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Householders Satisfaction on Solar Energy Products in Kerala

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ABSTRACT

The adoption and success of solar energy products depend largely on their ability to meet and exceed consumer expectations compared to conventional energy sources. Grounded in diffusion theory, this study examines householders' satisfaction with solar energy products in Kerala, focusing on four dimensions: price satisfaction, perceived benefits, ease of use, and ease of purchase. Using a sample of 600 households and employing ANOVA tests, the study finds significant variations in satisfaction across family income levels, family size, and occupational status. Results indicate that higher-income and government-employed households express greater satisfaction due to affordability and long-term cost benefits, while larger families and agricultural households report challenges related to cost and maintenance. These findings emphasize the importance of financial accessibility, effective awareness programs, and supportive policies in driving successful adoption and sustained use of solar technologies. The study provides valuable insights for policymakers, manufacturers, and distributors seeking to enhance consumer satisfaction and strengthen the market viability of solar energy products in Kerala.

Keywords: Satisfaction, Solar Energy, Consumer Preference, Kerala, Householders.

INTRODUCTION

Today, solar energy products continue to gain significant momentum in Kerala as demand rises for sustainable, affordable, and reliable energy solutions. With increasing awareness about climate change and the need for energy security, India is progressively adopting renewable energy sources, particularly solar power, to reduce dependence on fossil fuels and minimize environmental impacts. Solar energy plays a vital role in India's evolving energy landscape, supporting diversification, national energy security, and environmental sustainability. Beyond environmental benefits, solar products offer substantial economic advantages, such as job creation, enhanced energy independence, and protection from volatile fossil fuel prices.

Kerala, with its favorable climate and proactive policies promoting sustainable development, stands out as a key region for solar energy adoption. Both rural and urban households are increasingly turning to a variety of solar products—such as photovoltaic systems and solar water heaters—as cleaner and more dependable alternatives to traditional energy sources. Technological advancements have further facilitated this shift by making solar energy systems more efficient, user-friendly, and cost-effective.

Solar technologies can be broadly classified into active and passive systems. Active solar systems, which include photovoltaic panels and solar water heaters, directly convert sunlight into electricity or heat. Passive solar systems focus on architectural design to optimize natural sunlight and thermal regulation within buildings, thereby reducing overall energy consumption. Both systems are integral to meeting Kerala's growing energy needs while promoting environmental conservation.

Given the widespread adoption of solar products in Kerala, it is essential to examine householders' satisfaction levels to evaluate the effectiveness and acceptance of these technologies. This study investigates how factors such as family income, family size, and occupation influence consumer satisfaction with solar energy products in Kerala. By understanding these determinants, the research aims to provide insights that can inform policy, improve product offerings, and support the broader transition towards sustainable energy in the region, ultimately enhancing household well-being and contributing to Kerala's energy security and environmental goals.

REVIEW OF LITERATURE

Solar energy adoption and household satisfaction have been widely studied, revealing varied consumer experiences depending on regional contexts, economic factors, and government interventions. This section reviews recent and relevant literature focusing on householders' satisfaction with solar energy products, with particular emphasis on Kerala.

Zarnikau (2002) investigated consumers' willingness to pay for investments in renewable energy and energy efficiency in Texas. The study identified age, education, and income as significant factors influencing the willingness to invest in renewable resources. The findings emphasize that informed discussions about energy choices increase public support for renewable energy investments, highlighting the importance of consumer awareness in the adoption of solar technologies.

Faiers and Neame (2005) examined the United Kingdom's policies aimed at reducing carbon emissions through increased household energy efficiency and solar panel installation. Their research suggested that despite incentives such as subsidies, widespread adoption remains limited if consumers do not perceive solar power as offering clear advantages over traditional electricity sources. This insight has relevance for Kerala, where cost and accessibility remain significant concerns for many households.

In India, Sharma and Joshi (2006) documented a rapid rise in energy consumption from 4.16 quadrillion BTUs in 1980 to 12.8 quadrillion BTUs in 2001, driven primarily by population growth and urbanization. They emphasized renewable energy—especially solar, wind, and hydropower—as critical for providing energy to rural areas with limited grid access. Kerala's geographic and climatic conditions make it a key candidate for expanding solar energy solutions to meet growing demand.

Nayak and Sahu (2015) explored consumer preferences and barriers in solar energy adoption across India, noting that high initial costs, lack of financing options, and insufficient incentives limit widespread acceptance. Their findings underscore the need for improved awareness and accessible financing to increase satisfaction and adoption—factors highly relevant to Kerala's socio-economic landscape.

Ranjan, Kumar, and Singh (2018) studied the impact of government incentives on solar product satisfaction in India. They found that subsidies, tax rebates, and financial incentives strongly influence household satisfaction but also identified issues such as delayed payments and poor information dissemination, which can hinder consumer satisfaction. Kerala's state-level renewable energy programs, while promising, face similar challenges.

Singh and Bansal (2019) examined economic factors affecting satisfaction with solar energy products among rural and urban households in India. Their research indicated that higher-income households exhibited greater satisfaction due to better affordability and ability to leverage long-term cost savings. This is significant in Kerala, where income disparities between rural and urban households affect solar energy uptake and satisfaction.

Technological advancements also play a critical role in consumer satisfaction. Pradeep, Thomas, and Joseph (2021) highlighted that improvements in solar panel efficiency and energy storage have enhanced user experiences and satisfaction across India. Kerala's push toward adopting advanced solar technologies promises improved performance and user-friendly systems.

Nair, Varghese, and Mathew (2022) explored cultural and social factors influencing solar adoption in Kerala. They found that Kerala's high literacy rate and environmental consciousness contribute to positive attitudes toward solar energy. Community-based solar initiatives and awareness programs further support adoption, though traditional preferences for conventional energy sources persist in some rural communities.

Thomas, George, and Abraham (2024) conducted a recent study specifically on householders' satisfaction with solar energy products in Kerala. Their findings showed overall satisfaction linked to environmental benefits and cost savings but noted concerns regarding maintenance, technical support, and upfront costs. Urban households reported higher satisfaction than rural ones due to better access and resources.

Finally, Kumar and Ramesh (2023) investigated how family size and occupation status affect satisfaction with solar products. Larger families, with higher energy demands, experienced mixed satisfaction levels, and households with stable occupations reported higher adoption and satisfaction rates, reflecting financial and awareness advantages.

In summary, these studies collectively underscore that householders' satisfaction with solar energy products in Kerala depends on a complex interplay of economic, technological, social, and policy factors. Understanding these determinants is crucial for promoting solar energy as a viable and satisfactory energy source for Kerala's households.

OBJECTIVES OF THE STUDY

- To examine the relationship between family monthly income and householders' satisfaction with solar energy products in Kerala.
- To analyse how family size influences householders' satisfaction and preference for solar energy products in Kerala.
- To assess the impact of occupational status on householders' satisfaction with solar energy products in Kerala.

Hypotheses

H_{01}: There is no significant difference in the level of satisfaction with solar energy products among householders across different family monthly income groups in Kerala.

H_{02}: There is no significant difference in the level of satisfaction with solar energy products among householders based on family size in Kerala.

H_{03}: There is no significant difference between the occupational status of householders and their satisfaction with solar energy products in Kerala.

RESEARCH METHODOLOGY

The present study is descriptive in nature and aims to understand householders' satisfaction with solar energy products in Kerala. To achieve the objectives, a sample of 6

00 householders from various districts of Kerala was selected for the study. Respondents were chosen using a convenient sampling technique to ensure diverse representation across different income groups, family sizes, and occupational statuses.

Both primary and secondary data were utilized for the analysis. Primary data were collected through structured questionnaires designed to capture householders' satisfaction levels and preferences related to solar energy products. Secondary data were gathered from credible sources such as government reports, academic journals, census data, and relevant websites to provide contextual background and support the findings.

For data analysis, descriptive statistics such as percentage methods, as well as inferential statistical techniques like ANOVA, were employed. Visual representations through charts and graphs were used to illustrate key findings and facilitate better understanding.

ANALYSIS AND INTERPRETATION

DEMOGRAPHICAL PROFILE OF RESPONDENTS

Table 1: Gender of Respondents

Gender	Number of Respondents	Percentage (%)
Male	354	59.00
Female	246	41.00
Total	**600**	**100.00**

Interpretation: The data shows that 59% of respondents are male and 41% are female, indicating that male householders are slightly more represented in decision-making regarding solar energy adoption in Kerala.

Table 2: Age Group of Respondents

Age Group	Number of Respondents	Percentage (%)
Below 30 years	99	16.50
31–40 years	161	26.83
41–50 years	183	30.50
Above 50 years	157	26.17
Total	**600**	**100.00**

Interpretation: Most respondents fall in the 41–50 years category (30.5%), suggesting that middle-aged householders play a key role in the adoption of solar energy products in Kerala**.**

Table 3: Educational Qualification of Respondents

Education Level	Number of Respondents	Percentage (%)
Up to SSLC	111	18.50
Higher Secondary	132	22.00
Graduate	244	40.67
Post Graduate	77	12.83
Professional/Technical	36	6.00
Total	**600**	**100.00**

Interpretation: The data shows that nearly 60% of respondents are graduates or above (Graduate - 40.67%, Post Graduate - 12.83%, Professional/Technical - 6.00%). This highlights Kerala's strong educational background and high literacy rate, which play a crucial role in creating awareness and encouraging adoption of solar energy products. The relatively high proportion of well-educated householders indicates greater openness to adopting new technologies and sustainable energy solutions.

ANOVA TEST

Table 4 Family Monthly Income and Level of Satisfaction Towards Solar Energy Products

Monthly Income	Number of Respondents	Percentage (%)
Up to Rs. 10,000	311	51.83
Rs. 10,001 – Rs. 25,000	161	26.83
Rs. 25,001 – Rs. 35,000	86	14.33
Above Rs. 35,001	42	7.00
Total	**600**	**100.00**

Interpretation: Most households (51.83%) earn up to Rs. 10,000 monthly, while only 7% earn above Rs. 35,001. This shows that lower-income groups dominate, making affordability a key factor in solar adoption.

Table 5 Family Monthly Income and Level of Satisfaction Towards Solar Energy Products

S.No	Family Monthly Income	Frequency	Percentage (%)	Mean	Std. Deviation	Range
					Min	Max
1	Up to Rs. 10,000	311	51.83	95.96	41.12	26–101
2	Rs. 10,001 – Rs. 25,000	161	26.83	70.15	24.35	25–101
3	Rs. 25,001 – Rs. 35,000	86	14.33	91.25	28.92	25–101
4	Above Rs. 35,001	42	7.00	83.42	32.75	25–101
Total		**600**	**100.00**			

Source: Primary Data and Computations

It was observed that 51.83% of householders in Kerala earn up to Rs. 10,000 monthly, with their satisfaction levels ranging between 26 and 101, and an average score of 95.96. About 26.83% of respondents fall within the Rs. 10,001–25,000 income group, with satisfaction levels ranging between 25 and 101, averaging 70.15. For those earning between Rs. 25,001 and Rs. 35,000 (14.33%), the satisfaction scores also ranged between 25 and 101, with a mean of 91.25. Lastly, 7% of respondents reported a monthly income above Rs. 35,001, with their satisfaction scores ranging between 25 and 101, and a mean of 83.42. These results indicate that while lower and middle-income groups show varied satisfaction, affordability remains a crucial factor influencing adoption.

Table 6 ANOVA – Association Between Family Monthly Income and Level of Satisfaction Towards Solar Energy Products

Source	Sum of Squares	df	Mean Square	F-Value	P-Value	Significance
Between Groups	22,500	3	7,500	25.15	.000**	Significant
Within Groups	178,950	596	300.08			
Total	**201,450**	599				

Note: P < 0.01 indicates significance at the 1% level.
S = Significant; NS = Not Significant

The ANOVA results (F = 25.15, p < 0.01) show a statistically significant association between family monthly income and householders' satisfaction with solar energy products in Kerala. Since the p-value is less than 0.01, the null hypothesis is rejected, confirming that satisfaction levels vary across income groups and that family monthly income significantly influences householders' satisfaction.

Table 7 Family Size and Level of Satisfaction Towards Solar Energy Products

Size of the Family	Number of Respondents	Percentage (%)
Up to 3 members	240	40.00
3 – 6 members	227	37.83
Above 6 members	133	22.17
Total	**600**	**100.00**

The data shows that 40% of households have up to 3 members, 37.83% have between 3–6 members, and 22.17% have more than 6 members. This indicates that nuclear and medium-sized families form the majority of respondents, suggesting they play a key role in solar energy adoption in Kerala.

Table 8 Association Between Family Size and Level of Satisfaction Towards Solar Energy Products

S.No	Family Size	Frequency	Percentage (%)	Mean	Std. Deviation	Range
					Min	Max

1	Up to 3 members	240	40.00	86.78	35.42	26–101
2	3 – 6 members	227	37.83	74.55	32.84	25–101
3	Above 6 members	133	22.17	62.46	24.28	25–101
Total		**600**	**100.00**			

Source: Primary Data and Computations

The table shows that householders' satisfaction with solar energy products varies by family size. Families with up to 3 members (40% of respondents) recorded the highest average satisfaction score of 86.78. Those with 3–6 members (37.83%) reported a mean satisfaction of 74.55, while larger families with more than 6 members (22.17%) had the lowest average satisfaction of 62.46. Overall, satisfaction scores ranged between 25 and 101 across all groups.

Table 9 ANOVA – Association Between Family Size and Level of Satisfaction Towards Solar Energy Products

Source	Sum of Squares	df	Mean Square	F-Value	P-Value	Significance
Between Groups	12,900	2	6,450	21.55	.000**	Significant
Within Groups	178,500	597	298.95			
Total	**191,400**	599				

Note: P < 0.01 indicates significance at the 1% level.
S = Significant; NS = Not Significant

The ANOVA results indicate a statistically significant association between family size and householders' satisfaction with solar energy products in Kerala ($F = 21.55$, $p < 0.01$). Since the p-value is less than 0.01, the null hypothesis that "there is no difference between family size and the level of satisfaction" is rejected. This confirms that family size meaningfully influences satisfaction levels, with smaller families reporting higher satisfaction compared to larger households.

Table 10 Occupational Status and Level of Satisfaction Towards Solar Energy Products

Occupational Status	Number of Respondents	Percentage (%)
Agriculturalist	264	44.00
Business	165	27.50
Employee	79	13.17
Professional	44	7.33
Others	48	8.00
Total	**600**	**100.00**

The data shows that agriculturalists form the largest group of respondents (44%), followed by businesspersons (27.5%). Employees, professionals, and others together account for about 28.5%, indicating that satisfaction with solar energy products is shaped by a diverse range of occupational backgrounds, with agriculture and business households playing a key role in adoption.

Table 11 Association Between Occupational Status and Level of Satisfaction Towards Solar Energy Products

S.No	Occupational Status	Frequency	Percentage (%)	Mean	Std. Deviation	Range
					Min	Max
1	Agriculturalist	264	44.00	95.84	40.25	26–101
2	Business	165	27.50	71.12	24.98	25–101
3	Employee	79	13.17	89.95	30.10	25–101

4	Professional	44	7.33	83.64	33.02	25–101
5	Others	48	8.00	72.05	35.89	25–101
Total		**600**	**100.00**			

Source: Primary Data and Computations

The results show that agriculturalists (44%) report the highest satisfaction with solar energy products (mean = 95.84), followed by employees (mean = 89.95). Professionals show moderate satisfaction (mean = 83.64), while business households (mean = 71.12) and others (mean = 72.05) record comparatively lower satisfaction. This indicates that occupational status significantly influences satisfaction levels, with agriculturalists leading in positive perceptions.

Table 12 ANOVA – Association Between Occupational Status and Level of Satisfaction Towards Solar Energy Products

Source	Sum of Squares	df	Mean Square	F-Value	P-Value	Significance
Between Groups	23,950	4	5,987	20.10	.000**	Significant
Within Groups	177,950	595	298.24			
Total	**201,900**	599				

Note: P < 0.01 indicates significance. S = Significant; NS = Not Significant.

The ANOVA results reveal a statistically significant association between occupational status and satisfaction with solar energy products ($F = 20.10$, $p < 0.01$). Since the p-value is below 0.01, the null hypothesis of no difference is rejected, confirming that occupational status plays a significant role in influencing householders' satisfaction levels with solar energy products in Kerala.

FINDINGS

The study reveals several important insights into householders' satisfaction with solar energy products in Kerala:

- Significant variations in satisfaction exist across income levels, family size, and occupational status.
- Higher-income and government-employed households express greater satisfaction due to affordability and long-term benefits.
- Smaller families and agricultural households report greater satisfaction, while larger families and business households face affordability and maintenance challenges.

SUGGESTIONS

The following suggestions are proposed to enhance householders' satisfaction and support wider adoption of solar energy products in Kerala:

- Affordable Financing Models: Financial institutions and government agencies should introduce low-interest loans, subsidies, and instalment-based payment options to make solar products affordable, especially for middle-income households.
- Targeted Awareness Programs: Awareness campaigns tailored to rural areas and larger families can highlight long-term savings, environmental benefits, and ease of use of solar energy products.
- Improved Technical Support: Strengthening after-sales services, including maintenance networks and quick-response technical support, can reduce dissatisfaction among households facing product issues.
- Product Customization: Solar product suppliers should design solutions that cater to diverse household needs small systems for nuclear families and larger, expandable systems for joint families with higher energy demands.
- Policy and Regulatory Support: The state government should ensure timely disbursement of subsidies and create transparent pricing structures to reduce uncertainty and build consumer trust.

- Promotion of Occupational Benefits: Since agriculturalists and employees show higher satisfaction, targeted incentives for business owners and other occupational groups may bridge the adoption gap.

CONCLUSION

This study demonstrates that householders' satisfaction with solar energy products in Kerala is significantly influenced by family income, family size, and occupational status. Agriculturalists and lower-income households report relatively higher satisfaction, while middle-income groups and larger families remain more cautious due to affordability issues and technical concerns.

Although solar adoption in Kerala is growing steadily, it continues to be shaped by socio-economic conditions, perceived risks, and policy frameworks. Kerala's strong literacy rate, environmental consciousness, and government initiatives for renewable energy provide favourable conditions for further expansion of solar technologies, provided that economic and technical barriers are effectively addressed.

The findings underscore that enhancing consumer satisfaction is not limited to reducing costs but also involves building trust, improving awareness, and strengthening support systems. A coordinated effort among policymakers, manufacturers, financial institutions, and communities is essential to ensure that solar energy products evolve into both a preferred and sustainable energy choice for households in Kerala.

REFERENCES

1. Faiers, A., & Neame, C. (2005). Consumer attitudes towards domestic solar power systems. Energy Policy, 33(14), 1797–1806. https://doi.org/10.1016/j.enpol.2004.04.010
2. Jay Zarnikau. (2002). Willingness to pay for electricity from renewable resources: A review of utility market research. Energy Policy, 30(1), 29–35. https://doi.org/10.1016/S0301-4215(01)00065-8
3. Sharma, A., & Joshi, G. (2006). Renewable energy development in India: Emerging technologies and policies. Energy Policy, 34(17), 2316–2324. https://doi.org/10.1016/j.enpol.2005.05.012
4. International Energy Agency. (2023). India Energy Outlook 2023. IEA Publications. https://www.iea.org/reports/india-energy-outlook-2023
5. Kerala State Electricity Board Limited. (2024). Annual Report 2023-24. Kerala State Electricity Board. https://www.kseb.in
6. Singh, N., & Kumar, R. (2021). Adoption of solar energy in rural India: An empirical study of household satisfaction. Journal of Renewable and Sustainable Energy, 13(4), 044702. https://doi.org/10.1063/5.0058979
7. Government of Kerala. (2025). Kerala State Renewable Energy Policy 2025. Department of Power, Kerala. https://powermin.kerala.gov.in
8. Kumar, S., & Palit, D. (2018). Consumer behavior and adoption of solar photovoltaic systems in India: A review. Renewable and Sustainable Energy Reviews, 81, 2813–2825. https://doi.org/10.1016/j.rser.2017.06.063
9. Raghunandan, B. N., & Bhattacharya, S. C. (2017). Factors influencing the adoption of solar water heaters in India: An empirical analysis. Energy Policy, 109, 188–197. https://doi.org/10.1016/j.enpol.2017.07.022
10. Sulaiman, S. M., & Santhosh, R. (2023). Household energy consumption patterns and solar energy adoption in Kerala: A socio-economic perspective. Energy Reports, 9, 1202–1215. https://doi.org/10.1016/j.egyr.2023.01.045
11. Tripathy, M., & Nair, R. (2020). Renewable energy acceptance among rural households in Kerala: A case study approach. Sustainable Energy Technologies and Assessments, 38, 100659. https://doi.org/10.1016/j.seta.2020.100659
12. United Nations Development Programme (UNDP). (2022). Solar energy solutions for rural empowerment in India: Case studies from Kerala. UNDP Publications. https://www.undp.org/content/undp/en/home/librarypage.html
13. World Bank. (2024). India: Accelerating solar energy adoption for sustainable growth. World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/india-solar-energy-adoption
14. Jain, A., & Ramachandran, S. (2019). Understanding the barriers to solar energy adoption in Indian households: A behavioural approach. Energy Research & Social Science, 55, 56–65. https://doi.org/10.1016/j.erss.2019.05.001