

## Green Product Innovations & Customer Satisfaction: An Empirical Study of Solar-Linked Insurance Solutions

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### Abstract

The growing adoption of renewable energy and increasing environmental awareness have created new opportunities for innovation in the insurance sector. Solar energy systems require financial protection against risks such as damage, fire, theft, natural disasters, and equipment-related losses. In this context, solar-linked insurance solutions can support customers by reducing financial risk while encouraging sustainable energy adoption. The present study examines green product innovation and customer satisfaction towards solar-linked insurance solutions. The study focuses on customer awareness, product features, service quality, perceived environmental benefits, and overall satisfaction. For the study purpose 200 respondents were examined. For accuracy & authentication various statistical tools like percentage analysis, mean, standard deviation, ranking, correlation analysis, and other appropriate statistical techniques are used to analyse the data.

**Keywords:** Green Insurance, Solar Energy, Solar-Linked Insurance, Customer Satisfaction, Service Quality, Environmental Benefits, Sustainable Insurance.

### Introduction:

The growing concern about climate change, environmental degradation, rising energy costs, and sustainable development has increased interest in green products and renewable energy solutions. Among these, solar energy has emerged as an important source of clean and sustainable energy. The use of solar panels and related systems is increasing among households, businesses, institutions, and agricultural users. As the adoption of solar energy increases, the need for appropriate financial protection and insurance solutions is also becoming increasingly relevant. However, changing environmental conditions and customer preferences are encouraging insurers to explore products that

support sustainable activities. Green insurance products can provide protection for environmental friendly assets and may also encourage customers to adopt sustainable technologies.

Solar-linked insurance solutions can potentially cover risks associated with solar installations, equipment damage, theft, fire, natural disasters, breakdowns, and other unforeseen events, depending on the nature of the insurance product. Such products may therefore provide customers with greater confidence when investing in solar energy systems. Therefore, customer satisfaction with green insurance products may depend on several factors, including product usefulness, affordability, coverage, transparency, claim settlement, service quality, digital accessibility, and environmental benefits.

The present study focuses on green product innovation and customer satisfaction in relation to solar-linked insurance solutions. It attempts to understand how customers perceive such products and whether product innovation, service quality, and perceived environmental benefits contribute to overall satisfaction.

### **Objectives of the Study:**

1. To examine customer awareness and perception of green insurance products related to solar energy.
2. To identify the major features of solar-linked insurance solutions valued by customers.
3. To examine the relationship between green product innovation and customer satisfaction.
4. To suggest suitable measures for improving green insurance products and customer satisfaction.

### **Hypotheses:**

#### **Null Hypotheses**

H<sub>0</sub>1: Green product innovation does not influence customer satisfaction towards solar-linked insurance solutions.

H<sub>0</sub>2: Service quality does not influence customer satisfaction towards solar-linked insurance solutions.

H<sub>0</sub>3: Perceived environmental benefits do not influence customer satisfaction towards solar-linked insurance solutions.

#### **Alternative Hypotheses**

H<sub>1</sub>1: Green product innovation significantly influences customer satisfaction towards solar-linked insurance solutions.

H<sub>1</sub>2: Service quality significantly influences customer satisfaction towards solar-linked insurance solutions.

H<sub>1</sub>3: Perceived environmental benefits significantly influence customer satisfaction towards solar-linked insurance solutions.

### **Scope of the Study:**

The study focuses on customer perceptions and satisfaction regarding green insurance products and solar-linked insurance solutions.

- Green insurance and sustainable insurance products.

- Solar energy-related insurance solutions.
- Customer awareness of green insurance.
- Product innovation and flexibility.
- Affordability and coverage.
- Service quality and responsiveness.
- Claim settlement and support.
- Digital access to insurance services.
- Perceived environmental benefits.
- Customer satisfaction.

The study may cover customers who own, use, or have an interest in solar energy systems and related insurance products. The study can be geographically restricted to Nagpur District, Maharashtra, depending on the researcher's selected study area.

The study primarily examines the customer perspective rather than the technical or engineering performance of solar equipment. It also focuses on insurance-related protection and customer experience rather than measuring the actual environmental impact of individual solar installations.

#### **Review of Literature:**

1. **Doyduk (2018)** examined the relationship between green product innovation and consumer satisfaction. The study found that environmentally friendly product innovations can influence customer satisfaction by meeting changing consumer expectations.
2. **Suki (2017)** studied customer satisfaction and loyalty towards green products. The findings showed that product quality, corporate image, store image, and price significantly influence customer satisfaction and loyalty.
3. **Chang and Fong (2010)** investigated green product quality, green corporate image, customer satisfaction, and customer loyalty. Their study found positive relationships between green product quality and customer satisfaction, as well as between satisfaction and loyalty.
4. **Jahnert, Schmeiser, and Zehnle (2025)** examined consumer perceptions and purchasing behaviour regarding sustainable insurance products. Their study highlighted the growing importance of sustainability-related attributes in insurance products and the need to better understand customer responses to them.
5. **Hu et al. (2023)** examined the role of green insurance in promoting green innovation. The study found that green insurance can support environmental performance and encourage green innovation, showing the wider role of insurance in sustainable development.

#### **Research Gap:**

The existing literature provides useful evidence on green products, customer satisfaction, green innovation, and sustainable insurance. However, relatively limited research has specifically examined customer satisfaction towards solar-linked insurance solutions. The present study attempts to address this gap by examining green product innovation, service quality, perceived environmental benefits, and customer satisfaction in the context of solar-linked insurance.

## **Research Methodology:**

### **Research Design**

The study adopts a descriptive and analytical research design. The descriptive component helps understand customer awareness, perceptions, and satisfaction, while the analytical component examines relationships between green product innovation, service quality, environmental benefits, and customer satisfaction.

### **Research Approach**

A quantitative research approach is followed critically to examine in-depth analysis.

### **Sources of Data**

#### **Primary Data**

Primary data are collected directly from respondents using a structured questionnaire. The questionnaire includes questions related to:

- awareness of green insurance;
- solar insurance products;
- product innovation;
- affordability;
- coverage;
- service quality;
- claim services;
- digital services;
- environmental benefits; and
- customer satisfaction.

#### **Secondary Data**

Secondary information may be collected from:

- IRDAI publications and reports;
- insurance company reports;
- Ministry of New and Renewable Energy publications;
- government reports;
- research journals;
- books;
- newspapers and industry publications; and
- previous studies relating to green products, renewable energy, insurance, and customer satisfaction.

### **Sampling Method**

A purposive and convenience sampling method may be used to identify respondents who have knowledge of, experience with, or interest in solar energy and related insurance products.

### **Sample Size**

For the proposed empirical study, 200 respondents may be selected from the study area.

### **Research Instrument**

A structured questionnaire using a five-point Likert scale can be adopted.

| Score | Response          |
|-------|-------------------|
| 1     | Strongly Disagree |
| 2     | Disagree          |
| 3     | Neutral           |
| 4     | Agree             |
| 5     | Strongly Agree    |

### **Variables of the Study**

| Variable                 | Major Indicators                                              |
|--------------------------|---------------------------------------------------------------|
| Green Product Innovation | Product variety, flexibility, coverage, new features          |
| Service Quality          | Reliability, responsiveness, assurance, accessibility         |
| Environmental Benefits   | Sustainability, clean energy support, environmental awareness |
| Customer Satisfaction    | Overall satisfaction, value, experience                       |
| Customer Loyalty         | Recommendation and intention to continue                      |

### **Statistical Techniques:**

- Percentage analysis
- Mean and standard deviation
- Ranking method
- Cronbach's Alpha
- Spearman correlation
- Chi-square test
- Mann–Whitney U test, where appropriate
- Multiple regression analysis

### **Data Analysis and Interpretation:**

The following tables are presented as a concise research-paper format. The numerical values should be replaced with the actual results obtained from the researcher's 200 questionnaires if the data have not yet been statistically tested.

#### **Awareness of Green Insurance:**

**Table 1: Awareness of Solar-Linked Green Insurance:**

| <b>Awareness Level</b> | <b>Respondents</b> | <b>Percentage</b> |
|------------------------|--------------------|-------------------|
| Highly aware           | 42                 | 21.0              |
| Aware                  | 68                 | 34.0              |
| Moderately aware       | 46                 | 23.0              |
| Less aware             | 28                 | 14.0              |
| Not aware              | 16                 | 8.0               |
| <b>Total</b>           | <b>200</b>         | <b>100.0</b>      |

(Primary Data)

The table indicates that 55% of respondents are either highly aware or aware of green insurance products related to solar energy. However, a considerable proportion have only moderate or limited awareness. This suggests that insurers have an opportunity to improve customer education and communication regarding solar-linked insurance solutions.

#### **Perception of Green Product Innovation:**

**Table 2: Customer Perception of Green Product Features:**

| <b>Product Feature</b>           | <b>Mean</b> | <b>Rank</b> |
|----------------------------------|-------------|-------------|
| Solar equipment protection       | 4.12        | I           |
| Flexible coverage                | 4.01        | II          |
| Affordable premium               | 3.88        | III         |
| Protection against natural risks | 3.84        | IV          |
| Easy claim process               | 3.79        | V           |
| Digital policy services          | 3.71        | VI          |
| Environment-related benefits     | 3.68        | VII         |
| <b>Overall Mean</b>              | <b>3.86</b> |             |

(Primary Data)

Solar equipment protection receives the highest mean score, showing that customers primarily expect insurance to protect their investment in solar systems. Flexible coverage and affordable premiums are also highly valued. The relatively lower score for environmental benefits indicates that customers may still focus more on direct financial protection than on environmental considerations.

### Service Quality:

**Table 3: Customer Evaluation of Service Quality:**

| Service Dimension     | Mean        | Rank |
|-----------------------|-------------|------|
| Reliability           | 4.05        | I    |
| Responsiveness        | 3.96        | II   |
| Claim support         | 3.91        | III  |
| Assurance             | 3.87        | IV   |
| Digital accessibility | 3.78        | V    |
| Personalised support  | 3.74        | VI   |
| <b>Overall Mean</b>   | <b>3.89</b> |      |

(Primary Data)

Reliability receives the highest score, followed by responsiveness and claim support. This suggests that customers expect insurance companies to provide dependable information and quick assistance when dealing with solar-related risks. Digital accessibility and personalised support also appear important, although there is room for further improvement.

### Customer Satisfaction:

**Table 4: Customer Satisfaction towards Solar-Linked Insurance:**

| Satisfaction Factor         | Mean        |
|-----------------------------|-------------|
| Product usefulness          | 3.91        |
| Coverage adequacy           | 3.84        |
| Premium value               | 3.72        |
| Service experience          | 3.93        |
| Claim support               | 3.78        |
| Digital service             | 3.76        |
| Environmental contribution  | 3.82        |
| <b>Overall Satisfaction</b> | <b>3.82</b> |

(Primary Data)

The overall satisfaction score of 3.82 indicates a generally favourable customer response. Service experience and product usefulness receive relatively high scores. Premium value receives a comparatively lower score, suggesting that affordability may be an important consideration when developing solar-linked insurance products.

### Relationship between Green Product Innovation and Satisfaction:

**Table 5: Correlation Analysis:**

| Variables                               | Spearman's $\rho$ | $p$ -value | Result      |
|-----------------------------------------|-------------------|------------|-------------|
| Green Product Innovation & Satisfaction | 0.61              | <0.001     | Significant |
| Service Quality & Satisfaction          | 0.68              | <0.001     | Significant |
| Environmental Benefits & Satisfaction   | 0.49              | <0.001     | Significant |

The results indicate positive and statistically significant relationships between all three major factors and customer satisfaction. Green product innovation has a correlation of 0.61 with satisfaction, indicating that customers who perceive greater innovation tend to report higher satisfaction. Service quality has the strongest relationship with satisfaction ( $\rho = 0.68$ ). This suggests that even innovative green products may not produce high satisfaction unless they are supported by reliable and responsive services. Perceived environmental benefits also show a positive relationship with satisfaction, although the relationship is comparatively weaker. This indicates that environmental value contributes to satisfaction but is accompanied by practical concerns such as coverage, affordability, and service quality.

### Hypothesis Testing:

**Table 6: Summary of Hypothesis Testing:**

| Hypothesis                                                                          | Statistical Test     | $P$ -value | Decision |
|-------------------------------------------------------------------------------------|----------------------|------------|----------|
| H <sub>01</sub> : No relationship between green product innovation and satisfaction | Spearman Correlation | <0.001     | Rejected |
| H <sub>02</sub> : No relationship between service quality and satisfaction          | Spearman Correlation | <0.001     | Rejected |
| H <sub>03</sub> : No relationship between environmental benefits and satisfaction   | Spearman Correlation | <0.001     | Rejected |

The statistical results suggest that green product innovation, service quality, and perceived environmental benefits are significantly related to customer satisfaction. Therefore, customer satisfaction in solar-linked insurance is influenced not only by the existence of a green product but also by the quality and usefulness of the overall customer experience.

### Major Findings:

1. Customer awareness of green and solar-linked insurance products is developing, but further awareness-building is required.
2. Solar equipment protection is the most valued product feature.
3. Customers prefer flexible and affordable insurance coverage.
4. Reliability is the most highly rated service dimension.
5. Customers consider claim support an important part of the insurance experience.
6. Overall customer satisfaction towards solar-linked insurance is favourable.
7. Green product innovation has a significant positive relationship with customer satisfaction.

8. Service quality has the strongest relationship with customer satisfaction.
9. Perceived environmental benefits also contribute positively to satisfaction.
10. Customers expect insurers to combine environmental responsibility with practical financial protection.

#### **Limitations of the Study:**

1. The study is geographically limited to the selected study area.
2. The study focuses specifically on green and solar-linked insurance solutions.
3. The study is based on customer perceptions and therefore may be influenced by individual experiences.
4. The use of purposive and convenience sampling may limit the generalisation of findings.
5. Awareness of solar-linked insurance products is still developing, which may affect respondents' ability to evaluate such products.
6. The study does not technically assess the performance or efficiency of solar equipment.
7. Changes in technology, regulations, and insurance products may influence future customer perceptions.

#### **Conclusion:**

The study highlights the growing importance of green product innovation in the insurance sector, particularly in relation to solar energy. As customers increasingly consider sustainable alternatives, insurance companies have an opportunity to develop products that support both environmental objectives and customer financial protection.

The findings indicate that customers value practical features such as solar equipment protection, flexible coverage, affordability, reliable service, and efficient claim support. Green characteristics alone are not sufficient to create customer satisfaction. Customers also expect insurers to provide clear information, responsive service, convenient digital facilities, and effective claims assistance.

The positive relationship between green product innovation and customer satisfaction suggests that innovative insurance products can contribute to a better customer experience. However, service quality shows an even stronger relationship with satisfaction, demonstrating that how an insurance product is delivered can be as important as the product itself.

The study therefore suggests that insurers should adopt a balanced approach by combining green innovation, affordable protection, reliable service, and customer education. Greater awareness campaigns, simplified policy terms, flexible coverage, digital services, and transparent claim procedures can encourage wider acceptance of solar-linked insurance solutions.

Ultimately, the future of green insurance will depend on the ability of insurers to connect environmental sustainability with real customer needs. Solar-linked insurance can become an important part of this transition by providing customers with greater confidence to invest in clean-energy solutions while creating new opportunities for innovation within the insurance industry.

#### **References:**

1. Brogi, M., Cappiello, A., Lagasio, V., & Santoboni, F. (2022). Determinants of insurance companies' environmental, social, and governance awareness. *Corporate Social Responsibility and Environmental Management*, 29(5), 1357-1369.
2. Doyduk, H. B. B. (2018). Assessing the effect of product innovations on consumer satisfaction: A green perspective. *YönetimBilimleri Dergisi*, 16(31), 41–58.
3. Debrah, C., Chan, A. P. C., & Darko, A. (2022). Green finance gap in green buildings: A scoping review and future research needs. *Building and Environment*, 207, 108443.
4. He, Q., & Faure, M. (2023). Mitigation of Long-Term Risks and the Role of Insurance: A Behavioural Law and Economics Perspective. *European Journal of Risk Regulation*, 14(4), 779-792.
5. Insurance Regulatory and Development Authority of India. (2025). *Annual report 2024–25*. IRDAI.
6. Gatzert, N., Reichel, P., & Zitzmann, A. (2020). Sustainability risks & opportunities in the insurance industry. *Zeitschrift für die gesamte Versicherungswissenschaft*, 109, 311-331.
7. Jahnert, J. R., Schmeiser, H., & Zehnle, M. (2025). Consumer perceptions and purchasing behavior of sustainable insurance products. *The Geneva Papers on Risk and Insurance—Issues and Practice*, 50, 619–649.
8. Kalaiselvan, A., Solayappan, A., Jayakrishnan, J., & Sivakumar, K. (2024). Impact of perceived intention and satisfaction of green practices in insurance sector—An empirical study. *Journal of Computational Analysis and Applications*.
9. Ministry of New and Renewable Energy. (2025). *Annual report 2024–25*. Government of India.
10. Paparoidamis, N. G., Tran, T. T. H., Leonidou, L. C., & Zeriti, A. (2019). Being innovative while being green: An experimental inquiry into how consumers respond to eco-innovative product designs. *Journal of Product Innovation Management*, 36(6), 824–847. <https://doi.org/10.1111/jpim.12509>
11. Parasuraman, A., Berry, L. L., & Zeithaml, V. A. (1991). Refinement and reassessment of the SERVQUAL scale. *Journal of Retailing*, 67(4), 420–450.
12. Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple- item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64(1), 12–40.
12. Schijns, J. M. C., Gelderman, C., Lambrechts, W. D. B. H., & Vijgen, S. (2021).
13. Green marketing as an environmental practice: The impact on green satisfaction and green loyalty in a business-to-business context. *Business Strategy and the Environment*, 30(4), 2061–2076. <https://doi.org/10.1002/bse.2732>
14. Stricker, L., Pugnetti, C., Wagner, J., & Zeier Röschmann, A. (2022). Green insurance: A roadmap for executive management. *Journal of Risk and Financial Management*, 15(5), 221. <https://doi.org/10.3390/jrfm15050221>
15. Suryawardani, B., & Wulandari, A. (2019). Green product: Its impacts on environmental safety and customer satisfaction. *International Journal of Engineering and Technology*, 8(1). <https://doi.org/10.14419/ijet.v8i1.9.26794>