A Study on the Consumer Behaviour Towards the Solar Energy Devices in Rajakkad Grama Panchayath, Idukki District

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Abstract: Solar energy is radiant light and heat from the sun that is harness using a range of ever- evolving technologies such as solar heating, photovoltaic, solar thermal energy, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis. Solar energy is a highly delectable source of electricity.This study aims to study the awareness and satisfaction level of customers towards the solar energy device available in the market and the attitude towards the products. The study also focuses the various factors that influence the customers to choose the solar energy devices over electrical devices even they are comparatively cheap. The study of customer's behavior towards the acceptance of solar energy product with special reference to Rajakkad grama panchayath of idukki district , Kerala state is relevant because the study will help for future development of the area and place a major role for determining the standard of living and economic growth of people there and the benefits and problems of rural people by installing the solar energy products. This study found that most of the respondents monthly income lies between Rs.10000 to Rs.20000 and have their own house to live..Most of the respondents are non- governmental employees and entrepreneurs and get information about solar energy devices from mobile phone and installed hot water and photovoltaic solar energy devices.Majority of the respondents think that renewable source of energy is the main attractive factor about solar energy devices and use them for less than one year.Majority of the respondents reason for choosing solar device is cost saving and are satisfied with their usage.Though majority of the respondents facing problem of solar devices usage at night, they are satisfied with solar energy devices reducing electricity bills.The highest agreement is for solar energy being a reliable power source in Rajakkad Grama panchayath of Idukki district.

Key words: Key drivers of customer satisfaction, factors influencing the adoption of solar energy devices, marketing strategies of solar products

1.1 INTRODUCTION

Solar energy is radiant light and heat from the sun that is harness using a range of ever- evolving technologies such as solar heating, photovoltaic, solar thermal energy, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis. Solar energy is a highly delectable source of electricity. Solar system is mainly used as the collecting and storing device of energy from the wide source. Using solar panel or photovoltaic cell the solar energy should be converted to electrical energy can be used for both residential and industrial purposes. The technique of capturing and distributing solar energy is broadly classified into two, active solar and passive solar. Active solar are the technology including the use of photovoltaic system, concentrated solar power and solar water heating to harness the energy. Passive solar technology includes orienting a building to the sun. Nowadays solar sector is the most excellent felid for investment. There may be so many researches are to be conducted with the special consideration of Government funds and so many industries are turned to manufacture and distribute the solar devices. The manufacturers such as Tata, Luminous, Goodson, etc. with the view to Electricity Conservation. And, so many other companies are put forward to manufacture variety of quality solar devices which are suitable to both residential and industrial purpose. In this study an attempt was made to evaluate the consumer behavior towards the acceptance

of solar energy devices with special reference to Rajakkad gramapanchayath of Idukki district.

1.2 SIGNIFICANCE OF THE STUDY

The research aims to study the awareness and satisfaction level of customers towards the solar energy device available in the market and the attitude towards the products. The study also focuses the various factors that influence the customers to choose the solar energy devices over electrical devices even they are comparatively cheap. The study of customer's behavior towards the acceptance of solar energy product with special reference to Rajakkad grama panchayath of idukki district , Kerala state is relevant because the study will help for future development of the area and place a major role for determining the standard of living and economic growth of people there and the benefits and problems of rural people by installing the solar energy products.

1.3 OBJECTIVES OF THE STUDY

1. To identify customers' attitude towards solar products along with the factors influencing the adoption of solar energy devices.
2. To identify the key drivers of customer satisfaction in solar energy devices and the marketing strategies of solar products.

1.4 HYPOTHIESES OF THE STUDY

H_{01}: There is no significant difference in the attitude of respondent towards solar energy devices based on their age.

H_{02}: There is no significant relationship between the education level of the respondent and the factors influencing their decision regarding solar energy devices.

H_{03}: Income has no significant influence on the satisfaction of respondents towards the marketing strategies of solar products.

H_{04}: There is no significant difference in the satisfaction of respondents based on their years of use of solar products.

1.5 SCOPE OF THE STUDY

The scope of this study is focused on exploring the various factors that influence the adoption and acceptance of solar energy products within a specific rural context along with the attitudes, perceptions, and decision-making processes of consumers with particular emphasis on understanding how social, economic, cultural, and technological factors shape their views on solar energy. The geographical scope of this study is confined to Rajakkad grama Panchayath, a rural locality in the Idukki district of Kerala, which offers a unique setting due to its blend of rural characteristics and increasing exposure to renewable energy technologies. It will also explore the factors influencing the adoption of solar energy devices, including financial considerations (e.g., upfront costs, government subsidies, and savings), environmental concerns (e.g., reducing carbon footprints), social influences, and the perceived reliability and efficiency of the technology. Furthermore, the study will assess the impact of marketing strategies employed by solar companies and the government to encourage solar adoption. Another significant aspect of the study is to identify the key drivers of customer satisfaction in the context of solar energy adoption.

1.6 RESEARCH METHODOLOGY

Research methodology is a systematic way to solve the research problem. It may be understood as science of studying how research is done scientifically.

1.6.1 Sources of data

The data needed for the study are collected from primary and secondary sources. **Primary data**:

Primary data was collected from the respondents through questionnaire. **Secondary data**: Secondary data was collected from various journals, articles, books, websites, and other publications.

1.6.2 Population of the study

The population of study consisted of the residents of Rajakkad Grama Panchayath, including both households that have adopted solar energy devices and those that have not.

1.6.3 Sampling method

Convenient sampling technique was used to collect data.

1.6.4 Sample size

Sample size was limited to 60 .

1.6.5 Research design

The study was descriptive and inferential in nature.

1.6.6 Period of the study

The study was conducted for a period of 3 months .

1.6.7 Tools used for analysis

The data has been collected, arranged, analyzed, and interpreted using appropriate statistical and mathematical tools like percentage, average and inferential statistical tools like ANOVA using SPSS (Statistical Package for Social Science).

1.7 LIMITATIONS OF THE STUDY

- Geographical Limitation: The study is focused only on Rajakkad Panchayath, so the findings may not apply to other regions.
- Sample Size: The sample size may be small, limiting the ability to generalize the results to the entire population.
- Self-Reported Data: The data relies on participants' responses, which might be biased or inaccurate.
- Short-Term Study: The study looks at current consumer behavior, not long-term trends or changes over time.
- Limited Variables: The study may not consider all possible factors influencing solar energy adoption, such as political or technological influences.
- Participation Challenges: The study depends on the willingness of local people to participate, and low participation could affect the findings.
- Bias in Responses: Consumers who already use solar devices may give overly positive feedback, affecting the balance of opinions.
- Lack of Detailed Financial Data: The study may have limited access to specific cost or financial information about solar adoption.
- Time Constraints: Limited time may prevent exploring all factors influencing solar energy adoption in detail.

1.8 CHAPTERISATION

The project report is arranged in three chapters as;

Chapter 1. Introduction
Chapter 2. Data Analysis and Interpretation
Chapter 3. Findings, Suggestions and Conclusion

CHAPTER 2 DATA ANALYSIS AND INTERPRETATION

This chapter presents the analysis of the data collected using questionnaire. The data was analyzed using Statistical Package of Social Science (SPSS) such data was presented using tables and figures for easy understanding.

Table 2.1 Age of the respondents

Age (in years)	Frequency	Percent
Below 30	30	50.0
30 – 40	18	30.0
40 – 50	9	15.0
Above 50	3	5.0
Total	**60**	**100.0**

Source: Primary data

From the above table ,it is found that half of the respondents are in the age group of below 30, and the 30 percent are of 30-40 age group, 15 percent are in the age group of 40-50, and the rest of the 5 percent are in the age group of above 50 years.

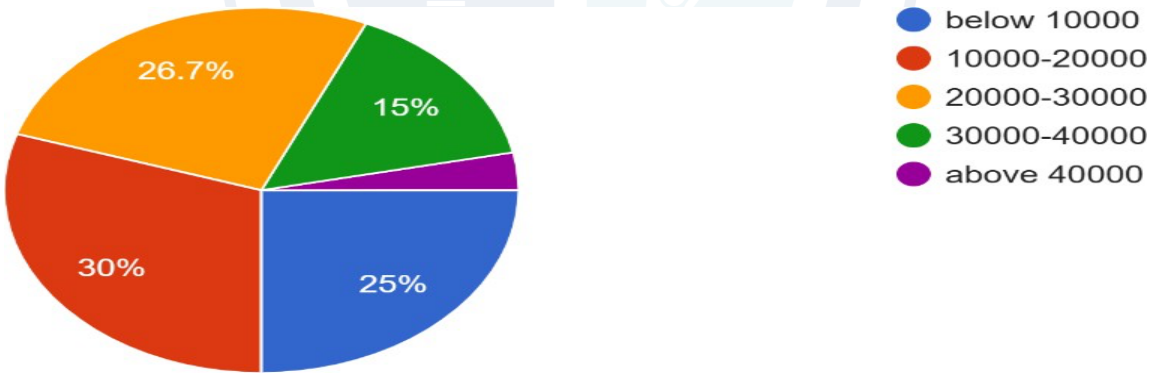
Table 2.2 Highest Educational Qualification of the respondents

Highest Education	Frequency	Percent
10^{th}	2	3.3
Plus-Two	9	15.0
Graduation	31	51.7
Post Graduation	16	26.7
Others	2	3.3
Total	**60**	**100.0**

Source: Primary data

From the above table it is clear that educational qualification of 51.7 percent respondents are Graduates,26.3 percent of the respondents are Post Graduates,15percent of the respondents are Plus- Two,3.3percent of the respondents are 10^{th} and others each. Monthly income of the respondents

Figure 2.1 Monthly income of the respondents



From the above figure, it is discovered that 30 percent of the respondents are in the monthly income group of 10000 – 20000, 26.7 percent of the respondents are in the group of 20000 – 30000, 25 percent of the respondents are in the group of below 10000 15 percent of the respondents are in the group of 30000 – 40000 and the rest 3.3percent are the group of above 40000.

Table 2.3 Residential status of the respondents

Classification	Frequency	Percent
Own House	47	78.3
Rental House	13	21.7
Total	**60**	**100.0**

Source: Primary Data

From the above table is clear that 78.3 percent of the respondents have Own House, while 21.7 percent have Rental House only**.**

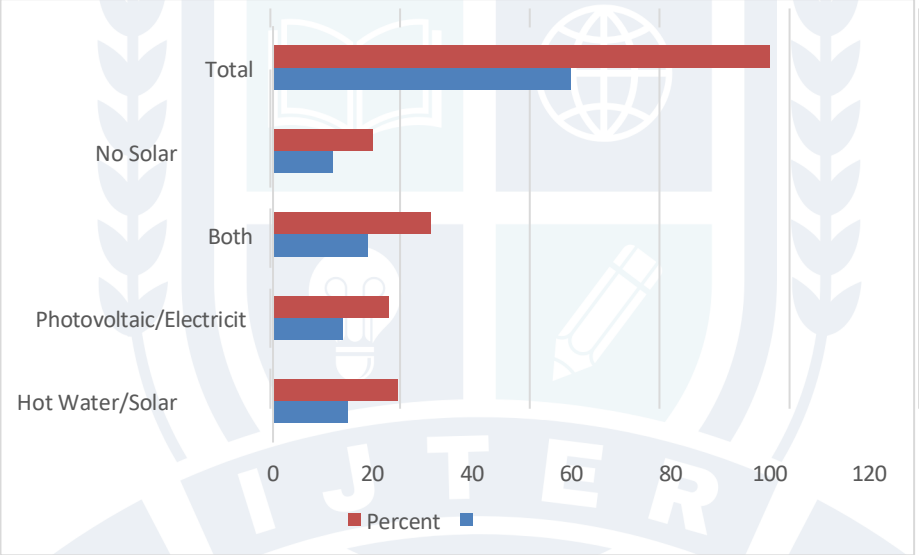
Table 2.4 Profession of the Respondents

Classification	Frequency	Percent
Government Employee	1	1.7
Non-Government Employee	20	33.3
Entrepreneur	19	31.7
Others	20	33.3
Total	60	100.0

Source: Primary Data

The above table showed that one-third of the respondents each are non-government employees and others , 31percent are entrepreneur and rest 1.7 percent are government employees .

Figure 2.2 Kind of solar device installed



From the above figure it is depicted that 31percent of the respondents have in use of both Electricity and Solar Thermal devices, while 25 percent have only Solar Thermal and 23.3 percent have use only Electricity devices.

Table 2.5 Source from which Respondents get the information about solar energy devices

Classification	Frequency	Percent
Television	19	31.7
Mobile Phone	20	33.3
Family and Friends	9	15.0
Colleagues	12	20.0
Total	**60**	**100.0**

Source: Primary Data

From the above table it is found that one -third of the respondents are get the information about solar energy devices from mobile phone and 31.7 percent of the respondents are get the information from television, 20 percent of the respondents are get the information from colleagues and last 15 percent of the respondents are get the information from family and friends.

Table 2 6 Factors influencing the choice of solar energy device

Classification	Frequency	Percent
Low pollution	12	20.0
Renewable source of energy	30	50.0
Environmentally friendly	16	26.7
Others	2	3.3
Total	**60**	**100.0**

Source: Primary Data

From the above table it is clear that half of the respondents, most influencing factor for election of solar energy device is renewable source of energy, 26.7percent of respondents attracted by environmentally friendly factor, other 20 percent of respondents attracted by low pollution and 3.3percent of the respondents are attracted by other factors.

Table 2.7 Respondents' year of using solar energy devices

Year	Frequency	Percent
Less than 1 year	20	33.3
1-3 years	14	23.3
3-5 years	18	30.0
Above 5 years	2	3.3
Never use	6	10.0
Total	**60**	**100**

Source: Primary Data

From the above table it is clear that 30 percent of respondents using solar energy devices in between 3-5 years, 33.3 percent of the respondents are using less than 1 year,23.3percent of respondents are using solar energy devices 1-3 years,10 percent of the respondents are never used solar energy devices and 3.3percent of the respondents used more than 5 years.

Table 2.8 Respondents' satisfaction level with the solar energy devices

Classification	Frequency	Percentage
Highly satisfied	10	16.7
Satisfied	34	56.7
Neutral	12	20.0
Dissatisfied	4	6.7
Total	**60**	**100**

Source: Primary Data

From the above table it is clear that 5 6 . 6 percent of the respondents are satisfied with solar energy devices ,20 percent respondents are neutral ,16.7percent are highly satisfied and 6.7percent of respondents are dissatisfied with solar energy devices.

Table 2.9 Respondents' reason for choosing solar energy devices

Classification	Frequency	Percent
Energy saving	13	21.7
Cost saving	30	50.0
Easy installation	11	18.3
No power failure	6	10.0

Total	**60**	**100**

Source: Primary Data

From the above table it is crystal clear that half of the respondents are choosing solar energy devices because of cost saving, distantly followed by 21.7percent by energy saving , 18.3 percent for easy installation and 10 percent because of no power failure.

Table 2.10 Factors that influence to purchase solar energy devices

Description	N	Mean	Std. Deviation
High initial cost of solar products discourages me from purchasing item	60	4.42	0.926
Government subsidies and financial incentive influence my decision to buy solar devices	60	4	0.759
I am influenced by the experience and recommendation of people	60	4.42	0.671
Strong after sale services and warranty would increase my confidence in purchase	60	4.45	0.832

Source: Primary Data

The data analysis reveals key factors influencing consumer behavior toward solar energy device adoption in Rajakkad Grama Panchayat. The high initial cost of solar products is the most significant barrier, with a mean score of 4.42, indicating that many consumers are discouraged by the upfront expense. However, government subsidies and financial incentives positively influence purchasing decisions (mean = 4.00). Additionally, peer recommendations and personal experiences play a strong role in influencing decisions, with a mean score of 4.42. The presence of after-sale services and warranties also increases consumer confidence (mean = 4.45), further encouraging adoption.

Table 2.11 The problem faced while using solar energy devices

Problem	Frequency	Percent
Space consumption	7	11.7
Maintenance cost	15	25.0
Usage at night	31	51.7
Limited storage capacity	7	11.7
Total	**60**	**100**

Source: Primary Data

The data indicated in the above table reflected that 51.7percent of the respondents are faced by problem of usage at night ,25 percent of the respondents faced by high maintenance cost and rest 11.7 percent of the respondents faced the problem of space consumption and limited storage capacity.

Table 2.12 Satisfaction level of respondents towards marketing strategies of solar energy device

Description	N	Minimum	Maximum	Mean	Std. Deviation

Advertisement and awareness campaign influence my perception of solar energy products	60	1	3	2.4	0.785
Social media and online reviews influence my decision to buy solar products	60	1	3	2.35	0.659
Seeing more people in my community using solar products would motivate me	60	1	3	2.37	0.736
I prefer to purchase solar energy products from a local supplier	60	1	3	2.33	0.681

Source: Primary Data

The above table showed the descriptive statistics indicate that various factors influence the adoption of solar energy products in Rajakkad Panchayath. The mean values, ranging from 2.33 to 2.40 on a scale of 1 to 3, suggest a generally positive inclination toward these factors. Advertisement and awareness campaigns (mean = 2.40) have the highest influence, highlighting the role of marketing in shaping perceptions. Social media (mean = 2.35) and community influence (mean = 2.37) also play crucial roles in decision-making. Preference for local suppliers (mean = 2.33) suggests trust in nearby vendors. The standard deviations indicate moderate variation in responses, suggesting diverse opinions.

Table 2.13 Level of satisfaction of respondents towards solar energy devices

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
Subsidies are high for solar products	60	2	5	4.0333	0.9382
They have low maintenance cost	60	2	5	3.55	0.9099
It reduces electricity bill	60	3	5	4.4167	0.72
It gives energy independence	60	2	5	3.8	0.6587
Power production only day time	60	1	5	3.5167	1.1273
Solar product is easily repairable	60	1	5	3.6833	0.9476
Solar product is safe to use	60	3	5	4.3667	0.7123

Source: Primary Data

The descriptive statistics indicate positive perceptions of solar energy products in Rajakkad Panchayath. The highest mean score (4.42) is for electricity bill reduction, highlighting cost savings as a key motivator. Safety (mean = 4.37) and subsidies (mean = 4.03) also contribute to favourable opinions. Energy independence (mean = 3.80) and repairability (mean = 3.68) are moderately valued. However, concerns exist regarding maintenance costs (mean = 3.55) and power production being limited to daytime (mean = 3.52). The standard deviations show some variability in opinions, suggesting that while solar energy is well- received, addressing maintenance and efficiency concerns could boost adoption.

Table 2.14 Level of awareness on the availability of the solar products

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
Water heater	60	1	4	2.3333	0.837
Solar inverters	60	1	3	2.28	0.175
Garden light	60	1	3	2.02	0.833
Complete solar energy system for home	60	1	3	1.78	0.761
Solar cook stove	60	1	3	1.93	0.8
Solar mobile charger	60	1	3	2.02	0.77
Selling of solar energy	60	1	3	2.17	0.763
Valid N	60				

Source: Primary Data

The data reflects the popularity of different solar energy products in Rajakkad Panchayath. Among them, solar water heaters (mean = 2.33) and solar inverters (mean = 2.28) are the most preferred, likely due to their practical benefits in daily life. Selling solar energy (mean = 2.17) also holds some interest. However, products like solar garden lights (mean = 2.02), mobile chargers (mean = 2.02), and cook stoves (mean = 1.93) have lower demand, possibly due to limited awareness or usability concerns. The complete solar energy system (mean = 1.78) scores the lowest, suggesting high costs or installation challenges hinder full adoption.

2.15 TESTING OF HYPOTHESIS

HYPOTHESIS1

H_0: There is no significant difference in the attitude of respondent towards solar energy devices based on their age.

H1 :There is a significant difference in the attitude of respondents towards solar energy devices based on their age.

Table 2.15.1 ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.661	3	1.22	3.166	0.031
Within groups	21.589	56	0.86		
Total	**25.25**	**59**			

Source: Primary Data

The ANOVA results indicated a statistically significant difference in respondents' attitudes toward solar energy devices based on age (F = 3.166, p = 0.031). Since the significance value (0.031) is less than 0.05, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1). This suggests that age influences perceptions of solar energy benefits. The between-group variance (SS = 3.661, df = 3) is not able compared to the within-group variance (SS = 21.589, df = 56), meaning age groups have differing attitudes.

HYPOTHESIS 2

H_0 :There is no significant relationship between the education level of the respondent and the factors influencing their decision regarding solar energy devices.

H_1 :There is significant relationship between the education level of the respondent and the factors influencing their decision regarding solar energy devices.

Table 2.15.2 ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1.646	4	0.411	2.059	0.099
Within Groups	10.991	55	0.2		
Total	**12.639**	**59**			

Source: Primary Data

The above ANOVA results showed an F-value of 2.059 and a significance level (p-value) of 0.099. Since the p-value is greater than 0.05, we fail to reject the null hypothesis (H_0). indicating that the differences in education level do not lead to significant variations in decision- making factors. While there is some variation between groups (Sum of Squares = 1.646), it is not strong enough to be considered statistically significant.

HYPOTHESIS 3

H_0: Income has no significant influence on the satisfaction of respondents towards the marketing strategies of solar products.
H_1 :Income has significant influence on the satisfaction of respondents towards the marketing strategies of solar products.

Table 2.15.3 ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1.542	1	1.542	7.148	0.01
Within Groups	12.511	58	0.216		
Total	**14.053**	**59**			

Source: Primary Data

The ANOVA results indicate a significant relationship between income and satisfaction with solar product marketing strategies. The F-statistic (7.148) and p-value (.010) suggest that income levels significantly impact satisfaction since the p-value is below the 0.05 threshold. This leads to the rejection of the null hypothesis (H_0), meaning that income does influence satisfaction. The between-groups sum of squares (1.542) shows variation due to income differences, while the within-groups sum of squares (12.511) reflects individual variations. The mean square values further support that income accounts for a meaningful portion of satisfaction differences.

HYPOTHIESIS 4

H_0 :There is no significant difference in the satisfaction of respondents based on their years of use of solar products.
H_1 :There is significant difference in the satisfaction of respondents based on their years of use of solar products.

Table 2.15.4 ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	3.191	4	0.798	4.392	0.004
Within Groups	9.991	55	0.182		
Total	**13.182**	**59**			

Source: Primary Data

The ANOVA results indicate a statistically significant difference in satisfaction levels based on years of solar product usage. The F-value is 4.392, with a p-value (Sig.) of 0.004, which is below

the 0.05 threshold. This leads to rejecting the null hypothesis (H_0) and accepting the alternative hypothesis (H_1), confirming that satisfaction varies with years of solar energy use. The between-groups variance (Sum of Squares = 3.191, Mean Square = 0.798) is higher than within-groups variance (Sum of Squares = 9.991, Mean Square 0.182), further supporting the finding. Thus, experience with solar products influences satisfaction significantly.

CHAPTER 3: FINDINGS, SUGGESTIONS AND CONCLUSION

The chapter presents the finding based on the data analysis. Conclusions are based on findings and overall observation during the study. The chapter has divided into three sections findings suggestion and conclusion

3.1 FINDINGS

- Half of the respondents are aged below 30 years and their highest education qualification is graduation.
- Most of the respondents monthly income lies between Rs.10000 to Rs.20000.
- More than three fourth of the respondents have their own house to live.
- Most of the respondents are non- governmental employees and entrepreneurs and get information about solar energy devices from mobile phone.
- Most of the respondents installed hot water and photovoltaic solar energy devices.
- Majority of the respondents think that renewable source of energy is the main attractive factor about solar energy devices and use them for less than one year.
- Majority of the respondents reason for choosing solar device is cost saving and are satisfied with their usage.
- Though majority of the respondents facing problem of solar devices usage at night, they are satisfied with solar energy devices reducing electricity bills.
- The highest agreement is for solar energy being a reliable power source in Rajakkad Grama panchayath of Idukki district.

3.2 SUGGESTIONS

- Introduce government subsidies and financial incentives to reduce the initial cost of solar installation.
- Promote easy financing options, such as low-interest loans or instalment plans, to make solar energy more accessible.
- Conduct community awareness programs to educate people on the long-term benefits of solar energy and provide hands-on training sessions for potential users to understand maintenance and efficiency improvements..
- Partner with local influencers and entrepreneurs to share user experiences and success stories to build trust.
- Promote battery storage solutions to address the problem of solar energy usage at night.
- Encourage the development of high-efficiency panels and hybrid systems that can work even in low sunlight conditions.
- Ensure strong after-sales support including regular maintenance, warranty coverage, and quick issue resolution.
- Establish local service centres to provide immediate assistance to users.
- Create a certification program for solar installers to ensure quality and professionalism.
- Offer trial programs or leasing options to allow hesitant consumers to test solar solutions before making a full investment.

- Encourage satisfied customers to act as brand ambassadors to spread awareness through word-of-mouth recommendations.

5.1 CONCLUSION

The study on consumer behavior towards the acceptance of solar energy devices in Rajakkad Grama Panchayath provides valuable insights into the attitudes, preferences, and challenges faced by consumers. The findings reveal that a majority of respondents, primarily young and educated individuals, recognize the importance of renewable energy and are willing to adopt solar solutions. Most respondents installed solar devices for cost savings and environmental benefits, with hot water and photovoltaic systems being the most popular choices. However, despite a positive outlook, barriers such as high initial costs, lack of knowledge, and concerns over nighttime usage hinder widespread adoption. To enhance the adoption of solar energy devices, the study suggests financial incentives, community awareness programs, technological improvements, and better after-sales services. Strengthening government support, offering flexible financing, and ensuring easy maintenance solutions can significantly boost consumer confidence and increase solar energy adoption in the region leading to a sustainable and energy-efficient future.

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