards sustainability.

Challenges

- There remain many challenges, however, including provision of necessary finance, robust business models, viability of local cooperatives, and the establishment of supply chains for product delivery and maintenance.
- Although it was found that it would be possible to gain a financial saving comparable to the price of solar LED lanterns in one year, that would still constitute a significant hurdle for many of the populations with a limited amount of incomes, suggesting a critical need for establishing financing options to facilitate adoption among poorer populations in rural areas.
- For market-based models of the dissemination of solar LED lanterns to have a real potential to be implemented and scaled up in off-grid regions in developing countries, it would be crucial to assess and improve the viability of local cooperatives and the establishment of supply chains for delivering and repairing products from a long-term perspective.

Collaboration with Stakeholders in Society

- Private Sector (Sanyo Electric)
  - Producing solar LED lanterns and providing facilities and equipment for local partners
- Local Entrepreneurs
  - Initiating rental business with charging stations for lanterns
- Local NGOs
  - Creating channels for distribution of the products
- Microfinance Institutions
  - Providing financial resources
- International Organization (UNDP)
  - Supporting a feasibility study on the introduction of solar LED lanterns to Kenya
- Japanese Government (JICA)
  - Supporting a pilot project for introducing lanterns in Africa
- Kenyan Government
  - Creating demands through public procurement and establishing legal and institutional environments
- Academia (University of Tokyo and University of Nairobi)
  - Conducting a sustainability assessment of the impacts of the products on environmental, economic, and social aspects

Towards Establishing a Social Business Model for Sustainability Innovation

- Competition on the local market from industrialized as well as emerging countries
- Strategic integration of corporate social responsibility (CSR) and core business competences for addressing societal needs as well as exploring business opportunities
- Partnerships with reliable and competent local stakeholders for establishing distribution channels and microfinance services
- Stable institutions (e.g. taxes and tariffs on solar lanterns) for providing a favorable environment for investment
- Financial schemes effective for reaching populations with low incomes
- Accurate and timely assessment of sustainability impacts with transparency, objectivity, and practicality