
This item was submitted to [Loughborough's Research Repository](#) by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Techno-economic and risk analysis of investments in an off-grid solar milk cooling system [Poster]

PLEASE CITE THE PUBLISHED VERSION

https://www.slideshare.net/ilri/tag/maziwa_zaidi

VERSION

VoR (Version of Record)

PUBLISHER STATEMENT

This work is made available according to the conditions of the Creative Commons Attribution 4.0 International (CC BY 4.0) licence. Full details of this licence are available at: <http://creativecommons.org/licenses/by/4.0/>

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Lukuyu, June, Richard E. Blanchard, Paul Rowley, and Amos Osmore. 2019. "Techno-economic and Risk Analysis of Investments in an Off-grid Solar Milk Cooling System [poster]". figshare. <https://hdl.handle.net/2134/25261>.

Techno-economic and risk analysis of investments in an off-grid solar milk cooling system

June Lukuyu, Richard Blanchard, Paul Rowley, Amos Omoro

May 2017

Key messages

- ❖ Due to lack of milk cooling facilities, dairy farmers in areas without access to reliable grid electricity in Tanzania are faced with the challenge of high milk spoilage and limited access to dairy markets.
- ❖ In addition, milk is only collected and transported to dairy markets in the morning therefore; evening milk goes to waste, as it cannot be stored, limiting income from milk production for remote dairy farmers.
- ❖ Renewable energy technologies, such as solar PV provide small-scale solutions and decentralized energy supply in areas where the power grid does not exist or is at a great distance.
- ❖ A technically and economically viable off-grid solar milk cooling system would offer smallholder dairy farmers in remote areas of Tanzania the opportunity to grow their businesses, consequently increasing their disposable income and improving their standards of living.

Objectives and approach

To evaluate the techno-economic viability of an off-grid solar-powered milk cooling system and assess the risk factors that have an impact on its economic success, the system was modeled and simulated using HOMER software in order to determine its Net Present Value (NPV), simple payback period and Internal Rate of Return (IRR). The sensitivity of the project's financial viability to changes in uncertain parameters such as milk prices and PV system costs was assessed. The risk-adjusted NPV and the probability of the system being profitable was calculated using a Monte Carlo simulation approach.

Key results

- ❖ A 1.83 kW PV system powering a 100-liter milk cooling tank was the most profitable option with a 57% return on initial investment over a period of 10 years, a 16% internal rate of return and a payback period of 5 years.
- ❖ The economic performance of the system is most sensitive to variations in the milk prices. The system becomes unprofitable when the net revenue per liter (\$ 0.03) reduces by about 37% (Figure 1).
- ❖ The key risk factors (milk prices, battery life, PV system cost) however, result in a significant likelihood of a financial loss (Figure 2), with only a 6% probability of being profitable.

Opportunities for inclusive investment and scaling

- ❖ Facilitate the setting up of solar milk cooling systems in dairy market hubs in off-grid communities in Tanzania, in order to reduce milk wastage.
- ❖ Facilitate the organization of milk producers into focal points for milk cooling, service and information delivery, and build their capacity to produce milk as a business.
- ❖ Adapt the system to different community sizes and cooling capacity and hence increased economic performance (Table 1).

Figure 1. Sensitivity characteristic model of the project net present value

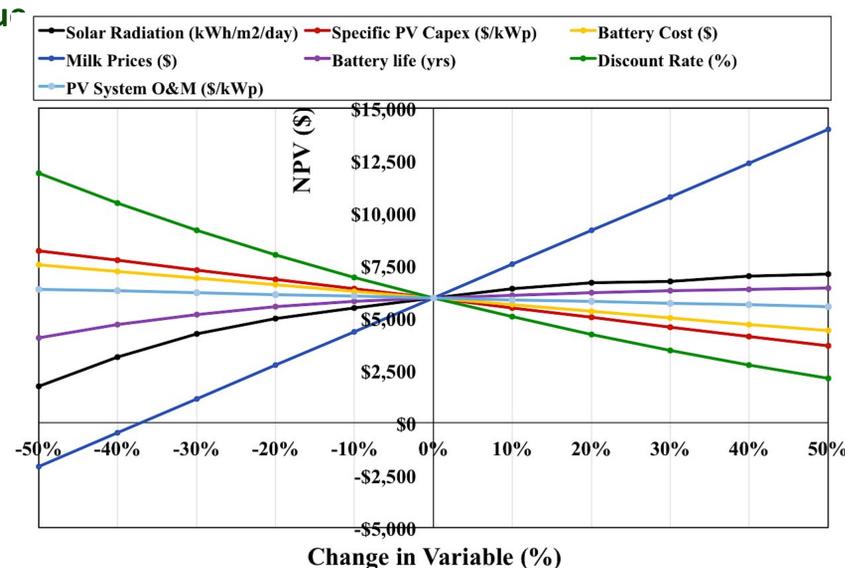


Figure 2. Risk adjusted economic performance of a solar milk cooling system

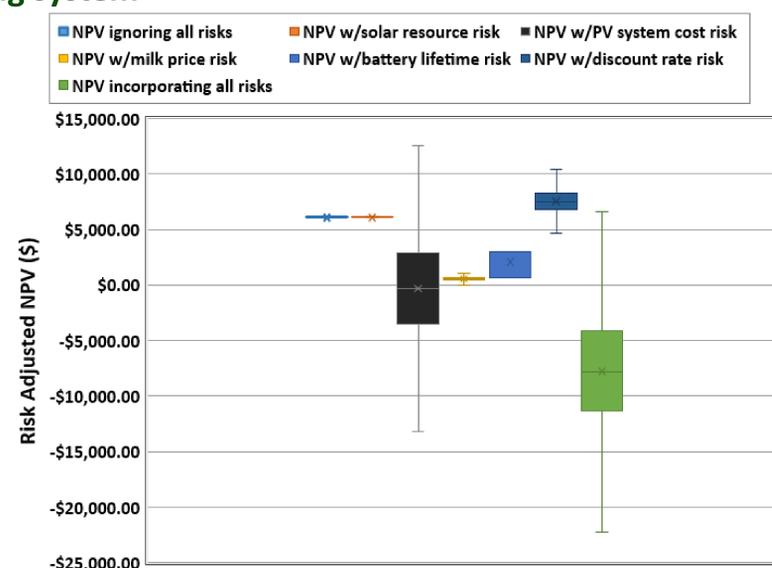


Table 1: Economic performance with increased cooling capacity

Milk Cooling Capacity (L)	Internal Rate of Return (%)	Payback Period (yrs.)
100	16%	5.1
200	24%	3.8
300	18%	4.7
550	25%	3.7
1000	24%	3.8

MAZIWA
ZAIDI



Loughborough
University



RESEARCH
PROGRAM ON
Livestock

ILRI
INTERNATIONAL
LIVESTOCK RESEARCH
INSTITUTE