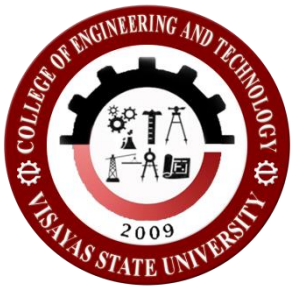
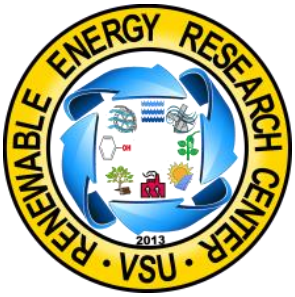
R&D ANNUAL REPORT
CY2021





Renewable Energy Research Center
Visayas State University
Visca, Baybay City, Leyte

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December 2021

CONTENTS

VSU R&D ANNUAL REPORT
CY 2021

Center/College/Department: Renewable Energy Research Center (RERC)

A. Research papers/posters disseminated/presented

TITLE OF PAPER/POSTER	DATE, VENUE	RESEARCHERS/PRESENTERS
a. Institutional		
None	N/A	N/A
b. Regional		
Weather-Resistant Solar-Based Evaporative Cooler for Intermediate Field Bulk Storage of Newly Harvested High Value Vegetables	32nd Joint ViCARP-RRDEN Symposium on March 23-24, 2021	Roberto C. Guarte; Jonalyn B. Sacay; Marjorie E. Timbal;
Hydraulic Ram Pump Development for Small Irrigation System in Upland Barangays	32nd Joint ViCARP-RRDEN Symposium on March 23-24, 2021	Roberto C. Guarte; Jaysonh B. Lua; Marjorie E. Timbal
Crude Biodiesel from Used Fried Chicken Cooking Oil and Fat from Chicken Wastes as an Environment-Friendly Fuel for Medium Scale Fried Chicken Venture	32nd Joint ViCARP-RRDEN Symposium on March 23-24, 2021	Roberto C. Guarte; April San J. Duarte; Fatima P. Gumamac
Operational Evaluation of Solar Home System Use by Households in Leyte and Southern Leyte	32nd Joint ViCARP-RRDEN Symposium on March 23-24, 2021	Jacqueline M. Guarte; Roberto C. Guarte; Joyce B. Maurillo; Jenefrey A. Niverba; Lara Nerissa A. Dominaco; Josef D. Poliquit; Susana B. Miñoza
c. National		
None	N/A	N/A
d. International		
None	N/A	N/A

B. Attendance of researchers to scientific *foral* training/workshop/seminars

TITLE	DATE, VENUE	RESEARCHERS ATTENDED
a. Institutional		
2021 VSU Agency In-House Review	Virtual	Roberto C. Guarte Marjorie E. Timbal Fatima P. Gumamac Susana B. Miñoza
b. Regional		
32nd Joint ViCARP-RRDEN Symposium	March 23-24, 2021 Virtual	Roberto C. Guarte Marjorie E. Timbal Fatima P. Gumamac Susana B. Miñoza

TITLE	DATE, VENUE	RESEARCHERS ATTENDED
c. National		
None	N/A	N/A
d. International		
None	N/A	N/A

C. Technologies/Information patented and commercialized

a. Technology patented (**Please give a brief description of the technology, generator and the status of patenting**)

None

b. Technology commercialized (**Please give a brief description of the product, impact and the researcher/generator**)

None

D. Research papers published

	TITLE	AUTHOR (S)	DATE/YEAR/PUBLICATION/ PUBLISHER	
a. Refereed Journal	None	N/A	N/A	
Institutional				
National				
International				
b. Semi-popular publ'n (newsletter, etc.)	None	N/A	N/A	
c. Popularized pub'ln (technoguides, etc.)	None	N/A	N/A	
d. Book Chapter/s	None	N/A	N/A	
e. Books	None	N/A	N/A	

E. R and D awards and recognitions received

NAME OF AWARDS	TITLE OF PAPER/ POSTER GAINED AWARD	RECIPIENT/S	PLACE AWARDED	DATE AWARDED	AWARD OBTAINED (Plaque; if cash, indicate amount)	SPONSORING AGENCY
a. Institutional						
None	N/A	N/A	N/A	N/A	N/A	N/A
b. Regional						
None	N/A	N/A	N/A	N/A	N/A	N/A
c. National						
None	N/A	N/A	N/A	N/A	N/A	N/A
d. International						
None	N/A	N/A	N/A	N/A	N/A	N/A

F. R and D inter-agency linkages forged/maintained

NAME OF AGENCY	NATURE OF LINKAGE	Brief Description of Linkage	Remarks (specify amt generated, etc.)
a. Local (with LGUs, NGOs, POs)			
None	N/A	N/A	N/A
b. Regional			
Municipality of Hinunangan, Southern Leyte; Municipality of Bato, Leyte; Municipality of Inopacan, Leyte	Collaborating Agencies	Recipients of the DOE-funded Solar Home Systems (SHS) Project in 2014 and 2015	• There was no actual monitoring visit conducted due to the COVID-19 Pandemic
Province of Leyte: 3 cities and 41 Municipalities	Collaborating Agencies	Recipients of the DOE-funded Solar Streetlighting Project in 2014 and 2015	• There was no actual monitoring visit conducted due to the COVID-19 Pandemic
Regional Climate Change Research and Development Center (RCCRDC) through the Visayas State University (VSU)	Collaborating Agency	Source of Fund of the ff. projects in 2021: CC16.RE.01.1718 CC18.RE.03.1719 CC19.RE.04.1718 CC17.RE.02.1718	 P130,000.00 P98,520.00 P 78,890.00 No Funding Requested
c. National			
None	N/A	N/A	N/A
d. International			
None	N/A	N/A	N/A

G. List of Ongoing/ Completed R&D Projects

Program/Project/ Study Title	Proponent/s	Collaborator/ cooperator	Lead Agency	Collaborating Agency
Hydraulic Ram Pump Development and Automation for Small Irrigation System in Upland Barangays (CC16.RE.01.1718)	Roberto C. Guarte (PL);	Ma. Grace C. Sumaria (SL)	Renewable Energy Research Center (RERC)	• Department of Agricultural and Biosystems Engineering (DABE), Visayas State University (VSU) • Regional Climate Change Research and Development Center (RCCRDC) through, VSU
Solar-Based Evaporative Cooling System for Intermediate Field Storage of Fruits and Vegetables (CC18.RE.03.1719)	Roberto C. Guarte (PL);	Eldon P. De Padua (SL)	RERC	• DABE, VSU • RCCRDC, VSU
Bioenergy Generation from Agricultural Wastes, Seaweeds, Aquatic Weeds, Algae, Cellulosic Materials, and Plant Oils for	Roberto C. Guarte (PL);		RERC	• DABE, VSU • RCCRDC, VSU

Program/Project/ Study Title	Proponent/s	Collaborator/ cooperator	Lead Agency	Collaborating Agency
Climate Change Mitigation and Food Security (CC14.RE.04.1718)				
Socio Economic Impact and Operational Evaluation of Renewable Energy System (RES) Installed in the Different Island Barangays in Leyte and Southern Leyte (CC17-RE.02.1718)	Jacqueline M. Guarte (PL);		RERC	• Municipality of Hinunangan, Southern Leyte • Municipality of Bato, Leyte • Municipality of Inopacan, Leyte • Department of Statistics (DepStat), VSU; • RCCRDC, VSU

H. List of Trainings/ Seminars/ Workshops Conducted

Title of Training/Seminar/Workshop	Date conducted	Venue	No. of Participants	Sponsoring Agencies
None	N/A	N/A	N/A	N/A

I. List of equipment/facilities purchased/enhanced

Equipment Purchased/ Upgraded/ Facilities Enhanced	Location/ Agency	Expenditure/ Cost	Source of Funds
Lab analytical balance electronic scale 500g x 0.01g	RERC	P 4,389.00	Consolation cash prize for submission of poster entry during the 32nd RRDEN

Submitted By:

ROBERTO C. GUARTE
Director
Date: 29 December 2021

Photo Documentation

Posters Submitted during the 32nd RRDEN

HYDRAULIC RAM PUMP DEVELOPMENT FOR SMALL IRRIGATION SYSTEM IN UPLAND BARANGAYS

Roberto C. Guarte[1], Jaysonh B. Lua[2], and Marjorie E. Timbal[2]

ABSTRACT

A field-type Testing Rig for evaluating the technical performance of Ram Pump prototypes was established at the Renewable Energy Research Center (RERC) of the Visayas State University. Using the testing rig, the technical performance of one ram pump prototype developed in RERC, was evaluated using a three-factor factorial experiment in a completely randomized design (CRD) with drive pipe angle (H, °), waste valve angle (Θ_w, °), and delivery pipe size diameter (Ø, in.) as factors. The angles of elevation used were: H_1 = 5°, H_2 = 10°, and H_3 = 15° for the drive pipe; and Θ_{w1} = 34°, Θ_{w2} = 46°, and Θ_{w3}^{59} = 59° for the waste valve. The delivery pipe diameter sizes were set $Ø_1$ = 1", $Ø_2$ = 3/4", and $Ø_3$ = 1/2". Results indicated that the combinations of H, Θ_w, and Ø have significant effect on the water discharge (Q, li/min), vertical height of discharge (h, m), and the pressure build-up inside the air chamber (P, kPa). The parameter combination that gave the highest water discharge of 15.44li/min and a delivery height 6.38m was at H=10°, Θ_w=34°, and Ø=1". These results revealed that the testing rig can be used for technical performance evaluation of any ram pump prototypes, and the RERC-developed ram pump can be used for small irrigation system for high value crops in areas where electricity is not present.

INTRODUCTION

A Ram Pump is a simple device for pumping water at a low flow rates without using electricity. It uses the energy of flowing water to lift water from a stream, pond, or spring to an elevated storage tank or to a discharge point. It is useful where the water source flows constantly and the usable fall from the water source to the pump location is about 1.0m (Watt, 1981).

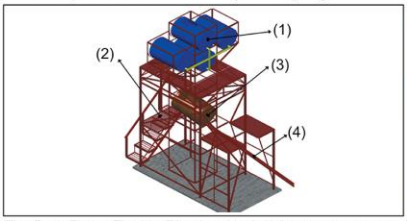
In upland areas where water supply is limited, a Ram Pump can be used to provide water from a flowing stream or creek located below the area. It is well adapted to locations where other power sources are limited. They do not need any electricity, can work anytime the stream is flowing, and do not need wind or sunshine to operate. In this study, a ram pump testing rig was developed for evaluation of the technical performance of any ram pump prototypes and to evaluate one (1) RERC-developed ram pump prototype.

OBJECTIVES

1. Develop a field-type testing rig for technical evaluation of any ram pump prototypes;
2. Evaluate the technical performance of the RERC-developed ram pump prototype; and
3. Establish the best operating combination parameters of the RERC-developed prototype in terms of water discharge and water delivery height.

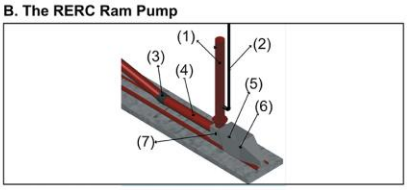
METHODOLOGY

A. Development of the Ram Pump Testing Rig



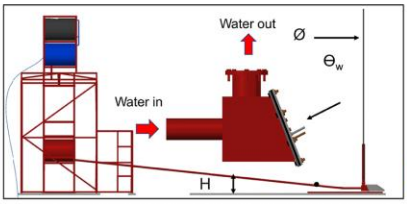
The Ram Pump Testing Rig showing its parts; water storage tank (1), stand for access valve (2), water header tank (3), and drive pipe (4)

B. The RERC Ram Pump



The RERC-developed ram pump showing its parts: air-pressure chamber (1), delivery pipe (2), flexible rubber coupling (3), drive pipe (4), waste valve (5), water catchment area (6), and ram pump body (7)

C. Technical Performance Evaluation of the RERC Ram Pump



Schematic diagram showing the performance evaluation at different drive pipe angles (H), waste valve angles (Θ_w), and delivery pipe size diameters (Ø)

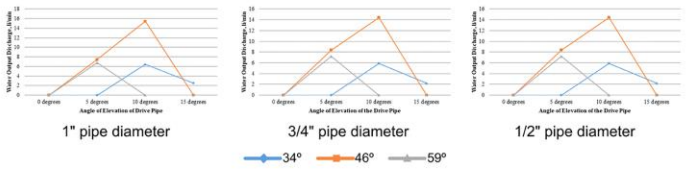
FINDINGS

1. The completed Testing Rig for Ram Pump

2. Pressure (kPa) in the air chamber, water discharge (li/min), and height of water discharge (m) of the Ram Pump

Treatment (H, Θ_w, Ø)	Pressure (kPa)	Water Discharge (li/min)	Height of water Discharge (m)
4 (5°, 46°, 1/2")	65.50	8.10^{cd}	
5 (5°, 46°,3/4")	62.05	8.36^{cd}	6.330^{de}
6 (5°,46°,1")	68.95	7.44^{def}	6.320^{f}
7 (5°, 59°, 1/2")	68.95	7.15^{ef}	6.350^{b}
8 (5°, 59°, 3/4")	68.95	7.21^{def}	6.350^{b}
9 (5°, 59°, 1")	68.95	6.77^{ef}	6.380^{a}
10 (10°, 34°, 1/2")	60.33	5.78^{h}	6.320^{ef}
11 (10°, 34°, 3/4")	60.33	5.91^{gh}	6.310^{f}
12 (10°, 34°, 1")	55.16	15.44^{a}	6.310^{f}
13 (10°, 46°, 1/2")	68.95	14.60^{ab}	6.387^{a}
14 (10°, 46°, 3/4")	68.95	14.43^{b}	6.347^{b}
15 (10°, 46°, 1")	62.05	6.45^{gh}	6.340^{bc}
19 (15°, 34°, 1/2")	51.71	2.10^{i}	6.333^{cd}
20 (15°, 34°, 3/4")	60.33	2.20^{i}	6.333^{cd}
21 (15°, 34°, 1")	60.33	2.54^{i}	6.330^{de}

3. Water output discharge (li/min) as affected by drive pipe angle and waste valve angle using output pipe of 1", 3/4", and 1/2" diameters



Highlights of Findings

- The field-type ***RERC Ram Pump Testing Rig*** for the technical performance evaluation of any ram pump prototype is very functional.
- Using the said ***Testing Rig***, the RERC-developed ram pump prototype performed best at the following parameter combinations:

Q_{max} = 15.44 li/min at H=10°, Θ_w=34°, and Ø=1"

h_{max} = 8.38m at H=10°, Θ_w=34°, and Ø=1/2"

ACKNOWLEDGEMENT

The researchers would like to express their deepest gratitude to the Visayas State University for funding the project through the Office of the Vice President for Research, Extension, and Innovation (OVPREI) and the Regional Climate Change Research and Development Center (RCCRDC).

Funding Agencies:
VISAYAS STATE UNIVERSITY
Regional Climate Change Research and Development Center (RCCRDC)

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WEATHER-RESISTANT SOLAR-BASED EVAPORATIVE COOLER FOR INTERMEDIATE FIELD BULK STORAGE NEWLY HARVESTED HIGH VALUE VEGETABLES

(Roberto C. Guarte[1], Jonalyn Sacay[2], and Marjorie E. Timbal[2])

ABSTRACT

A weather-resistant evaporative cooler, with 40m³ internal storage space, was developed and evaluated for intermediate field bulk storage of newly harvested vegetables. Its performance was evaluated in terms of temperature depression and relative humidity inside the storage space and the storage life of selected locally-grown vegetables. Results indicated that the evaporative cooler inside temperature can be reduced to a maximum 7°C during the hottest maintained relative humidity range of 80 to 90% during the day. Storage life of locally-grown vegetables like pechay (*Brassica rapa subsp. pekinensis*), cabbage (*Brassica oleracea var. capitata*), bitter gourd (*Momordica charantia*), and eggplant (*Solanum melongena*) without significant quality changes for 18, 18, 8, and 20 days, respectively, compared to their respective storage life under an open shed space of only 10, 10, 6, and 11 days only. The results imply that this solar-based evaporative cooler can be the best alternative to the expensive refrigerated chillers for intermediate bulk storage of vegetable few days prior to marketing.

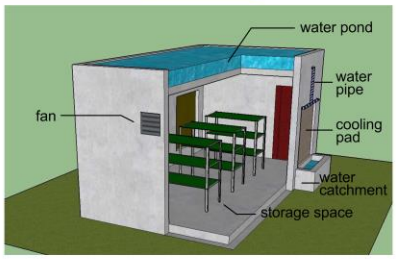
INTRODUCTION

The Department of Agriculture has aggressively promoted the growing of vegetables even in remote and hinterland barangays where farm-to-market roads are not yet well established. Because of the very perishable nature of fresh vegetables and the absence of the expensive refrigerated chillers for their intermediate immediate storage after harvest for bringing them to the central market. This is now a felt need to develop cheap but weather resistant structure for intermediate bulk storage of newly harvested vegetable in far-flung barangays. The best technical alternative is to use the principle of evaporative cooling, an environmental-friendly air conditioning system that operates using induced processes of heat and mass transfer where water and air are working fluids (Camargo, 2007). In this study, a weather resistant solar-based evaporative cooler, with 40m³ inside storage space, was developed, constructed, and evaluated for intermediate field bulk storage of newly harvested locally-grown vegetables.

OBJECTIVES

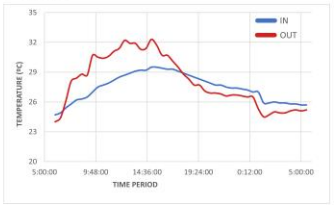
1. Develop a weather-resistant storage solar-based structure for intermediate bulk storage of newly harvested locally-grown vegetables;
2. Evaluate the technical performance of the evaporative cooler in terms of its inside temperature depression and relative humidity; and
3. Determine the storage life of selected locally-grown vegetables using the said evaporative cooler.

METHODOLOGY

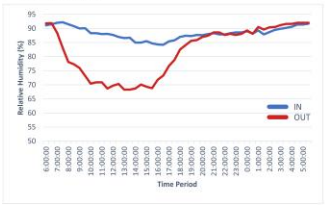


FINDINGS

Average temperature profiles of the outside and inside environment of the evaporative cooler.



Relative humidity (%) of inside and outside air of the evaporative cooler with stored vegetables.



Results indicated that the evaporative cooler inside temperature can be reduced to a maximum 7°C during the hottest maintained relative humidity range of 80 to 90% during the day.

Start of Storage

Pechay and cabbage | Bitter gourd and eggplant

Vegetables Inside

Pechay and cabbage | Bitter gourd and eggplant

Vegetables Inside

After Storage

Pechay | Cabbage | Bitter gourd | Eggplant

Vegetables inside

Pechay | Cabbage | Bitter gourd | Eggplant

Vegetables outside

Storage Life of Vegetables

Vegetable	Storage Life (days)	
	Inside	Outside
Pechay	16	10
Cabbage	16	10
Bitter gourd	8	6
Eggplant	20	11

ACKNOWLEDGEMENT

The researchers would like to express their deepest gratitude to the Visayas State University for funding the project through the Office of the Vice President for Research, Extension, and Innovation (OVPREI) and the Regional Climate Change Research and Development Center (RCCRDC).

Funding Agencies:
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Regional Climate Change Research and Development Center (RCCRDC)

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Visca, Baybay City, Leyte, Philippines 6521-A

Crude Biodiesel from Used Fried Chicken Cooking Oil and Fat from Chicken Wastes as an Environment-friendly Fuel for Medium Scale Fried Chicken Venture

(Roberto C. Guarte[a], April San J. Duarte[b], and Fatima P. Gumamac[b])

Abstract

Crude biodiesel is relatively very cheap compared to commercial biodiesel due to the significant reduction of the cost of raw materials and the elimination of the refining cost required to meet national standards. This study investigated the technical feasibility of producing crude biodiesel from used cooking oil generated from a medium scale fried chicken restaurant and from chicken fat from the wastes of chicken processing. The crude biodiesel was then used as fuel for the plant oil stove for possible adoption by fried chicken processors as an environment-friendly source of fuel. Results indicated that it is possible to produce crude biodiesel from used cooking oil and wastes chicken fat generated from fried chicken restaurant. One (1) liter (L) of used cooking oil and a kilogram of raw chicken fat produced an average of 0.987L, and 1.08L of crude biodiesel, respectively. Results of the technical evaluation of using crude oil as fuel for the plant oil stove indicated that a liter of crude biodiesel can operate it continuously for four (4) hours at an average power output range of 1.5-3.8 kilowatts. The average carbon monoxide (CO) emission of burning the biodiesel ranges from 1-4 ppm compared to burning of firewood, kerosene, and LPG which emit CO of 1000, 210, 160 ppm, respectively. The overall results imply that it is technically feasible to produce crude biodiesel from used cooking oil generated from fried chicken processing and from fat of chicken processing wastes and use this crude biodiesel as environment-friendly fuel for medium scale fried chicken business.

Introduction

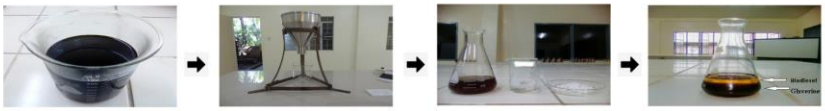
Production of fried chicken from medium scale processors generates two (2) important wastes that are harmful to the environment if not properly disposed of. These wastes include the poultry processing wastes and the used cooking oil generated after frying the chicken that may pollute both air, soil, and underground water if improperly disposed. This study investigated the technical feasibility of using the used cooking oil and chicken abdominal fat from poultry processing wastes as raw materials in the production of crude biodiesel and use it as an environment-friendly fuel for a medium scale fried chicken venture. Although high quality biodiesel is already available commercially, it is very expensive due to high cost of raw minerals and the refining process. Crude biodiesel that is processed using simple technology and facilities developed in the university, may provide windows to use it in medium food processing industries as an environment-friendly source of energy.

Objectives

1. Produce crude biodiesel from used cooking oil from fried chicken food chain and chicken abdominal fat from poultry processing wastes;
2. Evaluate the technical performance of the plant oil stove using crude biodiesel as fuel following the international standard cooking test; and
3. Compare the carbon monoxide (CO) emission of burning crude biodiesel to existing fuel used for cooking stove.

Methodology

A. Production of biodiesel from used vegetable oil



Used cooking oil from fried chicken processing → Filtering of used cooking oil → Mixing of 100 ml of used vegetable oil, 20 ml of methanol, and 1 g of KOH flakes → Settling process to separate biodiesel from glycerine

B. Production of biodiesel from chicken fat

Raw chicken abdominal fat from poultry processing → Rendering of chicken abdominal fat → Filtering of the rendered fat → Mixing of 100 ml extracted chicken fat, 20 ml methanol, and 1 g of KOH flakes → Settling process to separate biodiesel from glycerine

Findings

1. Biodiesel produced from used vegetable oil

2. Biodiesel produced from abdominal fat

Feedstock	Amount of Feedstock	Volume of Biodiesel Produced
Used Vegetable Oil	1L	0.987L
Chicken Fat	1kg	1.08L

Note: L = liter

3. Average biodiesel recovery from used vegetable oil and chicken fat

4. Plant oil stove "Protos"

Fuel	CO Emission (ppm)	Power Output (kW)
Biodiesel	1-4	1.5-3.8
Gas (LPG)	160	2.0-3.5
Kerosene	210	1.1-3.2
Firewood	>1000	Variable

5. Carbon monoxide emission and power output

Highlights:

a. One (1) liter of used cooking oil produced 0.987 liters of crude biodiesel and one (1) kilogram of chicken abdominal fat produced 1.08 liters of crude biodiesel.

b. Using the plant oil stove, one (1) liter of crude biodiesel can operate the stove continuously for four (4) hours at an average power output range of 1.5-3.8 kilowatts.

c. The average carbon monoxide (CO) emission of burning the crude biodiesel ranges from 1-4 ppm only compared to burning of firewood, kerosene, and LPG which emit CO of 1000, 210, 160 ppm, respectively.

Acknowledgements

The researchers would like to express their deepest gratitude to the Visayas State University for funding the project through the Office of the Vice President for Research, Extension, and Innovation (OVPREI) and the Regional Climate Change Research and Development Center (RCCRDC).

Funding Agencies:

VISAYAS STATE UNIVERSITY

Regional Climate Change Research and Development Center (RCCRDC)

[a] Director, RERC and Dean, College of Engineering and Technology, Visayas State University, Visca, Bayba City, Leyte

[b] Science Research Assistant, Renewable Energy Research Center, Visayas State University, Visca, Baybay City, Leyte

Operational Evaluation of Solar Home System (SHS) Use by Households in Leyte and Southern Leyte

(Jacqueline M. Guarte[1], Roberto C. Guarte[2], Joyce B. Maurillo[3], Jenefrey A. Niverba[3], Lara Nerissa A. Domanaco[3], Josef D. Poliquit[3], Susana B. Miñoza[4])

Abstract

This study investigated how the 530 solar home systems (SHSs) installed in individual households in the following island barangays: Apid (76) in Inopacan and Dawahon (283) in Bato, Leyte; San Pablo (57) and San Pedro (114) in Hinunangan, Southern Leyte were used and maintained by the household beneficiaries and if operational problems were encountered using data collected through the household surveys conducted from 2017 to 2018. Results showed that all households use the SHS for its primary purpose of lighting. Less than 42% were using the other functions of the SHS. While most household beneficiaries in San Pedro and San Pablo can be expected to clean regularly the solar module, this cannot be said for those in Apid and Dawahon. The most common parts of the SHS that became nonfunctional include the AM radio for the first supplier of SHS and both AM and FM radios for the second supplier of SHS.

Introduction

This project stems from the Household Electrification Program (HEP) of the Department of Energy (DOE) which is in line with the Philippine government's goal of achieving 90% household electrification by 2017 (Energy Development Plan 2011-2016). In 2012, DOE, in collaboration with the then Visayas State University-Affiliated Renewable Energy Center (VSU-AREC) targeted lighting the households in the different island and hinterland barangays in the provinces of Leyte, Southern Leyte, and Biliran which cannot be electrified in the next five (5) years based on the plans and programs of the electric cooperatives (ECs) in these areas using the solar home system (SHS).

Installation of the first batch of solar home systems (SHSs) in Apid (42), San Pablo (24) and San Pedro (94) was in 2013. The second batch was in 2014 with 35, 33 and 30 SHS units, respectively. In Dawahon, the first batch (108) was installed in 2014 while the second (175) was in 2015. The supplier of SHS installed in 2013 was different from those installed in 2014 and 2015.

This study was conceptualized as a result of various monitoring and repair of SHS activities were conducted. This seeks to know how the SHS was used by the household in relation with existing sources of energy and in terms of load management, primarily for lighting.

Objectives

- Characterize the use of the SHS by household beneficiaries;
- Assess the maintenance of the SHS; and
- Identify the parts of the SHS with operational problems encountered.

Methodology

- Conduct of household surveys on all SHS beneficiaries with functional units.
- Generation of classification and regression trees (CART) on household SHS use and load management by barangay.

Findings

Uses of SHS

Household use of the solar home system in the four (4) island barangays (multiple response)

Island Barangay	Lighting (%)	Listening to Radio (%)	Charging Cellphone (%)	Listening to MP3 (%)
Apid (n=55)	100	52.7	43.6	10.9
Dawahon (n=97)	100	29.9	13.4	20.6
San Pablo (n=41)	100	34.1	43.9	39
San Pedro (n=106)	100	20.8	64.2	35.8
Average	100	34.4	41.3	26.6

Maintenance of SHS

Percentage distribution of household beneficiaries on whether or not they are cleaning regularly the solar module of the solar home system

Island Barangay	Cleaning the Solar Module Regularly (%)	Not Cleaning the Solar Module Regularly (%)
Apid (n=55)	45.4	54.6
Dawahon (n=97)	20.6	79.4
San Pablo (n=41)	67.9	32.1
San Pedro (n=106)	56.1	43.9
Average	47.5	52.5

Operational Problems

Percentage of household beneficiaries with nonfunctional solar home system parts by island barangay (multiple response)

Island Barangay	SHS Component						
	AM Radio	FM Radio	CP Charger	MP3 Player	Left Speaker	Right Speaker	Fuse
Apid (n=29)	**44.8**	31.0	17.2	17.2	20.7	20.7	0
San Pablo (n=13)	30.8	30.8	**46.2**	30.8	23.1	23.1	0
San Pedro (n=80)	**72.5**	32.5	17.5	27.5	53.8	50.0	1.2

Supplier A Installation: 2013 Survey Conducted: 2017

Island Barangay	SHS Component						
	AM Radio	FM Radio	CP Charger	MP3 Player	Left Speaker	Right Speaker	Fuse
Apid (n=26)	26.9	30.8	**38.5**	30.8	30.8	30.8	0
San Pablo (n=28)	50.0	**64.3**	39.3	42.9	46.4	39.3	3.6
San Pedro (n=26)	**50.0**	30.8	26.9	38.5	42.3	46.2	0
Dawahon, batch 1 (n=48)	**37.5**	**37.5**	20.8	27.1	35.4	35.4	0
Dawahon, batch 2 (n=49)*	45.9	**46.9**	24.5	24.5	44.9	42.9	0

Supplier B Installation: 2014 Survey Conducted: 2017
*Installation: 2015 Survey Conducted: 2018

Conclusions

- Household beneficiaries are using the SHS mainly for lighting. Less than 50% are using the AM/FM radio, MP3 player and cellphone charger.
- There is a clear evidence that more that one-half of the household beneficiaries are not cleaning their solar module regularly despite knowing the impact of having a clean solar module in absorbing light energy.
- The presence of nonfunctional SHS components hinders the household beneficiaries from enjoying the full benefit brought by having SHS in the household.

Recommendations

- There should be at least one (1) well-trained SHS technician in every recipient barangay to oversee the operation and regular maintenance of all installed SHS units;
- LGUs should assist the benefiaries by conducting trainings to SHS technicians on on-site inspection, evaluation and repair of solar home systems.

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