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Assessing the Impact of Power Outages on Appliances of Farmers and Fisherfolks in Selected Barangays of Cawayan, Masbate, Philippines: Basis for a Proposed Extension Program

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ABSTRACT

This paper presents data on the economic background and power supply situation in selected barangays of the Municipality of Cawayan in Masbate, Philippines. It examined the constraints in power supply experienced by the respondents. The study results showed that many respondents had an annual income of less than ₱18,200, which was considered low and may have resulted in difficulty in paying high bills brought by power outages. All respondents relied on the power grid as their source of electricity, and power interruptions were a common occurrence. The data revealed that 97.7% of respondents experienced power interruptions, with 51.1% experiencing 3-4 hours of interruption. Almost all respondents claimed that power interruption increased their electric consumption and bill, and 56% were not satisfied with their electric bill when there was a power interruption. The study also found that refrigerators and televisions were the most power-consuming appliances, and bulbs were reported to be the most affected by power interruption. Possible reasons for power interruptions cited by respondents included part of the service and performing maintenance. The study findings suggested a need for capacity training for farmers and fishers on adopting solar energy to address power supply constraints. The extension project proposal titled, Electrical and Electronic Designs using Renewable Energy that Led to Net Zero, was an excellent opportunity to provide training to all marginalized sectors in the municipality of Cawayan. The proposal included training on solar installation and maintenance.

Keywords*: households, outages, power grid, solar energy, trip-off*

INTRODUCTION

The issue of power interruptions or outages is a prevalent concern across the globe and has significant repercussions on households and businesses (Fakih et al., 2020). The availability of consistent and reliable electricity is fundamental for promoting economic competitiveness and sustainability, as energy security is a crucial aspect of modern economics (Gielen et al., 2029). Access to uninterrupted power supply is considered a vital catalyst for economic growth (Sanni et al., 2021), and its absence can hinder development efforts and impede social progress (Casey et al., 2020).

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The Municipality of Cawayan in Masbate Province, the Philippines, is one area where frequent power outages have become a pressing issue for the local community, particularly in rural areas with underdeveloped power infrastructure. This issue is consistent with research indicating that power interruptions are common in developing countries (Taniguchi, 2019), particularly in rural areas (Ali, 2016). In such regions, unreliable electricity supply not only affects daily life but also hampers agricultural productivity (Seetharaman, 2019), limits educational opportunities (Meles, 2020), and restricts access to healthcare services (Mechtenberg et al., 2020).

The adverse effects of frequent power interruptions on household appliances in the Municipality of Cawayan, Masbate, have been reported on various social media platforms, including Cawayan Talks and Masbate Talks pages. The electric surges caused during power outages can disrupt the normal functioning of appliances, leading to damage,

overheating, and grounding issues (Nduhuura et al., 2021). A study by Francisco (2022) found that electricity customers in the Philippines experienced an average of 5.7 power interruptions or 8.8 hours. Luzon encountered more frequent power interruptions than Visayas, while Visayas experienced more prolonged power outages. A study by Al-Shaalan (2017) in the Kingdom of Saudi Arabia found that frequent power interruptions had caused economic losses to households, inconvenience, and frustration.

This study aims to investigate the frequency and duration of power outages in the rural areas of the Municipality of Cawayan and analyze their effect on household appliances. The study also seeks to examine the coping mechanisms that households use in response to power outages and their perceptions of the impact of these outages on their daily lives. While prior studies have focused on the impact of power outages on businesses and industries, there needs to be a greater understanding of how households are affected. Therefore, this study will contribute to the existing literature by providing insights into the impact of power interruptions on household appliances and the coping mechanisms the households use in response to these outages.

This research is significant in the context of the Philippine government's efforts to enhance power infrastructure and address power outages in rural areas, particularly in remote barangays of Cawayan in Masbate. The Department of Energy has prioritized improving the power infrastructure in rural areas to promote sustainable economic development and enhance the quality of life of rural communities (DOE, 2019). Additionally, the United Nations' Sustainable Development Goals (SDG 7) aim to ensure universal access to affordable, reliable, sustainable, and modern energy services for all by 2030, with a focus on renewable energy sources to support sustainable development (United Nations, 2015).

The findings of this study will provide valuable insights into the management of power infrastructure and the development of policies to mitigate the impact of power outages on households in the Municipality of Cawayan and other similar areas. This research will also shed light on the importance of investing in power infrastructure and promoting energy security to achieve sustainable economic development and enhance the quality of life of rural communities.

METHODOLOGY

Research Design and Sampling

The study employed a descriptive research design to gather data about the impacts of power interruptions in the Municipality of Cawayan and their effects on household appliances. The researchers utilized quantitative data collection methods, including various forms of surveys, such as paper surveys and face-to-face interviews. A convenience systematic sampling technique was used to select respondents that were readily available to the researchers without any specific pattern. The study's respondents were fisherfolks and farmer-consumers in selected Barangays in the Municipality of Cawayan, including Begia, Recodo, and Mahayahay. A total of 266 respondents were selected, including 86 from Recodo, 90 from Mahayahay, and 90 from Behia. The sample size was determined using Slovin's formula.

Data Collection and Statistical Analysis

Data was collected using a survey questionnaire adapted from the study of Nduhuura et al. (2021), which was personally delivered to the respondents, and information was gathered by asking questions during face-to-face interviews in the selected Barangays of Behia, Mahayahay, and Recodo in the Municipality of Cawayan. The respondents were informed first about the purpose of the study and how the data were kept anonymously before the start of the study. The respondents' responses during the interview were recorded and subjected to content analysis. The frequency of power interruptions and their effects on household appliances were computed by recording and analyzing data using cross-tabulation of the convenience sample.

The statistical tools used in this study were frequency count, percentage, and the arithmetic mean or average.

RESULTS AND DISCUSSION

Socio-Demographic Profiles of the Consumers

The data presented in Table 1 shows the economic background of fisherfolks and farmer-consumers in selected Barangays in the Municipality of Cawayan. One of the variables presented was the annual income of the respondents. The table showed that a significant number of the respondents had an average monthly income of Php1,083.00. This income level was considered low and may result in difficulty paying high bills brought about by power outages (Philippine Institute for Development Studies, 2020). Paying bills could be challenging and expensive, especially for lower-income individuals (Toh, 2021).

Power outages could disrupt the daily activities of individuals and businesses and even damage appliances and equipment. Repairing or replacing these appliances could be a significant burden for low-income households. Furthermore, power interruptions could also impact the livelihood of individuals whose source of income was dependent on electricity, such as those in the fishing industry. With frequent power outages, they

Table 1. Economic background of the fisherfolks and farmer-consumers in selected Barangays in the Municipality of Cawayan

Variable	Recodo (*n*=86)		Mahayahay (*n*=90)		Behia (*n*=90)		Total (*n*=266)	
	F	%	F	%	F	%	F	%
Occupation								
Farming	30	34.9	6	6.7	2	2.2	38	14.3
Vendor	14	16.3	20	22.2	15	16.7	49	18.4
Unemployed	10	11.6	0	0.0	10	11.1	20	7.5
Driver	6	7.0	11	12.2	5	5.6	22	8.3
Fishing	21	24.4	25	27.8	49	54.4	95	35.7
Employment	3	3.5	18	20.0	9	10.0	30	11.3
Security Guard	1	1.2	0	0.0	0	0.0	1	0.4
Carpenter	1	1.2	10	11.1	0	0.0	11	4.1
Monthly Income								
Less than ₱10,957	86	100.0	90	100.0	90	100.0	266	100.0
₱10,957 to ₱21,914	0	0.0	0	0.0	0	0.0	0	0.0
₱21,914 to ₱43,828	0	0.0	0	0.0	0	0.0	0	0.0
₱43,828 to ₱76,699	0	0.0	0	0.0	0	0.0	0	0.0
₱76,699 to ₱131,484	0	0.0	0	0.0	0	0.0	0	0.0
₱131,483 to ₱219,140	0	0.0	0	0.0	0	0.0	0	0.0
At least ₱219,140 and up	0	0.0	0	0.0	0	0.0	0	0.0

may have needed help properly storing or processing their catch, resulting in spoilage and loss of income. Therefore, it was important for policymakers to consider the affected population's economic background when addressing power interruptions. Programs and policies to improve access to reliable and affordable electricity could alleviate the burden on low-income households and support the livelihood of those dependent on electricity.

Power Supply of Selected Barangays in the Municipality of Cawayan

Table 2 presents the power supply of the selected barangays in the Municipality of Cawayan. The data showed that all three barangays were connected to the power grid as their source of electricity, with 266 respondents. None of the respondents reported using their own generator or barangay electrification system, nor did anyone report using solar energy as a source of electricity. The table also presented the year each barangay was connected to the power grid. The data revealed that the earliest connection was in 1999, with only four respondents from Mahayahay reporting this connection year. Most respondents (24.8%) were connected to the power grid from 2016-2020, 23.7% from 2000-2005, and 22.2% from 2006-2010. The remaining respondents were connected to the power grid from 2011-2015 (19.2%) and 2021-2022 (8.6%).

The data in this table were relevant to the research as they provided information on the availability and source of electricity in the selected barangays. This information was important in understanding the impact of power outages on the respondents' appliances. With all respondents relying on the power grid as their source of electricity, power outages may have had a significant impact on their daily lives and appliances. Additionally,

Table 2. Power Supply of Selected Barangay in the Municipality of Cawayan

Variable	Recodo (*n*=86)		Mahayahay (*n*=90)		Behia (*n*=90)		Total (*n*=266)	
	F	%	F	%	F	%	F	%
Source of electricity								
Power Grid	86	100	90	100	90	100	266	100
Own generator	0	0	0	0	0	0	0	0
Barangay electrification system	0	0	0	0	0	0	0	0
Solar	0	0	0	0	0	0	0	0
The year started that connected to a power grid								
2021-2022	5	5.8	10	11.1	8	8.9	23	8.6
2016-2020	25	29.1	22	24.4	19	21.1	66	24.8
2011-2015	14	16.3	17	18.9	20	22.2	51	19.2
2006-2010	22	25.6	24	26.7	13	14.4	59	22.2
2000-2005	20	23.3	14	15.6	29	32.2	63	23.7
1999	0	0.0	3	3.3	1	1.1	4	1.5

the data on the year that each barangay was connected to the power grid may have helped understand the level of development and infrastructure in each barangay, which could have impacted the frequency and duration of power outages experienced by the respondents.

Constraints in Power Supply

The data in Table 3 presented the power supply constraints in selected barangays of Cawayan, Masbate, Philippines. The data was derived from the survey results from 266 respondents in three barangays: Recodo, Mahayahay, and Behia. The data showed that power interruptions were common, with 97.7% of respondents experiencing them. The duration of power outages varied, with 51.1% of respondents experiencing 3-4 hours of interruption. Power interruption occurred weekly for 54.9% of respondents. The frequency of power interruption in a day/week/month/year varied, with 42.5% of respondents experiencing 6-7 times per day, which did not conform to the annual power interruption experienced by the Philippines in the year 2021, which was 5.7 times (Francisco, 2022). This meant that power interruptions suffered by consumers in selected barangays of Cawayan were alarming and required immediate attention from the concerned agency to improve its service to serve its consumers better.

Regarding the impact of power interruption, almost all respondents (93.6%) claimed that it increased their electric consumption and bill, similar to the findings of (Francisco, 2022). Moreover, 56% of respondents were unsatisfied with their electric bill during a power interruption. Regarding appliances that consumed a high amount of electricity, respondents reported that refrigerators (37.2%) and televisions (30.8%) were the most power-consuming. Power interruption also affected the respondents' appliances, with 83.1% experiencing it. Among the appliances, bulbs were reported to be the most affected, with 40% of respondents saying that they malfunctioned or got damaged. This finding was similar to the study of Meles (2020) in that one of the impacts of power interruption suddenly came back when it damaged the appliances due to the high or low ideal voltage supplied. The quality of the voltage supply to the respondents' houses was mainly normal, with 93% of respondents indicating that their voltage supply was normal. However, a significant number of respondents (22.2%) reported having a low voltage supply. This suggested that there might be some issues with the electrical infrastructure in the municipality that needed to be addressed.

According to the respondents, the possible reasons for power interruptions in the Municipality of Cawayan varied. The most common reasons cited were part of the service (41.9%) and performing maintenance (26.7%), and it contradicted the findings of Francisco (2022) that major disasters caused the main reason for power interruption. This suggested that the electricity provider in the municipality may need to improve its infrastructure and maintenance practices. A relatively small proportion of respondents (38.4%) reported having solar-powered equipment at home, while the majority (61.6%) reported none. This suggests the potential for increasing the adoption of solar energy in the municipality. Most respondents (96.5%) agreed that using solar systems instead of power corporations or generators can save electricity bills. This suggested a positive perception of the benefits of solar energy among the respondents. However, a small proportion of respondents (3.5%) disagreed with this statement, which indicates some resistance to adopting solar energy.

Support Services Received

Table 4 presents data on the support services received by Recodo, Mahayahay, and Behia barangays residents in Cawayan, Masbate, Philippines, in case of power outages. The data was essential in assessing the impact of power interruptions on appliances. For the first variable, which asked about the support appliances received from the government or barangay during calamities, only a few residents received support in the form of solar power, flashlights, and generators. The majority (96.2%) received no support, indicating a lack of preparedness and resources in the barangays during calamities. This highlighted the need for the government and barangay officials to support their constituents during calamities, including power outages adequately.

The second variable asked if the municipality or barangay gave an alternate power supply to the constituent during a power interruption. Unfortunately, the majority (73%) of the respondents answered "no," indicating that the residents were left without any alternative power supply. This could be a cause of concern, especially for those who relied heavily on electricity for their livelihood, such as those who ran small businesses. For the last variable, which asked about the possible alternative power supply in the municipality or barangay during a power interruption, the majority (73%) answered "none," which was a cause for concern as it implied that the residents were left with no options during power outages. The rest of the respondents mentioned solar and generator power as possible alternatives, indicating that some resources were still available for those who could afford it.

Generally, the data from Table 4 suggested that there needed to be more support services and resources for the residents of Recodo, Mahayahay, and Behia barangays in Cawayan, Masbate, Philippines, in case of power outages. The low number of support appliances received and the absence of alternate power supply options highlighted the need for the government and barangay officials to provide better support to their constituents during power outages and other calamities.

Table 3. Constraints of power supply in selected barangays of Cawayan

Variable	Recodo (n=86)		Mahayahay (n=90)		Behia (n=90)		Total (n=266)	
	F	%	F	%	F	%	F	%
1. If the source of electricity is through the power grid, did you experience power interruption?								
Yes	81	94.2	89	98.9	90	100.0	260	97.7
No	5	5.8	1	1.1	0	0.0	6	2.3
1.1 If yes, how many hours would it take?								
1-2 hrs.	35	40.7	26	28.9	33	36.7	94	35.3
3-4 hrs.	40	46.5	50	55.6	46	51.1	136	51.1
5-24 hrs.	11	12.8	14	15.6	11	12.2	36	13.5
1.2. How often do power interruptions occur?								
Daily	28	32.6	26	28.9	30	33.3	84	31.6
Weekly	50	58.1	49	54.4	47	52.2	146	54.9
Monthly	8	9.3	15	16.7	13	14.4	36	13.5
1.3. What is the frequency of power interruption in a day/week/month/year?								
4-5 times/day	32	37.2	34	37.8	38	42.2	104	39.1
6-7 times /day	35	40.7	38	42.2	40	44.4	113	42.5
8-10 times/day	19	22.1	18	20.0	12	13.3	49	18.4
2. Does the power trip-off increase your electric consumption and bill?								
Yes	85	98.8	83	92.2	81	90.0	249	93.6
No	1	1.2	7	7.8	9	10.0	17	6.4
2.1 If yes, what percentage of your electric consumption and bill will increase?								
20%	0	0.0	3	3.3	2	2.2	5	1.9
15%	5	5.8	9	10.0	12	13.3	26	9.8
10%	28	32.6	29	32.2	13	14.4	70	26.3
5%	52	60.5	42	46.7	54	60.0	148	55.6
3. Are you satisfied with your electric bill when there is a power interruption?								
Yes	36	41.9	19	21.1	34	37.8	89	33.5
No	33	38.4	61	67.8	55	61.1	149	56.0
Maybe	17	19.8	10	11.1	1	1.1	28	10.5
4. In your observation, what electronic or electrical appliances consume high electricity?								
Refrigerator	32	37.2	43	47.8	24	26.7	99	37.2
Television	26	30.2	29	32.2	27	30.0	82	30.8
Aircon	16	18.6	6	6.7	3	3.3	25	9.4
Bulb	12	14.0	12	13.3	36	40.0	60	22.6
5. Does the power trip-off affect your appliances?								
Yes	79	91.9	80	88.9	62	68.9	221	83.1
No	7	8.1	10	11.1	28	31.1	45	16.9
5.1. If yes, what happened to your appliances?								
No effect	7	8.1	10	11.1	28	31.1	45	16.9
Malfunctioned	46	53.5	49	54.4	35	38.9	130	48.9
Totally damage	33	38.4	31	34.4	27	30.0	91	34.2
6. What are the appliances that can easily be damaged?								
Computers	1	1.2	2	2.2	0	0.0	3	1.1
Refrigerator	23	26.7	26	28.9	10	11.1	59	22.2
Television	27	31.4	47	52.2	34	37.8	108	40.6
Bulb	35	40.7	15	16.7	46	51.1	96	36.1
7. What is the quality of the voltage supply to your house?								
Very Low	0	0.0	25	27.8	1	1.1	26	9.8
Low	2	2.3	20	22.2	20	22.2	42	15.8
Normal	80	93.0	42	46.7	53	58.9	175	65.8
High	4	4.7	3	3.3	16	17.8	23	8.6
Very High	0	0.0	0	0.0	0	0.0	0	0.0

Table 3. Constraints of power supply in selected barangays of Cawayan *(cont'd)*

Variable	Recodo (*n*=86)		Mahayahay (*n*=90)		Behia (*n*=90)		Total (*n*=266)	
	F	%	F	%	F	%	F	%
8. What are the possible reasons for power interruptions in the Municipality of Cawayan?								
Perform maintenance	23	26.7	7	7.8	53	58.9	83	31.2
Part of the service	36	41.9	48	53.3	27	30.0	111	41.7
Installation of new electrical lines	17	19.8	3	3.3	6	6.7	26	9.8
Due to natural calamities	10	11.6	9	10.0	0	0.0	19	7.1
Human activities	0	0.0	23	25.6	4	4.4	27	10.2
9. Do you have any solar-powered equipment at home?								
Yes	33	38.4	22	24.4	15	16.7	70	26.3
No	53	61.6	68	75.6	75	83.3	196	73.7
10. Do you agree that using solar systems instead of power corporations or generators can save electricity bills?								
Yes, of course	83	96.5	76	84.4	76	84.4	235	88.3
No, it costs too much	3	3.5	13	14.4	11	12.2	27	10.2
It is a waste of time	0	0.0	1	1.1	1	1.1	2	0.8

Table 4. Support Services received from the government if the power supply is not available

Variable	Recodo (*n*=86)		Mahayahay (*n*=90)		Behia (*n*=90)		Total (*n*=266)	
	F	%	F	%	F	%	F	%
1. If there is a calamity, what support appliances have you received from the government or barangay?								
Solar Power	0	0.00	4	4.4	0	0.00	4	1.5
Flashlight	0	0.00	1	1.1	0	0.00	1	0.4
Generator	0	0.00	5	5.6	0	0.00	5	1.9
None	86	100.0	80	88.9	90	100.0	256	96.2
2. During power interruption, does the municipality or barangay give an alternate power supply to the constituent?								
Yes	0	0	0	0	0	0	3	5
No	86	100	90	100	90	100	43	73
2.1. If yes, what are the possible alternative power supply in your municipality or barangay during the power interruption?								
Solar	0	0	0	0	0	0	20	34
Generator	0	0	0	0	0	0	29	49
None	86	100	90	100	90	100	43	73

Proposed Extension Capability Training among Fishers and Farmers

Cawayan, Masbate, is an agricultural and fishing community heavily reliant on electrical appliances for farming and fishery operations. Unfortunately, the area faces frequent power outages, which disrupt daily activities and adversely affect the livelihoods of the residents. Moreover, the Philippines is committed to reducing its greenhouse gas emissions, making it essential to transition towards renewable energy sources. Based on the findings of the study, the solution offered by the researchers to the perennial problem suffered by the marginalized sectors in the municipality of Cawayan is to capacitate the farmers and fishers on harvesting the energy from renewable energy through an extension project named "Electrical and Electronic Designs using Renewable Energy that Led to Net Zero." This extension addresses the critical issue of power outages affecting farmers and fishers in selected barangays of Cawayan, Masbate, Philippines. The proposal aims to provide a sustainable solution by introducing Electrical and Electronic Designs using Renewable Energy technologies. These technologies will not only enhance the resilience of the local community against power outages but also contribute to the broader goal of achieving a net-zero carbon footprint. The following are the topics to be delivered during capability training to the target beneficiaries:

1. *Introduction to renewable energy.* This topic will introduce the different types of renewable energy, such as solar, wind, and hydropower. It will also discuss the benefits of using renewable energy, such as reducing air pollution and climate change.
2. *Designing and building renewable energy systems.* This topic will teach farmers and fishers how to

design and build their renewable energy systems. It will cover topics such as solar panel installation.

3. *Maintenance and troubleshooting of renewable energy systems.* This topic will teach farmers and fishers how to maintain and troubleshoot their renewable energy systems. It will cover topics such as cleaning solar panels.
4. *The environmental benefits of renewable energy.* This topic will discuss the environmental benefits of using renewable energy, such as reducing air pollution and climate change. It will also discuss the importance of protecting the environment for future generations.
5. *The economic benefits of renewable energy.* This topic will discuss the benefits of using renewable energy, such as saving money on energy bills and improving productivity. It will also discuss the opportunities for job creation in the renewable energy sector.
6. *The social benefits of renewable energy.* This topic will discuss the social benefits of using renewable energy, such as improving access to electricity in rural areas and reducing poverty. It will also discuss the importance of community participation in developing and implementing renewable energy projects.

The proposed extension program is a valuable initiative that will help address the problem of power outages in Cawayan, Masbate. The program will also help to reduce air pollution and climate change and build the capacity of farmers and fishers to adapt to climate change.

CONCLUSION AND RECOMMENDATIONS

It is concluded that power outages are common in the selected barangays of Cawayan and Masbate, with almost all respondents experiencing it. The duration and frequency of the outages vary, and the most common reasons for the interruptions are part of the service and maintenance. The study also found that power interruptions increase the electric consumption and bill of the respondents and affect the appliances, with refrigerators and televisions being the most power-consuming. Low-income households are most affected by power interruptions, as they have difficulty paying high bills and may lose income due to disruptions in their livelihoods.

The study recommends that policymakers consider the affected population's economic background when addressing power interruptions. Programs and policies to improve access to reliable and affordable electricity can help alleviate the burden on low-income households and support the livelihood of those dependent on electricity. The electricity provider in the municipality may need to improve its infrastructure and maintenance practices to reduce power interruptions. Moreover, there is potential for increasing the adoption of solar energy in the municipality, given the respondents' positive perception of the benefits of solar energy. The study suggests that the Electrical and Electronic Designs using Renewable Energy that Led to Net Zero Extension proposal should be extended to all barangays concerned to capacitate the people on how to utilize the free energy from the environment.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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