



Green Product Attributes Modelled Employing Structural Equation Modelling

Prof. (Dr) Pinki Rai

Research Scholar, ITM Navi Mumbai, India

Abstract

Purpose: Green products are growing more popular as environmental concerns gain traction. The purpose of this research paper is to investigate the features of green products and confirm the most essential elements that contribute to the Green Product. The study adopts a structural equation modelling (SEM) approach to investigate the relationships between major green product attributes among so many stated Green Product features.

Design/methodology/approach: The research begins with a thorough assessment of the literature to identify the essential features associated with green products. Environmental friendliness, Resource Efficiency, Energy Efficiency, Less Toxic, and socially responsible production process are some of these characteristics. The conceptual framework was created in response to the requirement for a fixed definition of green products. The different definitions are taken from current literature. These gathered data is then examined using structural equation modelling techniques to investigate the hypothesised correlations between these asserted properties.

Originality/value: This study is the first to construct such a model because there is no established definition of green products, and consequently no fixed properties of green products, and definitely no statistical model on same.

Keywords: Green Products, Resource Efficiency, Energy Efficiency, Recyclability, CSR.

Paper Type: Research Paper

1. Introduction

In recent years, there has been a growing concern about the environmental impact of human activities, particularly in relation to the production and consumption of goods. This concern has given rise to the emergence of green products, which are designed to minimize negative environmental effects throughout their life cycle. Green products encompass a wide range of consumer goods, ranging from appliances and electronics to clothing and household items. Understanding the features and characteristics of green products is crucial for both consumers and businesses as they navigate the sustainable market.

This research paper aims to provide a comprehensive model on the features of the Green Product, extracted from the current literature. By analysing and synthesizing the available scholarly works, this study seeks to identify the key factors that define green products and distinguish them from conventional alternatives. Furthermore, it aims to shed light on these Green attributes and the correlation between them.

The features of green products can be multifaceted, encompassing various dimensions such as materials used, manufacturing processes, energy efficiency, recyclability, and packaging. By examining these dimensions, this research paper aims to explore how these factors contribute to making of Green Products and its make for sustainability. Additionally, it will highlight the potential benefits of green products for consumers, including cost savings, improved health and well-being, and a reduced ecological footprint.

Furthermore, this study will examine the role of government policies, regulations, and industry standards in shaping the features of green products. Understanding the formative landscape of Green Product definition is essential for comprehending the criteria and certifications that define a product as "green." Moreover, it will provide insights into the latent features and characteristics understood by businesses in adopting sustainable practices and developing green products.

By consolidating the existing literature on green product features, this research paper aims to contribute to the ongoing discourse on sustainability and consumer behavior. The findings of this study will serve as a valuable resource for policymakers, businesses, and consumers seeking to make informed choices and promote the adoption of green products. Furthermore, it will identify research gaps and future directions for scholars and researchers interested in further exploring and advancing the field of green product development and consumption.

In conclusion, this study intends to validate the characteristics of green products using a statistical model. Manufacturers and producers can utilize this model to create green products that are uniform in their quality. This will win the trust of environmentally conscious consumers, thereby promoting sustainability, a topic frequently discussed.

2. Literature Review

When it comes to identifying and understanding the specific aspects of green products, the existing literature on green marketing and green products indicates a considerable level of ambiguity (Berger, 2019). While there is broad agreement on the underlying goal of environmental sustainability, the specific characteristics that designate a product as "green" differ between studies and perspectives (Mariusz, Adnan 2020). Several factors contribute to this ambiguity, including the complexity of sustainability challenges, the dynamic nature of green technologies and practices, and the lack of standardized criteria for green product classification.

One aspect contributing to the ambiguity is the multidimensionality of green products. Scholars often consider various dimensions, such as resource conservation, energy efficiency, waste reduction, and emissions reduction, when discussing the features of green products, (Haws et al., 2014). However, the weighting and prioritization of these dimensions may differ depending on the context, industry, or stakeholder perspective. For example, some studies may place more emphasis on renewable materials, while others prioritize energy efficiency or recyclability, (Joshi & Rahman, 2015)

Another source of ambiguity arises from the diverse perspectives within the green marketing literature. Different scholars and researchers approach green products from various disciplines, such as marketing, engineering, environmental science, and consumer behaviors, (Laheri et al., 2014). These disciplinary differences can lead to varying conceptualizations and definitions of green product features. For instance, engineering-focused studies may focus on technical aspects, such as product life cycle analysis and energy efficiency, while consumer behavior studies may emphasize attributes that resonate with consumer values and preferences.

Furthermore, the evolving nature of green technologies and practices contributes to the ambiguity surrounding green product features (Kumar and Yadav, 2021). As new innovations emerge and scientific knowledge advances, the definition of what constitutes a green product may shift over time, (Bradue et al., 2022). For instance, the introduction of new materials or manufacturing processes may lead to different criteria for assessing the environmental performance and sustainability of products, (H. Kaebernick S. Kara, M. Sun, 2003). This dynamic nature of green products poses challenges for both researchers and practitioners in keeping up with the latest developments and aligning their understanding of green product features, (Ceschin & Gaziulusoy, 2016)

The lack of standardized criteria for green product classification is another factor that contributes to ambiguity, (Evangelia Sdrolia, 2018). While several eco-labeling schemes and certifications exist, there is no universal agreement on the precise attributes that qualify a product as green. Different countries, industries, and organizations may have their own sets of criteria, leading to inconsistencies and confusion. This lack of standardization makes it challenging for consumers, businesses, and policymakers to make informed decisions about green products and hinders effective communication in the marketplace (Bickart and Ruth, 2013).

Addressing this ambiguity requires a multidisciplinary and collaborative approach. Researchers, policymakers, industry representatives, and consumers must engage in ongoing dialogue and knowledge sharing to develop a clearer understanding of green product features. Standardization efforts, such as the harmonization of eco-labelling schemes, can help establish consistent criteria for green product classification, (Yi Zhu* et al, 2020) Additionally, interdisciplinary research and cross-sector collaborations can contribute to a more holistic and comprehensive understanding of green products, considering their economic, environmental, and social dimensions.

In conclusion, while the literature on green marketing acknowledges the importance of green product features, there is inherent ambiguity surrounding their definition and understanding. This ambiguity stems from the multidimensionality of green products, diverse disciplinary perspectives, the evolving nature of green technologies, and the lack of standardized criteria, (Li et al., 2022). Addressing this ambiguity requires collaborative efforts, standardization initiatives, and interdisciplinary research to foster a clearer and more consistent understanding of green product features, enabling better decision-making by consumers, businesses, and policymakers.

3. Conceptual Framework and hypothesis on attributes of Green Products

3.1 (Bhamra et al., 2011). Design for sustainable behaviour: using products to change consumer behaviour, this book explores the concept of sustainable behaviour in design and how it can be used to encourage consumers to adopt more sustainable practices. It looks at how green products can be designed to incorporate sustainable attributes that influence consumer behavior and lead to more sustainable outcomes. The authors also provide case studies and practical examples to illustrate the concept in action.

(Mele et al., 2019), This study investigates the determinants of green purchase behavior for eco-friendly appliances, with a particular focus on energy efficiency as an important attribute of green products. The authors conducted a survey among

consumers in South Korea to examine the factors that influence green purchase behavior. The results indicate that energy efficiency is one of the most important attributes that consumers consider when purchasing eco-friendly appliances. The study concludes that incorporating energy efficiency into green product design can increase consumer adoption and support for sustainable practices.

Hypothesis (H1):Energy efficiency and green product adoption has positive affect

3.2 Yusof, N. M., & Yusof, N. M. (2020), this study explores the relationship between green product attributes and consumer purchase intention. The authors conducted a survey among consumers in Malaysia to determine the importance of different green product attributes, including sustainability, on consumer purchase intention. The results indicate that sustainability is one of the most important attributes of green products that influence consumer purchase intention. The study concludes that incorporating sustainability into green product design and marketing can lead to increased consumer adoption and support for sustainable practices.

Maxwell, J. W., & Van der Vorst, R. (2018). Sustainable packaging design: A holistic approach for driving environmental performance in product packaging. *Journal of Cleaner Production*, this research paper examines the role of sustainable packaging design in driving environmental performance. It emphasizes recyclability as an important attribute of green products, specifically focusing on product packaging. The authors propose a holistic approach to sustainable packaging design that considers various factors, including material selection, packaging design, and end-of-life management. The study highlights the significance of recyclability in reducing waste and promoting a circular economy. It concludes that incorporating recyclability into green product packaging design can contribute to overall sustainability goals and consumer preferences.

Hypothesis (H2): Recyclability and Green Products have positive relation.

(Wijekoon& Sabri, 2021), this research paper proposes a conceptual framework to understand the determinants of green product purchase intention. One of the key attributes considered in the framework is Corporate Social Responsibility (CSR). The authors argue that CSR initiatives undertaken by companies in relation to their green products positively influence consumers' purchase intention. The paper suggests that CSR activities, such as promoting environmental sustainability, social responsibility, and ethical practices, can enhance the perceived value and attractiveness of green products to consumers.

Green product features and corporate social responsibility (CSR) cover a wide variety of actions and characteristics that support social and environmental sustainability. CSR Qualities, like Ethical Labour Practices, Promoting diversity and inclusivity in the workplace, as well as fair salaries, secure working conditions, and employee rights. Community Engagement like assisting neighborhood groups and organizations through philanthropic endeavors, volunteer work, and alliances with charities. Responsible sourcing, fair trade, and labour standards are just a few examples of the ethical and sustainable practices suppliers must follow. Engaging actively with stakeholders, including as staff members, clients, investors, and communities, in order to address their issues and take into account their viewpoints during the decision-making process.

Supporting social causes and organizations through donations, grants, and corporate philanthropy initiatives is known as philanthropy and charitable giving.

Hypothesis (H3):There is a positive relationship between Corporate Social Responsibility (CSR) and the perceived green attributes of a product.

4. Research Design:

(Apuke, 2017), a quantitative research approach was employed to examine the correlations between key factors. The quantitative research method is appropriate when there are more subjects in the investigation. And by doing so, it is possible to generalize the conclusions, and by adopting acknowledged standards, the research can be replicated. (Nunan D, Birks DF, and Malhotra NK (2017).

4.1 Procedures:

In this study, the target population comprised of anyone who uses green products. The population comprised of consumers above 18 and is the decision maker in the purchase process. The population was from across demography and irrespective of the gender. It was made sure through the question in the questionnaire if they are aware of the "Green Products". The data was collected in the 1st half of the year and was collected through Google form. The total data collected was 550 people.

The structured questionnaire has 30 items covering three important factors Recyclability, Energy Efficiency and Corporate social responsibility as the important features of the Green Product. These items were rated on Likert scale of Strongly Disagree to Strongly Agree. All 30 items were extracted from the existing literature for quality study and exploratory test was performed before running the confirmatory test.

4.2 Data Analysis:

Lynd D. Bacon, (2000), Structured equation modelling (SEM) was used to analyse the data acquired using SPSS version 23.0 and Amos for modelling. The measurement model and the structural model are the two phases of the two-phase SEM procedure that Anderson and Gerbing proposed. Most researchers believe that using SEM requires a sample size of 200 individuals, (Kline 2005), so the sample size meets the criterion. Internal consistency, convergent validity, and discriminant validity were tested to see if the model constructs were appropriate for the items.

5. Results:

5.1 Findings and Analysis:

The quantitative data, used in the study, was examined by using AMOS 23. Anderson and Gerbing (1998) outlined two-step process – first to develop measurement model and then structural model in SEM, AMOS. The measurement model that is utilized to access the latent variable for each component was tested using CFA with maximum likelihood. The validity and reliability of all the constructs in the study were then assessed using the structural modelling (SEM), which included construct validity and discriminant validity. In addition, the goodness-of-fit indices were checked and construct validity and discriminant validity were employed to furtherer explore the links across constructs.

5.2 Measurement model: *Evaluation, Validation and reliability of the model.*

Each measurement model's objective is to delineate how latent (hidden) variable can be measured using observed variable as their measurement instrument(Li et al., 2019)

Over all 12 items were generated from existing literature and to test the reliability and validity of three constructs the

CONSTRUCT	ITEMS	ITEMLOADIG	AVE	CR
Environmental Sustainability	RC1	0.712	0.61	0.719
	RC3	0.665		
	EE1	0.805		
	EE2	0.72		
Resource Efficiency	LW1	0.61	0.752	0.829
	LW2	0.74		
	LW3	0.64		
	Ltc 2	0.719		
Social Responsibility	CSR 1	0.62	0.771	0.819
	TB2	0.851		
	TB3	0.8		
	TB4	0.612		

confirmatory factor analysis was used.

The table 1 below, shows the factor loading of above .6 as the convergent validity(Chin et al., 1997)

The study evaluated the reliability of the construct through the application of Cronbach's Alpha and composite reliability for each construct, the Cronbach's Alpha exceeded the required limit of .60 as specified by (Chin et al., 1997).

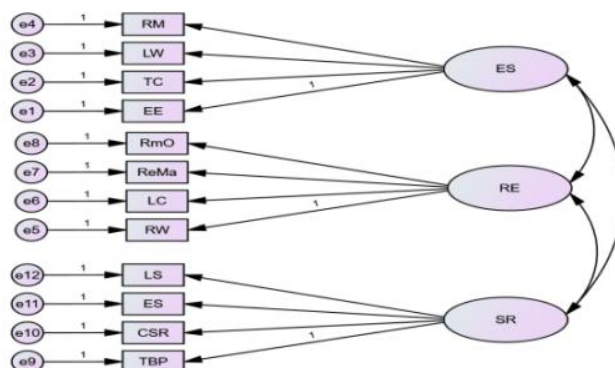
Moreover, the Composite Reliabilities demonstrates the range between .80 to .91, surpassing the benchmark of .70, as outlined by (Hair et al., 2012). As a result, the study successfully established the construct reliability of each of the constructs.

The present study assessed the convergent validity of the scale items by utilizing the Average Variance Extract (Fornell& Larcker, 1981). The results indicate that the average variance extracted value exceeded the minimum threshold value of .50. as estimated by Fornell& Larker, 1981. As the consequence the scales utilized in this study demonstrated the

necessary level of convergent validity.

In light of this, the squared correlation between the constructs was greater than the AVE value. The study's overall conclusion was that the concept it examined had generally recognised one-dimensionality, reliability, and validity.

6. Structural Model:



Second order structural model was used to determine if the three factors – Environmental Sustainability (ES), Resource Efficiency (RE) and Corporate Social Responsibility (CSR) was explaining the Green Products attributes through consumer behaviour. In this study all three variables were regarded as the independent variable and consumer behaviour as observed or latent variable.

The result presented in Table 2 shows Chi-square to be significant at 154.653, $\chi^2/df = 2.93$, $P = .000 < .05$. The root mean square of .48 and CFI value of .909, measures the goodness of fit of the said model. The value of AGFI too met the value of .90 (.956). The other important indices too met the set criterion, RMR = .48 (<.50), RFI = .910 (>.90).

Particulars	χ^2/df	GFI	NFI	TLI	AGFI	CFI	SRMR	RMSEA
Recommended Value	$\leq 3^a$	$\geq 0.9^b$	$\geq 0.9^b$	$\geq 0.9^b$	$\geq 0.9^b$	$\geq 0.9^b$.8 ^c	.8 ^d

The values were within the acceptable limits as said by (Hair, Anderson, Babin & Black, 2010). The study successfully explains that the relationship between exogenous variable (unobserved) and endogenous variable (observed) meaning all the factors like – energy efficiency, recyclability, waste reduction successfully explains Environmental Sustainability (ES).

And ES has positive effect on consumer consumption of Green Products. H1 is confirmed with the beta value of .61. P=.000. This confirms Environmental Sustainability as one of the attributes to measure Green Products.

On the same lines, features like low waste, low water wastage, low toxic material explains factor Resource Efficiency. And this has positive effect on consumer consumption, H2 is confirmed with Beta value of .72, P=.000. This confirms Resource Efficiency (RE) to be second attribute to measure Green Product, (Peter Ansu-Mensah, 2021).

With the 3rd factor Corporate Social Responsibility, CSR, the features like labour standards, working condition of the labour, ethical sourcing and community involvement successfully explain it as the attribute of the Green Products, and with Beta value of .89 and P = .000, shows that it has positive effect on the consideration of "Green Products". So, CSR can be taken as the 3rd attribute of the Green Products, (Mohd Suki & Mohd Suki, n.d.).

Fit Indices	Criteria	Indicators
Chi-Square,		154.653
χ^2/df	< 5 acceptable	2.983
	<3 good	
Adjusted Goodness of Fit (AGFI)	> 0.8 acceptance	0.956
	>0.9 good	
Goodness of FIT (GFI)	>.8 acceptable	0.961
	>.9 good	
Comparative Fit Index (CFI)	>.9	0.909
Normed Fit Index (NFI)	>.9	0.902
Relative Fit Index (RFI)	>.9	0.91
Root mean square residual (RMR)	<.05	0.48
Root mean Square error of approximation (RMSEA)	<.1 acceptable	0.09
	<.08 good	

7. Analysis and Management Implications

Energy efficiency, resource efficiency, and corporate accountability are what constitute green products, according to the study's conclusions. When it comes to green products, these criteria can now be employed for a variety of measurements and claims. These elements can be used by industrialists while creating the product communication. Their ability to assert the "Greenness of the Product" will be stronger owing to the study.

Previous studies' descriptions of each component of the concept of a green product were ambiguous. Thus, the industrialists have utilised a variety of ambiguous criteria to assert the "greenness" of Green Goods, which has diminished customer confidence in green goods. These elements will provide consumers with a foundation for a more favourable perception of "Green Goods".

References:

- i. Apuke, O. D. (2017). Quantitative Research Methods : A Synopsis Approach. *Kuwait Chapter of Arabian Journal of Business and Management Review*, 6(11), 40–47. <https://doi.org/10.12816/0040336>
- ii. Bhamra, T., Lilley, D., & Tang, T. (2011). Design for Sustainable Behaviour: Using products to change consumer behaviour. *Design Journal*, 14(4), 427–445. <https://doi.org/10.2752/175630611X13091688930453>
- iii. Bradu, P., Biswas, A., Nair, C., Sreevalsakumar, S., Patil, M., Kannampuzha, S., Mukherjee, A. G., Wanjari, U. R., Renu, K., Vellingiri, B., & Gopalakrishnan, A. V. (2022). Recent advances in green technology and Industrial Revolution 4.0 for a sustainable future. *Environmental Science and Pollution Research*. <https://doi.org/10.1007/s11356-022-20024-4>
- iv. Ceschin, F., & Gaziulusoy, I. (2016). Evolution of design for sustainability: From product design to design for system innovations and transitions. *Design Studies*, 47, 118–163. <https://doi.org/10.1016/j.destud.2016.09.002>
- v. Chin, W. W., Gopal, A., & Salisbury, W. D. (1997). Advancing the Theory of Adaptive Structuration: The Development of a Scale to Measure Faithfulness of Appropriation. *Information Systems Research*, 8(4), 342–367. <https://doi.org/10.1287/isre.8.4.342>
- vi. Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, 40(3), 414–433. <https://doi.org/10.1007/s11747-011-0261-6>
- vii. Haws, K. L., Winterich, K. P., & Naylor, R. W. (2014). Seeing the world through GREEN-tinted glasses: Green consumption values and responses to environmentally friendly products. *Journal of Consumer Psychology*, 24(3), 336–354. <https://doi.org/10.1016/j.jcps.2013.11.002>
- viii. Joshi, Y., & Rahman, Z. (2015). Factors Affecting Green Purchase Behaviour and Future Research Directions. *International Strategic Management Review*, 3(1–2), 128–143. <https://doi.org/10.1016/j.ism.2015.04.001>
- ix. Laheri, V. K., Dangi, H., & Vohra, A. (2014). Green Marketing: Development of Construct and Its Evolution. *Asia-Pacific Journal of Management Research and Innovation*, 10(2), 147–155. <https://doi.org/10.1177/2319510x14536220>
- x. Li, S., Li, X., Zhao, Q., Zhang, J., & Xue, H. (2022). An Analysis of the Dimensional Constructs of Green Innovation in Manufacturing Enterprises: Scale Development and Empirical Testing. *Sustainability (Switzerland)*, 14(24). <https://doi.org/10.3390/su142416919>
- xi. Li, S., Sari, Y. A., & Kumral, M. (2019). New approaches to cognitive work analysis through latent variable modeling in mining operations. *International Journal of Mining Science and Technology*, 29(4), 549–556. <https://doi.org/10.1016/j.ijmst.2019.06.014>
- xii. Mele, P. M., Gomez, J. M., & Garay, L. (2019). To green or not to green: The influence of green marketing on consumer behaviour in the hotel industry. *Sustainability (Switzerland)*, 11(17). <https://doi.org/10.3390/su11174623>
- xiii. Mohd Suki, N., & Mohd Suki, N. (n.d.). *An Investigation of E-shopping Quality Determinants among Students at a Higher Learning Institution*. <http://ssrn.com/abstract=1867900><https://ssrn.com/abstract=1867900>Electronic copy available at: <http://ssrn.com/abstract=1867900>
- xiv. Wijekoon, R., & Sabri, M. F. (2021). Determinants that influence green product

purchase intention and behavior: A literature review and guiding framework. In *Sustainability (Switzerland)* (Vol. 13, Issue 11). MDPI AG. <https://doi.org/10.3390/su13116219>

- xv. Wynne W. Chin; Abhijit Gopal and W. David Salisbury, (1997), Advancing the Theory of Adaptive Structuration: The Development of a Scale to Measure Faithfulness of Appropriation, *Information Systems Research*, 8, (4), 342-367