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An Empirical Analysis of Customer Satisfaction with Residential Solar Rooftop Installations in Kannur, Kerala

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Abstract:

The rising demand for sustainable energy and the pressing need to address climate change have accelerated the adoption of renewable energy technologies across India. Among these, solar rooftop systems have emerged as a viable and eco-friendly solution for household energy needs. This study examines consumer satisfaction with household solar rooftop products in Kannur district, Kerala a region noted for its progressive stance on environmental issues. Through surveys and interviews with users, the study evaluates key factors influencing satisfaction, including system performance, installation quality, maintenance support, cost-effectiveness, and post-installation service. The analysis reveals that while awareness and adoption rates are steadily increasing, gaps still exist in service delivery and after-sales support. Consumers generally express satisfaction with the environmental and financial benefits, but concerns persist regarding technical reliability and vendor responsiveness. The study also highlights the role of government incentives and local agencies like KSEB and ANERT in shaping user experiences. Overall, the findings offer valuable insights to enhance policy formulation, improve service standards, and promote wider acceptance of solar energy systems in household sectors.

Keywords:*Solar Rooftop Systems, Consumer Satisfaction, Renewable Energy, Kannur District, Kerala State Electricity Board (KSEB), Post-Installation Service.*

I. Introduction

1.1 Introduction

The global rise in energy demand, coupled with the critical need to combat climate change, has driven nations to adopt sustainable energy alternatives. Among the renewable energy options, solar power has emerged as a leading choice due to its natural abundance, wide availability, and the steady decrease in installation costs. In India, solar energy is increasingly seen as a crucial addition to the conventional energy mix rather than merely an alternative. The Indian government has actively promoted solar energy through national initiatives such as the Jawaharlal Nehru National Solar Mission (JNNSM) and various state-level policies, leading to a significant increase in the use of solar rooftop systems.

Kerala, recognized for its eco-conscious population and high literacy rate, has been at the forefront of adopting environmentally friendly technologies. Organizations like the Kerala State Electricity Board (KSEB) and the Agency for Non-conventional Energy and Rural Technology (ANERT) have implemented multiple programs to encourage households to install solar rooftop systems. These systems not only help reduce reliance on traditional grid electricity but also support lower electricity bills and align with the state's clean energy targets.

In the northern part of Kerala, Kannur district has made noteworthy strides in the deployment of solar energy solutions. However, despite the apparent increase in installations, there remains a lack of detailed data regarding consumer satisfaction. Key concerns still surround aspects such as system efficiency, installation quality, maintenance services, and overall value for money. Understanding consumer satisfaction is vital, as it provides insights into user experiences and serves as valuable feedback for manufacturers, service providers, and policymakers working to improve and expand solar energy adoption.

Furthermore, consumer satisfaction directly influences the rate at which solar technologies are embraced by new users. Positive experiences can lead to word-of-mouth recommendations, increased trust in solar solutions, and faster diffusion of the technology within communities. Conversely, unresolved issues related to service quality, poor communication from vendors, or lack of technical support can create resistance to adoption. Therefore, it is essential to address these areas systematically to sustain and scale the progress made so far.

This Paper on household solar rooftop systems in Kannur aims to fill the knowledge gap by exploring the actual experiences and satisfaction levels of users. The insights gathered can help refine existing policies, improve service standards, and ensure that solar initiatives are not only technologically viable but also socially accepted. As Kerala continues to move toward a more sustainable future, understanding and addressing consumer perspectives will be key to long-term success.

1.2 Need for the Study

Despite government incentives and awareness campaigns, the rate of adoption and satisfaction with solar rooftop products varies widely. While technical aspects of solar panels are frequently researched, the perception, satisfaction, and feedback of the end-users consumers are often underexplored. It is essential to evaluate how satisfied consumers are with these systems after adoption to identify pain points and areas for improvement.

This study aims to bridge this gap by focusing on the real-world experiences of consumers who have installed household solar rooftop systems in Kannur district. Understanding these experiences can help stakeholders, including manufacturers, service providers, and policymakers, make informed decisions. It can also guide future campaigns and policy interventions to promote broader adoption of solar energy in households.

1.3 Objectives of the Study

The study is centered on the following key objectives:

- To examine the level of consumer satisfaction with household solar rooftop systems in Kannur district, Kerala.
- To evaluate the influence of various factors such as installation quality, maintenance services, system efficiency, cost, government support, and user awareness on satisfaction.
- To provide suggestions to improve consumer satisfaction and facilitate greater adoption of rooftop solar energy systems.

1.4 Scope of the Study

The Paper is confined to the Kannur district in Kerala and specifically targets household consumers who have installed solar rooftop systems. It does not include commercial or industrial installations. The scope includes an analysis of consumer opinions, satisfaction levels, and challenges faced during and after the installation of solar systems. The study takes into account variables such as product performance, service quality, government subsidy awareness, and customer support.

This research provides valuable insights into how end-users perceive solar rooftop systems and what improvements are necessary to enhance their experience. It will contribute to policy formulation and practical implementation strategies to ensure long-term consumer satisfaction and sustainability in the renewable energy sector.

1.5 Significance of the Research

This study is significant for several reasons:

- Policy Implications: The findings can inform policymakers about user concerns and help design more effective and responsive solar energy policies at the local and state level.
- Improved Services: Solar vendors and service providers can utilize the insights to enhance customer service, technical support, and product features based on real consumer experiences.
- Increased Adoption: Understanding and addressing consumer pain points can help improve the reputation and attractiveness of solar rooftop systems, potentially leading to increased adoption.

- Sustainable Development Goals (SDGs): The study contributes to global efforts toward sustainability, particularly in promoting affordable and clean energy (SDG 7) and building resilient infrastructure (SDG 9).

II. Literature Survey

Joseph (2022) highlighted that despite Kerala's high literacy rate, the adoption of grid-connected rooftop solar systems remains low due to poor consumer awareness and lack of promotional campaigns. He noted that less than 20,000 people had applied for rooftop projects in the state, indicating a significant gap in consumer engagement.

Varghese *et.al.,*(2024) examined consumer satisfaction with rooftop solar systems across different income groups in Kollam District. Their study found that higher income groups were more satisfied with factors such as efficiency, environmental benefits, after-service, and aesthetic appeal. However, government subsidies and promotional efforts did not significantly affect satisfaction levels, suggesting that income plays a crucial role in shaping consumer perceptions. (

Joshi (2023) reported that Kerala experienced an 18% growth in rooftop solar capacity between Q2 2022 and Q2 2023. This growth was attributed to increased consumer willingness to transition from traditional power sources to solar energy, reflecting a positive shift in consumer attitudes towards solar adoption.

Choudary (2024) discussed Freyr Energy's initiative to solarize 2,000 homes in Kerala, emphasizing the role of government subsidies and financing options in making solar energy more accessible to homeowners. She highlighted that the payback period for a typical 3 kW solar plant had reduced to three to four years, with annual savings of approximately ₹33,000, enhancing consumer satisfaction.

Mithosh Joseph (2022) noted that the low patronage of grid-connected rooftop solar systems in Kerala is attributed to poor consumer awareness and lack of appropriate promotional campaigns. He emphasized the need for improved field-level activities by the Kerala State Electricity Board (KSEB) and the Agency for New and Renewable Energy Research and Technology (ANERT) to boost consumer engagement.

Menon, A. (2022) reported that despite competitive prices for rooftop solar in Kerala, the adoption rate remains low due to poor consumer awareness and lack of appropriate promotional campaigns. The article suggests that addressing these issues is crucial for meeting the state's solar energy targets.

Rajan P. (2023) reported that more households in Kerala are gravitating towards solar energy to handle their daily electricity needs. He attributed the surge in solar adoption to its affordability and eco-friendly nature, with consumers increasingly opting for 'On solar grids' that allow excess electricity to be fed into the KSEB grid, generating income from surplus energy.

Cleedin*et.al.,*(2024) discussed the future prospects of rooftop solar systems in Kerala, emphasizing the need for tailored strategies to enhance consumer satisfaction across all income groups. They highlighted that higher income groups are more satisfied with factors such as efficiency, environmental benefits, after-service, and aesthetic appeal, suggesting that income plays a crucial role in shaping consumer perceptions.

III. Methodology

The methodology section outlines the systematic approach adopted for conducting the study. It defines how the research was planned, data was collected, and results were analysed. The geographical focus of this research is Kanur District, located in the Indian state of Kerala. This district was chosen because it has witnessed a significant increase in the adoption of rooftop solar energy in recent years. Kanur presents a balanced mix of urban and rural households, which offers diverse insights into consumer behavior and satisfaction levels. The climatic conditions and solar energy potential in the region also make it an ideal location for studying solar energy adoption.

3.1 Target Population

The target population for the study includes household consumers who have installed solar rooftop systems in their homes in Kanur District. These are users who have had practical experience with the system, allowing

them to give informed opinions about performance, satisfaction, and challenges. To ensure relevant and accurate data, the study only considered participants who had been using the system for at least six months.

3.2 Sampling Method

To ensure comprehensive coverage and the reliability of results, the study employed a hybrid sampling methodology combining both stratified random sampling and purposive sampling techniques.

- The target population was divided into distinct strata based on key variables such as:
  - Geographic location (urban and rural areas)
  - Income groups (low, middle, and high-income households)
  - Type of solar rooftop systems installed (on-grid, off-grid, and hybrid systems)
- From each stratum, households were selected using a random sampling process. This ensured:
  - Equal representation across different demographic segments
  - Reduction in sampling bias
  - The ability to make comparisons among sub-groups
- To ensure relevance, the study further applied a purposive sampling technique, selecting only those:
  - Households that had installed solar rooftop systems
  - Users with actual experience to provide meaningful feedback
  - Participants from varied educational backgrounds and installation durations (new and long-term users)
- This combined approach allowed the researchers to:
  - Focus data collection on appropriate and knowledgeable respondents
  - Enhance the validity of findings related to consumer satisfaction
  - Include households with differing levels of awareness and support experiences

In total, 300 households from across Kannur District were selected. This provided a robust and diverse dataset, enabling the study to generate accurate, insightful, and actionable conclusions on consumer satisfaction with household solar rooftop systems.

3.3 Data Collection

The data collection process is a critical component of this study, as it provides the foundational information necessary for analyzing consumer satisfaction with household solar rooftop systems in Kanur District, Kerala. A systematic and structured approach was adopted to ensure the reliability, validity, and comprehensiveness of the collected data.

3.3.1 Types of Data

This study utilizes both primary and secondary data:

- Primary Data: Collected directly from household consumers who have installed and used solar rooftop systems. This data forms the core of the study and provides first-hand insights into consumer experiences, usage patterns, and satisfaction levels.
- Secondary Data: Sourced from government reports, solar energy agencies, research publications, company websites, and news articles to supplement and validate the findings from the primary data.

3.3.2 Data Collection Instrument

- A structured questionnaire was the main instrument used for gathering primary data. The questionnaire was designed in both English and Malayalam to ensure clarity and accessibility for all respondents. It consisted of four main sections:

- Demographic Information – To capture details such as age, gender, occupation, income level, and type of residence.

- Solar Installation Details – Including year of installation, type of system, service provider, and subsidy status.

- Usage Patterns – Questions focused on energy consumption, percentage of offset by solar energy, and frequency of system usage.

- Satisfaction Measurement – Assessed using a 5-point Likert scale across dimensions such as product performance, installation experience, maintenance service, cost-effectiveness, and overall satisfaction.

3.3.3 Method of Data Collection

A mixed-method approach was employed to reach a diverse range of participants:

- Face-to-Face Interviews: Conducted by trained field investigators, especially in rural areas where internet access was limited. This method ensured higher response accuracy and allowed for clarification of any doubts regarding the questionnaire.

- Online Surveys: Shared through digital platforms such as Google Forms, email, and WhatsApp to reach respondents in urban areas who preferred the convenience of online participation.

Approximately 60% of the responses were collected through direct interviews, while the remaining 40% were received via online submissions.

3.3.4 Pre-testing and Validation

To ensure the validity and clarity of the questionnaire, a pilot study was conducted with 20 households. Based on the feedback received, minor modifications were made to improve the wording and structure of certain questions. Additionally, inputs from academic experts and professionals in the solar energy sector were incorporated to enhance the reliability of the instrument.The study also helped assess the overall flow and comprehensibility of the questionnaire, ensuring that respondents could interpret the questions accurately and consistently. It provided valuable insights into the time required to complete the survey and identified any ambiguities or redundancies. By incorporating expert feedback and real-world responses, the final version of the questionnaire was refined to be more user-friendly and effective in capturing relevant data, thereby strengthening the overall quality and credibility of the research.

3.3.5 Ethical Considerations

The data collection process strictly adhered to ethical research standards. All participants were informed about the purpose of the study and their right to decline participation. Informed consent was obtained prior to participation. The anonymity and confidentiality of all respondents were maintained, and the data collected was used solely for academic and analytical purposes.

IV. Results And Discussion

4.1 Overview of Consumer Satisfaction Trends

The data collected from households across Kannur District revealed an overall high level of consumer satisfaction with solar rooftop systems. The average satisfaction score stood at 4.2 out of 5, signifying that most users are content with their decision to adopt solar energy. This suggests successful dissemination of solar technology and the positive reception of government-led initiatives. High sunlight availability and growing energy awareness contribute significantly to this trend.

4.2 Economic Viability as a Motivating Factor

A major finding from the study is the importance of cost-effectiveness in shaping consumer satisfaction. With a mean score of 4.5, this category outperformed all others. Most respondents noted significant reductions in electricity bills, which not only made the initial investment worthwhile but also ensured ongoing financial savings. These cost savings have become a primary motivator for adoption, especially in middle-income households that value long-term economic benefits.

4.3 Service Experience and Support Gaps

Although satisfaction levels were generally high, customer service emerged as a weak area, scoring only 3.8 out of 5. Respondents frequently mentioned poor communication, long wait times for repairs, and lack of timely maintenance. These shortcomings indicate a need for solar service providers to enhance their after-sales infrastructure, provide better staff training, and introduce user-friendly support mechanisms such as mobile apps or toll-free lines.

In addition to the identified issues, many customers expressed frustration over inconsistent follow-up and insufficient updates regarding the status of their service requests. This lack of transparency often led to decreased trust and lowered overall satisfaction. To address these concerns, companies should consider implementing proactive communication strategies, including regular notifications and clear timelines for service completion. Strengthening these areas will not only improve the customer experience but also foster greater loyalty and positive word-of-mouth referrals.

4.3.1 Detailed Analysis of Key Satisfaction Parameters

To better understand the components contributing to overall satisfaction, a breakdown of key parameters along with their mean scores and standard deviations is presented in Table 4.3. These metrics provide insights into consumer sentiment and highlight areas requiring improvement.

Table 4.1: Summary Statistics of Consumer Satisfaction Parameters

Parameter	Mean Score	Standard Deviation	Interpretation
Product Quality	4.2	0.65	High satisfaction
Pricing	3.6	0.89	Moderately satisfied
Service Quality	3.4	1.01	Slightly below expectation
System Efficiency	4.0	0.78	Good performance
Value for Money	3.8	0.73	Reasonably satisfied

4.4 Impact of Household Income on Satisfaction

The analysis uncovered a positive correlation between income and satisfaction. Higher-income households were more likely to report positive experiences with solar rooftop systems. This could be due to their ability to afford higher-capacity systems, professional installation services, and additional maintenance features. Lower-income users, on the other hand, often faced challenges in accessing support or optimizing usage due to budget constraints or limited information.

Table 4.2: Average Consumer Satisfaction by Monthly Income Group

Monthly Income (INR)	Avg. Satisfaction Score
Below ₹20,000	3.7
₹20,001 – ₹40,000	4.0

₹40,001 – ₹60,000	4.2
Above ₹60,000	4.5

4.5 Consumer Feedback on Operational Challenges

Apart from customer service issues, several operational challenges were reported by users:

- Systems underperforming during cloudy or rainy seasons.
- Lack of clear instructions on operation and maintenance.
- Difficulty in availing government subsidies or incentives.

These problems affect user confidence and highlight the need for better communication, consumer training, and smoother administrative procedures.

4.6 Stakeholder-Specific Insights

The results have distinct implications for various stakeholders:

- Manufacturers & Service Providers: Must focus on building trust through reliable products, timely installation, and responsive maintenance services.
- Government & Policymakers: Should create more inclusive policies, especially for low-income households, and ensure that awareness campaigns reach rural areas. Simplifying subsidy access will encourage wider adoption.
- Consumers: Need to be better informed about solar technology, including basic troubleshooting, energy output expectations, and how to maintain the system efficiently.

4.7 Strategic Recommendations for Improvement

Based on the data and consumer feedback, the following strategic measures are recommended:

- Consumer Awareness Programs: Seminars, community workshops, and digital content can educate users on solar benefits and maintenance.
- Technical Training for Staff: Service teams should be trained in both technical installation and customer interaction.
- Scheduled Maintenance Services: Proactive checks and AMC (Annual Maintenance Contract) options can prevent breakdowns and boost trust.
- Expanded Financial Support: More inclusive subsidy schemes and solar loans can make adoption easier for economically weaker sections.
- Digital Feedback Platforms: Apps or helplines should be used to gather consumer complaints and suggestions to improve service delivery.

4.8 Visualization of Satisfaction Metrics

A visual representation of satisfaction ratings helps illustrate the disparity between different service components. The table reflects the average rating across five key dimensions: product quality, customer service, installation process, maintenance support, and overall value for money. By comparing these ratings side by side, stakeholders can quickly identify strengths and areas needing improvement. This clear overview facilitates targeted actions to enhance customer satisfaction effectively.

Table 4.3: Average Satisfaction Scores across Key Service Dimensions

Criteria	Average Score (out of 5)
Cost-Effectiveness	4.5
Product Reliability	4.3

Installation Experience	4.1
Customer Service	3.8
Overall Satisfaction	4.2

Awareness of household solar rooftop systems among consumers in Kannur District shows a generally positive trend, particularly in terms of understanding the benefits, with 90% of respondents demonstrating familiarity in this area. A slightly lower but still substantial 80% are aware of government subsidies, indicating that financial support schemes are relatively well communicated, though 20% remain uninformed.

Environmental impact awareness is also strong at 85%, reflecting a growing concern for sustainability Table 4.4. However, knowledge of maintenance requirements lags behind, with only 70% of respondents indicating awareness. This suggests a need for more focused educational efforts on system upkeep to ensure long-term satisfaction and efficient use. Figure 4.1 show the level of public awareness regarding various aspects of solar rooftop systems, including benefits, government subsidies, environmental impact, and maintenance requirements.

In addition to environmental awareness, the data highlights a gap in understanding the practical aspects of maintaining solar rooftop systems. While most respondents recognize the ecological benefits and are informed about government incentives, fewer are aware of the ongoing maintenance needed to keep these systems operating efficiently. This imbalance in awareness could lead to underperformance or dissatisfaction over time if users are not properly educated on system care. Strengthening outreach and informational campaigns focused on maintenance can help bridge this knowledge gap, ensuring users are better prepared for long-term ownership and optimal system performance.

Moreover, limited awareness about maintenance requirements may hinder the overall effectiveness and longevity of solar rooftop installations. Without proper knowledge, users might overlook routine upkeep, resulting in reduced energy output or technical issues that could have been prevented. Educating users on simple maintenance practices—such as periodic cleaning of panels and regular system checks can significantly improve efficiency and satisfaction. Therefore, integrating maintenance education into awareness programs and subsidy initiatives can empower consumers to take full advantage of their solar systems, ensuring sustained performance and return on investment.

Table 4.4: Awareness about Solar Rooftop Systems

Awareness Parameter	Aware (%)	Not Aware (%)
Knowledge of solar rooftop benefits	90%	10%
Awareness of government subsidies	80%	20%
Awareness of environmental impact	85%	15%
Knowledge of maintenance requirements	70%	30%

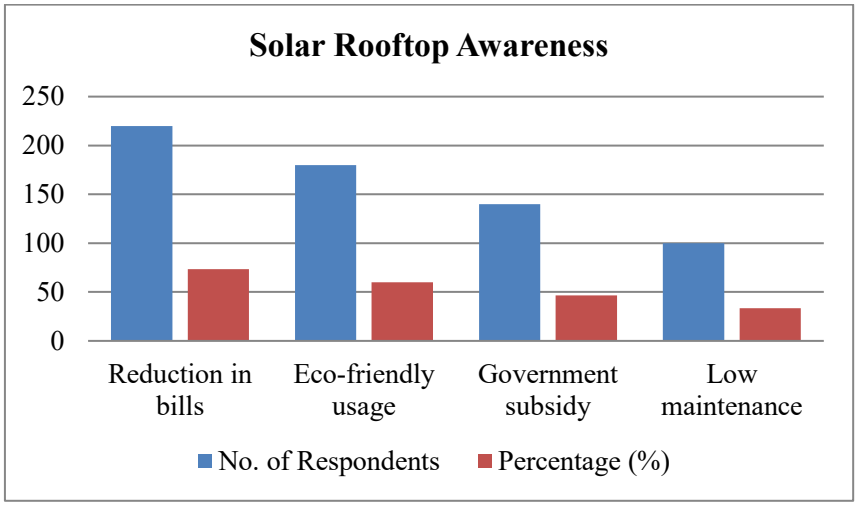

Figure 4.1: Public Awareness of Key Aspects of Solar Rooftop Systems

Table 4.5: Awareness about Solar Rooftop Products

Awareness Level	No. of Respondents	Percentage (%)
Fully aware	160	53.3
Somewhat aware	100	33.3
Not aware	40	13.3

Table 4.5 presents the level of awareness among respondents regarding solar rooftop products. The data indicates that a majority of consumers, accounting for 53.3%, are fully aware of the available solar rooftop options, suggesting a strong penetration of product knowledge in the region.

Additionally, 33.3% of respondents are somewhat aware, implying that while they have a basic understanding, they may lack comprehensive information needed for decision-making. A smaller segment, 13.3%, is not aware of solar rooftop products at all, highlighting a gap that can be addressed through targeted awareness campaigns and educational initiatives. Overall, the table underscores the need for continued efforts to elevate awareness, particularly among the partially and non-aware groups, to support informed adoption of solar technology.

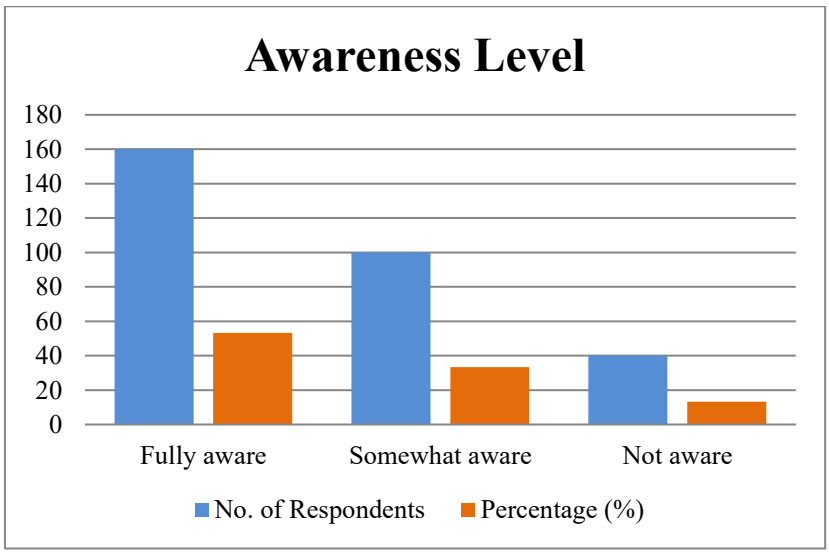

Figure 4.2: Awareness Levels of Respondents

The perceived benefits of solar rooftop systems among consumers in Kannur District highlight key motivations for their adoption. A significant 73.3% of respondents identified reduction in electricity bills as the primary benefit, indicating strong financial incentives. Additionally, 60.0% recognized the eco-friendly nature of solar energy, reflecting increased environmental awareness.

Government subsidies were acknowledged by 46.7% of the respondents as a motivating factor, showcasing the influence of policy-driven support. However, only 33.3% considered low maintenance requirements as a benefit, suggesting that further education on the ease of upkeep may enhance user confidence and system adoption in table 4.6.

These findings suggest that while economic and environmental factors are well understood by consumers, the practical advantages of solar rooftop systems such as minimal maintenance are not as widely recognized. This indicates a potential area for improvement in awareness campaigns, where highlighting the user-friendly and low-maintenance nature of these systems could positively influence adoption rates. Emphasizing the long-term reliability and ease of operation may help address hesitations among potential users, thereby encouraging broader acceptance and utilization of solar technology across the Kannur District.

Table 4.6: Perceived Benefits of Solar Rooftop

Benefit	No. of Respondents	Percentage (%)
Reduction in bills	220	73.3
Eco-friendly usage	180	60.0
Government subsidy	140	46.7
Low maintenance	100	33.3

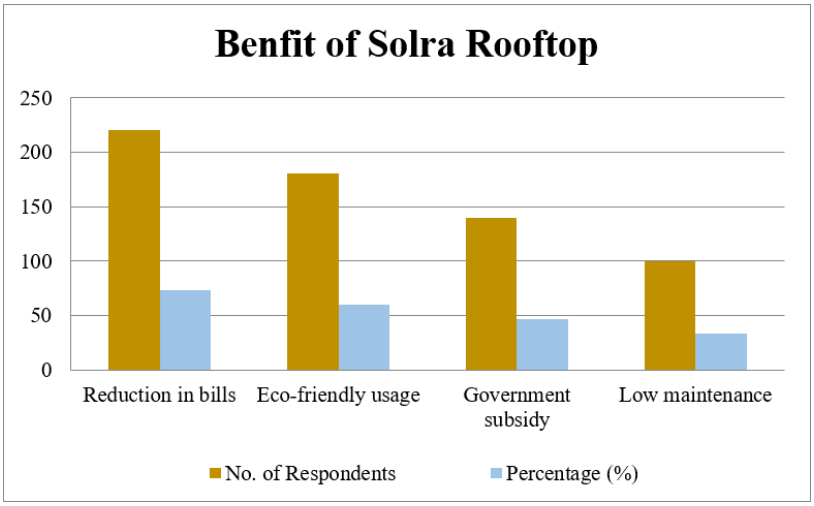

Figure 4.3: Key Benefits of Solar Rooftop Systems

The adoption of rooftop solar systems has led to significant variations in the amount of energy consumption offset among users. As shown in Table 4.7, a substantial portion of respondents have been able to offset a considerable percentage of their energy needs through solar power. Specifically, 36.7% of the respondents reported offsetting between 51% and 75% of their energy consumption, while 33.3% achieved an even higher offset of over 75%. Meanwhile, 23.3% experienced a moderate reduction of 25% to 50%, and only a small fraction, 6.7%, reported minimal offsets below 25%. These findings highlight the effectiveness of rooftop solar installations in reducing dependency on conventional energy sources for a majority of users.

Table 4.7: Energy Consumption Offset by Solar Rooftop

Percentage of Energy Offset	No. of Respondents	Percentage (%)
Below 25%	20	6.7
25%–50%	70	23.3
51%–75%	110	36.7
Above 75%	100	33.3

The trend of rooftop solar adoption has seen a noticeable increase over the years, reflecting growing interest and awareness among users. As indicated in Table 4.8, installations steadily rose from 10.0% of respondents having adopted the technology before 2020 to a peak in 2023, when 26.7% of respondents installed solar systems. The years 2020, 2021, and 2022 also showed progressive growth, with 13.3%, 16.7%, and 23.3% adoption rates respectively. Interestingly, the number of installations dropped back to 10.0% in 2024, matching the pre-2020 level. This overall upward trend up to 2023 suggests increasing momentum in solar adoption, possibly driven by incentives, falling costs, or environmental awareness, while the dip in 2024 may indicate market saturation or changing external factors affecting adoption.

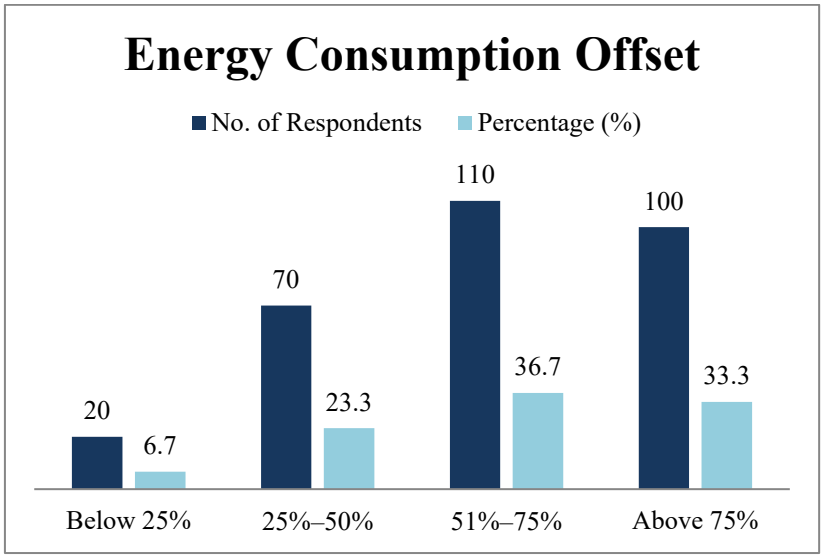

Figure 4.4: Solar Rooftop Impact on Energy Consumption Offset

Table 4.8: Year-Wise Adoption Trend

Year of Installation	No. of Respondents	Percentage (%)
Before 2020	30	10.0
2020	40	13.3
2021	50	16.7
2022	70	23.3
2023	80	26.7
2024	30	10.0

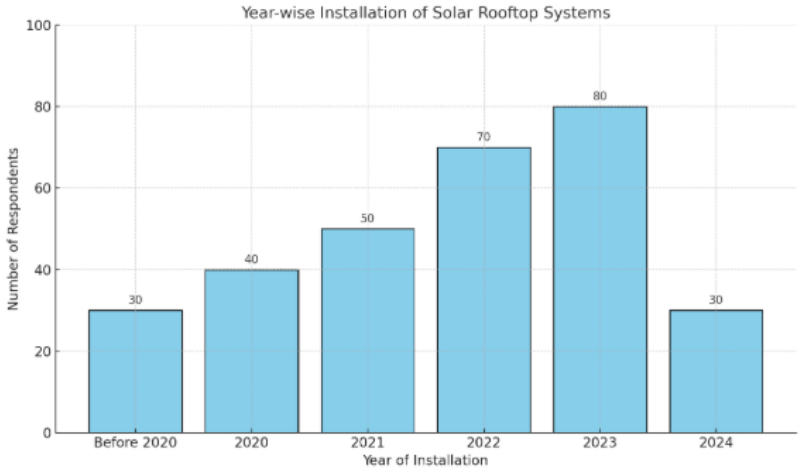

Figure 4.5:Year-Wise Distribution of Solar Rooftop Installations among Respondents

V.conclusion

The study on consumer satisfaction regarding household solar rooftop products in Kannur district, Kerala, reveals that the adoption of solar energy is gaining momentum due to increasing environmental awareness, rising electricity costs, and supportive government policies. Most respondents expressed moderate to high satisfaction with the performance, cost-effectiveness, and environmental benefits of their solar rooftop systems.

Key factors contributing to consumer satisfaction included reliability of the product, reduction in electricity bills, and the availability of subsidies and after-sales service. However, the study also identified challenges such as high initial installation costs, occasional maintenance issues, and limited awareness about government incentives.

Overall, the findings highlight a positive outlook toward solar rooftop systems among consumers in Kannur, with room for improvement in awareness campaigns, technical support, and financing options. Strengthening these areas can further boost consumer confidence and encourage widespread adoption of solar energy solutions, contributing to the region's sustainable development goals.

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