AI in Sustainable Retail Packaging: Consumer Awareness in Indian Supermarkets

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Abstract

Retail Packaging is a major contributor to global waste, and with the growing demand for products in India, sustainable packaging is becoming very important. The study figures out how Artificial intelligence (AI) can help create eco-friendly packaging and examines whether Indian Supermarket shoppers are aware of these changes, as well as their willingness to pay extra for such packaging. AI helps design packaging that uses fewer materials, reduces waste, and minimize the environmental impact, while still being durable and affordable.

The research was conducted among consumers in both urban areas like Bengaluru and rural regions, using a structured survey method. A sample of 100 respondents provided insights into their demographics, awareness of sustainable packaging, and their willingness to support it financially. Chi-square analysis was used to understand whether factors such as location, income, age or education influence consumer choices related to eco-friendly packaging.

The results of this study are intended to help businesses, policymakers and retailers better understand consumer behavior around sustainability in packaging. It highlights the importance of increasing public awareness and creating cost-effective solutions that encourage responsible consumer choices. Finally, the Study also opens up new opportunities for future research into how AI can be used more effectively to support sustainability in the retail sector.

Keywords

Sustainable retail Packaging, Artificial Intelligence (AI), Consumer Awareness, metro consumer behavior.

Introduction

Every day, we see products wrapped in layers of Packaging much of which ends up as waste. In India, where more people are buying packaged goods, this waste is growing rapidly. To tackle this problem, businesses are looking for sustainable packaging solutions that are better for environment. one way they are able to achieve this is by using Artificial Intelligence (AI) to design packaging that reduces waste, lowers pollution and uses eco-friendly materials without making products more expensive. Artificial Intelligence helps company create lighter and stronger packaging that requires fewer materials and is easier to recycle. It also helps reduce plastic waste by suggesting better alternatives, like biodegradable or recyclable materials. Leading brands in India, such as Flipkart, Amazon India and Nestle have already started using AI-driven packaging solutions to make their products more sustainable.

This study focuses on how much Indian supermarket shoppers know about AI-driven sustainable packaging and whether they are willing to pay extra for it. The research focuses on metro city like Bengaluru, where people are more familiar with eco-friendly products,

Conceptual Literature Review: How technology and Consumer Behavior shape sustainable packaging

1. Consumers Perspective about Eco-Friendly packaging

A big part of whether sustainable packaging becomes popular depends on how people think about it. According to Boz, Korhonen, and Koelsch Sand (2020), even though many people say they care about the environment, they don't always

choose eco-friendly products. This happens because of things like confusion over labels, higher prices, or simply not knowing which option is better for the environment. This gap between what people say and what they do is called the **Attitude-Behavior Gap.**

A study in Romania by Orzan and Colleagues (2018) found that people do care about sustainability, by they often won't pay more for green packaging unless they clearly understand its benefits. So, **better communication and affordable prices** are needed to help more people make eco-friendly choices.

2. The bigger picture: Global Sustainability goals

Sustainable packaging is also a big part of international goals to protect the planet. Kozik (2020) explains that good packaging today must not only protect products but also be kind to the planet, cost-effective, and meet people's needs. The idea is that packaging should work well from start to finish – from making it, to using it, to recycling or disposing of it.

Ibrahim et al. (2022) add that we need to move away from plastics and use more **biodegradable or recyclable materials.** But even with these better options, we still face issues like poor waste management and lack of recycling facilities.

3. How AI is changing the game.

Artificial Intelligence (AI) is becoming a powerful tool in making packaging more sustainable. Zhu(2024) shows that AI helps companies design packaging that uses fewer materials and can be recycled more easily. This not only helps the environment but also saves time and money. Interestingly, younger shoppers in cities are more likely to spend eco-friendly packaging, showing a clear trend in changing values.

Hamdi (2024) shows how big brands like Nestle are using AI and other smart tech like Blockchain and RFID to make packaging more efficient and reduce plastic. Still, there are challenges like the cost of switching to these **technologies** and the need for more Public awareness.

Dobrucka (2024) points out that AI also helps during manufacturing by reducing waste and making production lines more efficient. Meanwhile, Zhang (2022) talks about how AI can track energy use and material choices to reduce pollution and support low-carbon packaging solutions. The downside is that these tools can be expensive and not easily available in rural or low-income areas.

4. What's Holding Us Back – and What's Next

Even though we're making progress, there are still things that make sustainable packaging hard to adopt everywhere. These include high costs, lack of awareness, weak recycling systems, and limited access to new technology. Moving forwards, we need more teamwork between companies, governments, and consumers research should focus on making eco-friendly options cheaper, smarter, and easier to use, especially for small businesses and communities outside big cities.

Thus, we can understand by the literature review that, both peoples' behavior and smart technology play a big role in shaping the future of packaging. While tools like AI are making big improvement, educating consumers and creating support systems are just as important. If we combine better tech with better understanding, we can create packaging that works for everyone-and for the planet too.

Statement of Problem

In today's world, we see a lot of packaging waste every time we but something-especially in supermarkets. In India, as more people start buying packaged goods, this waste is becoming a big problem for the environment. companies are now using artificial intelligence (AI) to design packaging that is eco-friendly and creates less waste. But many people still don't know about these changes.

This study looks at a simple but important question: Do Indian Shoppers know about AI-Driven sustainable packaging, and are they ready to pay a little more for it? It also tries to understand whether people's age, income, education, or the place they live (in a big city or in rural areas) affect their choices.

By finding answers to these questions, we can help businesses and governments promote better, greener packaging that people will actually support.

Research methodology

This study aims to understand how aware Indian supermarket shoppers are about AI-driven sustainable packaging and whether they are willing to pay extra for it. To explore this, a survey was carried out mainly in metro areas like Bengaluru, where people are generally more exposed to eco-friendly practices. A structured questionnaire was used to collect responses from 100 individuals with different age groups, educational levels, income brackets, and places of residence (rural and urban). The survey gathered basic demographic details along with questions about their awareness of sustainable packaging, their understanding of AI in packaging, and their willingness to pay extra for such options.

A random sampling method was used to keep the process unbiased. The collected data was analyzed using Ch-Square tests to see whether factors like age, income, education, or location influence consumer awareness or willingness to pay. The findings are presented through tables and graphs for better clarity.

Overall, this methodology helps reveal what drives consumer choices regarding eco-friendly packaging-and what barriers still exist to adoption AI-based sustainable solutions more widely.

Scope and Limitations of the Study:

This study focuses on understanding how aware Indian supermarket shoppers are about AI-driven sustainable packaging and whether they are willing to pay extra for it. The survey was conducted mainly among shoppers in Bengaluru (A metro City) and rural areas, which gives a good mix of urban and non-urban perspectives. However, like any research there are few limitations. First, the sample size was limited to 100 respondents, which gives useful insights but may not fully represent the entire Indian Population. The study also relied on self-reported answers – this means we measure what people say there are aware of or say they are willing to do, not what they actually buy or how they behave in real-life shopping situations.

In addition, the concept of Artificial Intelligence (AI) was not explained in great detail to participants. So when people responded about AI in Packaging, it was based on their existing level of understanding which could vary quite a bit. Finally, the study mainly focused on supermarkets and did not include other types of retail formats like local kirana stores or online platforms.

Despite these limitations, the research offers valuable

Objectives of the study

1. To assess consumer awareness of AI-driven sustainable packaging in Indian Supermarkets
2. To analyze the factors influencing consumer's willingness to pay extra for eco-friendly packaging.
3. To examine the relationship between key demographic factors and consumer awareness and willingness to pay for AI-driven sustainable packaging.
4. To evaluate the impact of AI-driven innovations on packaging sustainability and waste reduction.
5. To provide insights for businesses and policymakers on promoting AI-driven sustainable packaging solutions in India.

Demographics

Table 1: Demographic Profile of Respondents

		Frequency	Percent	Cumulative Percent
Age group of Respondents	Below 18	1	1	1
	18 to 25	61	61	62
	26 to 35	28	28	90
	36 to 50	8	8	98

	above 50	2	2	100
	Total	100	100	
Place	**Rural**	38	38	38
	Urban	62	62	100
	Total	100	100	
Highest Level of Education	**High School**	10	10	10
	Graduate	43	43	53
	Post-Graduate	47	47	100
	Total	100	100	
Monthly Household income	**Below Rs. 30,000**	43	43	43
	Rs.30,000 to Rs.60,000	33	33	76
	Rs.60,000 to Rs.1,00,000	14	14	90
	Above Rs.1,00,000	10	10	100
	Total	100	100	

1. Age group of Respondents:

Most of the respondents (61%) are between the ages of 18 to 25, showing that young adults form the major group in this survey. 28% are in the 26 to 35 age group, suggesting that millennials are also fairly represented. Very few respondents are above 36 years of age, with only 8% between 36 to 50 and 2% above 50. Just 1% below 18.

Inference: since most of the participants are young adults, the study mainly reflects the awareness and opinions of the younger generation, who are generally more open to tech-based and eco-friendly solutions.

2. Place of Residence:

62% of the respondents are from Urban Areas, while 38% are from rural areas.

Inference: This shows a good mix of urban and rural respondents, though urban opinions are slightly more dominant. This helps in comparing how location influences consumer awareness and behaviour toward sustainable packaging.

3. Education Level

47% of respondents are postgraduates, and 43% are graduates. Only 10% have completed just high school.

Inference: This majority of respondents are well-educated, which might influence higher awareness and a stronger understanding of eco-friendly and AI-driven Packaging concepts.

4. Monthly Household Income:

43% of the respondents have an income below Rs. 30,000, while 33% fall in the Rs.30,000 to Rs.60,000 range. Only 14% earn between Rs. 60,000 and Rs.1,00,000, and 10% earn above Rs. 1,00,000.

Inference: Most of the respondents come from lower to middle-income households, which will help you understand how affordability affects the willingness to pay extra for sustainable packaging. This income distribution can also reflect the real-life budget constraints many Indian families face.

Frequency Analysis

Table 2: Consumer Awareness About Sustainability and AI in Packaging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	88	88.0	88.0	88.0
	No	12	12.0	12.0	100.0
	Total	100	100.0	100.0	

Interpretation: out of 100 people surveyed, 88 people (88%) said Yes, they are aware of Sustainable packaging. Only 12 people (12%) said No, they are not aware of it.

Inference: This clearly shows that most shoppers are already familiar with the idea of Eco-Friendly or sustainable packaging. That's a positive sign because awareness is the first step toward encouraging people to choose greener options. However, the fact that 12% of people still don't know about it means there's room for improvement. This highlights the need for better consumer education and awareness campaigns, especially in areas or age groups where awareness may be low. This level of awareness also suggests that many shoppers are ready to accept or consider AI-driven sustainable packaging, which is promising for businesses and policymakers working on green solutions.

Table 3: Awareness about Eco-Friendly Packaging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	91	91.0	91.0	91.0
	No	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

Interpretation: Among 100% respondents, 91% said they are aware of eco-friendly packaging. Only 9% said they are not aware of it.

Inference: the high awareness rate (91%) shows that eco-friendly packaging is no longer a new concept for most Indian supermarket shoppers-especially in metro areas like Bengaluru. This growing awareness reflects a shifting mindset toward sustainability, and it sets the stage for deeper acceptance of AI-driven innovations in packaging. However, awareness alone in not enough. For AI-Powered sustainable packaging to truly make an impact, awareness must translate into action. This is where your study becomes crucial-by exploring whether this awareness is supported by a willingness to pay more or make conscious choices. This insight also suggests that consumers are ready for the next step: understanding how AI enhances eco-friendly packaging and how these smart solutions can benefit both the environment and their everyday lives. Brands and policymakers can build on this momentum by integrating AI messaging into their sustainability campaigns, making tech-driven eco-packaging feel both relatable and reliable.

Table 4: Awareness about usage of AI in Packaging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	82	82.0	82.0	82.0
	No	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

Interpretation: out of 100 respondents, 82% are aware that artificial intelligence is being used in packaging. The remaining 18% are not aware of AI applications in this Area

Inference: an awareness level of 82% indicates that AI in packaging is gaining visibility among Indian consumers, especially in urban area. This is a promising sign because it shows that people are becoming more conscious not just of sustainability, but also of the technology driving it forward. Consumers are starting to recognize that AI is not just about robots or automation-its also about creating smarter, greener packaging solutions that reduce waste and environmental harm. However, the 18% unaware signals a clear opportunity. For AI-based sustainable packaging to be widely adopted, more efforts are needed to bridge the knowledge gap, especially in rural and semi-urban areas. This aligns with the study objective of examining how demographics influence awareness and adoption.

The insight reinforces the importance of transparent communication from brands and policymakers. When consumers understand how AI contributes to eco-friendly outcomes – like using less plastic, smarter material choices, or efficient designs-they're more likely to support and invest in it. The research helps highlight this bridge between technological innovation and public awareness, making it easier for sustainability efforts to succeed.

Table 5: Belief that Sustainable packaging Reduces waste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	95	95.0	95.0	95.0
	No	5	5.0	5.0	100.0
	Total	100	100.0	100.0	

Interpretation: The survey results indicated that 95% of the respondents believed that sustainable packaging contributes to waste reduction, whereas only 5% did not share this belief. This shows a high level of public trust in the environmental benefits associated with sustainable packaging practices.

Inference: this strong belief among consumers reinforces the relevance of promoting AI-integrated sustainable packaging solutions. When the public perceives eco-friendly packaging as a genuine method to reduce environmental waste, it creates a positive attitude and openness towards innovation in the packaging industry. The insight is aligned with the objectives of this study, emphasizing that consumer perception plays a vital role in the success of sustainable technology. Such high levels of belief in the efficacy of sustainable packaging indicate that introducing AI-driven innovations will likely receive public support, especially if these technologies are communicated as tools to enhance waste reduction and ecological responsibility. This trust also presents an opportunity for retailers, manufacturers, and policymakers to invest more confidently in sustainable design systems powered by AI.

Table 6: Awareness about existing Brands using AI sustainable packaging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	57	57.0	57.0	57.0
	No	43	43.0	43.0	100.0
	Total	100	100.0	100.0	

Interpretation: The analysis showed that 57% of the respondents were aware that some brands are already using AI-based sustainable packaging, while the remaining 43% were not aware of such developments. This suggests a moderate level of awareness regarding brand-level adoption of AI for sustainability.

Inference: while more than half of the respondents recognize that companies are implementing AI in sustainable packaging, the fact that a significant 43% remain unaware points to a communication and visibility gap. This gap could slow down the consumer-driven momentum needed to make AI-Powered packaging a mainstream practice. From research point, this insight reinforces the need for better information flow from brands to consumers, even though companies like Flipkart, Amazon India, and Nestle have taken major steps in this direction, these efforts may not be sufficiently highlighted in public-facing platforms or retail environments. For AI-driven sustainability to gain deeper consumer support, it is essential that these initiatives are made more visible and relatable. This finding also aligns with the study's broader objectives, emphasizing that consumer education and transparency are critical elements in promoting sustainable innovation. Increasing awareness about brand practices can build trust, influence purchase behaviour, and encourage consumers to make more conscious informed choices in support of environmental sustainability.

Table 7: Preference for eco-friendly packaging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	99	99.0	99.0	99.0
	No	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Interpretation: the survey findings revealed an overwhelming majority-99% of the respondents-expressed a preference for eco-friendly packaging, while only 1% indicated otherwise. This near-unanimous result reflects a strong consumer inclination toward environmentally sustainable options in the retail packaging space.

Inference: this result highlights a clear and powerful shift in consumer values, where environmental responsibility is not just acknowledged but actively preferred in purchasing decisions. The near-total agreement on eco-friendly packaging preference suggests that the market is primed for innovation, particularly through the integration of AI-driven sustainable packaging solutions. For businesses and policymakers, this serves as a critical insight: there is already an existing demand base that supports eco-conscious choices. With such a high level of preference, efforts to introduce or scale AI-powered, sustainable packaging technologies are likely to be met with enthusiastic consumer reception, especially if they maintain affordability and accessibility.

Furthermore, this preference aligns strongly with the research objectives by affirming that consumer sentiment is a major driving force behind the future of sustainable retail packaging in India. Capitalizing on this positive attitude through targeted communication and transparent implementation of AI Solutions could significantly accelerate progress toward greener, smarter and retail ecosystems.

Table 8: Willingness to pay Extra

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5% More	47	47.0	47.0	47.0
	10% More	24	24.0	24.0	71.0
	15% More	11	11.0	11.0	82.0
	Not willing to pay	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

Interpretation: The responses indicate that 82% of participants are willing to pay an additional amount for eco-friendly packaging. Specifically, 47% are comfortable paying up to 5% more, 24% up to 10% more, and 11% up to 15% more. However, 18% of respondents stated that they are not willing to pay any extra cost for such packaging.

Inference: This data provides a compelling insight into the price sensitivity and environmental commitment of India supermarket consumers. The fact that a substantial majority are ready to bear some level of additional cost – even if modest demonstrates a strong willingness to support sustainable choices, provided they are reasonably priced. This finding is directly relevant to the study's objective evaluating consumer willingness to invest in AI-driven sustainable packaging.

The preference for affordability, with a majority leaning toward smaller cost increases (5-10%) signals that cost-effective implementation of AI technologies will be essential for widespread acceptance. For businesses and policymakers, this suggests a strategic direction: introducing eco-friendly packaging innovations that are incremental in cost but high in impact. Communicating the long-term environmental benefits alongside the minimal financial trade-offs can help convert even hesitant consumers into supporters.

Moreover, 18% unwilling to pay extra represents a segment that may need greater awareness and value demonstration – indicating that education, transparency, and possibly incentive based approaches will be key in achieving universal buy-in for sustainable retail solutions.

Table 9: Support for Mandatory Use of Sustainable packaging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	96	96.0	96.0	96.0
	No	4	4.0	4.0	100.0
	Total	100	100.0	100.0	

Interpretation: The data indicated that 96% of respondents are in Favor of making sustainable packaging mandatory, while only 4% oppose the idea. This shows near-universal agreement among consumers on the need for enforce adoption of eco-friendly practices in packaging.

Inference: this strong consensus reflects a societal readiness for policy-level changes in how retail packaging is regulated in India. Consumers are not only aware of environmental concerns but are also willing to support stricter regulations to ensure sustainable practices are followed by all brands-regardless of cost or convenience.

This also algins with the study's purpose of offering insights to businesses and policymakers. With 96% consumer support, the regulatory environment is likely to face minimal resistance if sustainability measures become compulsory. It also sends a clear message to retailers: sustainability is not just a trend-it is a consumer expectation that may soon become a compliance standard.

Furthermore, this high level of support also strengthens the case for AI integration in packaging processes. As AI makes packaging smarter, lighter and greener, the combination of technology and regulation can work together to drastically reduce packaging waste. The public backing for mandatory adoption reinforces that the time for voluntary action is over-consumers now expect systemic change.

Table 10: Biggest Barrier to AI Sustainable packaging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lack of Awareness	31	31.0	31.0	31.0
	High Cost	39	39.0	39.0	70.0
	Limited Availability	8	8.0	8.0	78.0
	Doubts About effectiveness	22	22.0	22.0	100.0
	Total	100	100.0	100.0	

Interpretation: When asked about the primary barrier to adopting AI-driven sustainable packaging, 39% of respondents identified high cost as the biggest challenge. This was followed by lack of awareness (31%), doubts about its effectiveness (22%), and limited availability (8%).

Inference: The results clearly indicate that cost remains the most significant hurdle in the widespread adoption of AI-based sustainable packaging solutions. Even though the public is increasingly environmentally conscious, financial concerns still dominate decision-making, especially in a price-sensitive market like India. The second major barrier-lack

of awareness – underscores a pressing need for consumer education and transparent communication from brands and policymakers. Many consumers may not fully understand how AI contributes to sustainability or why its worth the investment, leading to hesitation or scepticism.

Interestingly, 22% of respondents are uncertain about the effectiveness of such packaging. This highlights a trust gap that must be bridged through data backed demonstrations, labelling transparency, and third-party endorsements. Although limited availability is the least cited barrier, it still indicates that access to eco-friendly packaging powered by AI may be concentrated in urban or premium segments, leaving other regions underserved.

Altogether, this insight supports the research objective of identifying what influences consumer behaviour and what structural barriers must be addressed. For sustainable packaging to become mainstream, cost-reduction strategies, educational campaigns, and scalable AI Solutions must go hand in hand. This also provides a roadmap for stakeholders: focus on making AI innovations affordable, accessible, and trustworthy, especially for everyday supermarket shoppers in both metro and rural India.

Hypothesis Statements:

1. Association Between place of residence and Awareness of AI-Driven Sustainable packaging

H0 (Null Hypothesis): There is no significant association between place of residence and awareness about AI in sustainable packaging.

H1 (Alternative Hypothesis): There is a significant association between place of residence and awareness about AI in sustainable packaging.

Variables Used: Place of Residence (Independent variable) and Awareness of AI in Sustainable Packaging (Dependent Variable)

Type of Area * Aware AI is Used in Packaging Crosstabulation

Count

		Aware AI is Used in Packaging		
		Yes	No	Total
Type of Area	Rural	36	2	38
	Urban	46	16	62
Total		82	18	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.736[a]	1	.009		
Continuity Correction[b]	5.416	1	.020		
Likelihood Ratio	7.801	1	.005		
Fisher's Exact Test				.014	.007
Linear-by-Linear Association	6.669	1	.010		
N of Valid Cases	100				

Interpretation: This result shows that where a person lives – whether in a rural or urban area, has a real connection to their awareness of AI in sustainable packaging. The P-Value of 0.009 is less than 0.05, which means this result is statistically significant. In other words, people living in rural and urban area do not have the same level of awareness – the difference is meaningful and not random.

Since the P-Value is below 0.05, we reject the null hypothesis and accept alternative hypothesis, which says that there is a significant association between place of residence and awareness of AI-driven sustainable packaging.

2. The relationship between income level and willingness to pay for AI-Based Sustainable Packaging

H0 (Null Hypothesis): There is no significant relationship between income level and willingness to pay extra for AI-Based sustainable Packaging.

H1 (Alternative Hypothesis): There is a significant relationship between income level and willingness to pay extra for AI-Based sustainable Packaging.

Variables Used: Income Level (Independent variable) and Willingness to pay extra (Dependent Variable)

Monthly Household income * Willingness to pay Crosstabulation

Count

		Willingness to Pay		
		Yes	No	Total
Monthly Household income	Below Rs. 30,000	30	13	43
	Rs.30,000 to Rs.60,000	30	3	33
	Rs.60,000 to Rs.1,00,000	12	2	14
	Above Rs.1,00,000	10	0	10
Total		82	18	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.460[a]	3	.037
Likelihood Ratio	9.987	3	.019
Linear-by-Linear Association	6.135	1	.013
N of Valid Cases	100		

Interpretation: The chi-square test showed a statistically significant relationship between income level and Willingness to pay extra for AI-Based Sustainable packaging. The likelihood ratio and linear-by-linear association tests also confirmed this significant relationship (P=0.019 and p=0.013, respectively)

Since the P-Value (0.037) is significantly less than the 0.05 significance level, we reject the null hypothesis and accept the alternative hypothesis (H1). Which says There is a significant relationship between income level and willingness to pay extra for AI-Based sustainable Packaging. This means that income level influences willingness to pay for AI-Based sustainable packaging.

3. Type of Area Vs. Willingness to pay extra for sustainable packaging

H0 (Null Hypothesis): There is no significant relationship between place of residence and willingness to pay extra for AI-Based sustainable Packaging.

H1 (Alternative Hypothesis): There is a significant relationship between place of residence and willingness to pay extra for AI-Based sustainable Packaging

Variables Used: Place of Residence (Independent variable) and Willingness to pay extra (Dependent Variable)

Type of Area * Willing to pay Extra Crosstabulation

Count

		Willing to pay Extra				
		5% More	10% More	15% More	Not willing to pay	Total
Type of Area	Rural	19	11	7	1	38
	Urban	28	13	4	17	62
Total		47	24	11	18	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.853[a]	3	.008
Likelihood Ratio	14.142	3	.003
Linear-by-Linear Association	3.232	1	.072
N of Valid Cases	100		

Interpretation: The Chi-Square value is 11.853, with a P-Value of 0.008. the likelihood ratio test also shows a p-value of 0.003, which supports the rejection of the null hypothesis. The linear-by-linear association test shows a p-value of 0.0072, which is slightly above 0.05, but this doesn't affect the overall result since the Pearson chi-square and like hood ratio tests both show significant results.

Since P-Value is 0.008, we conclude that there is a significant relationship between the type of area and the willingness to pay extra for AI-Based sustainable packaging. This suggests that individual's willingness to pay extra for sustainable packaging differs based on whether they live in urban or rural areas.

4. Awareness about Sustainable Packaging Vs. Willingness to pay extra for sustainable packaging

H0 (Null Hypothesis): There is no significant relationship between having heard of sustainable packaging and willingness to pay extra for AI-Based sustainable Packaging.

H1 (Alternative Hypothesis): There is a significant relationship between having heard of sustainable packaging and willingness to pay extra for AI-Based sustainable Packaging.

Variables Used: Awareness about Sustainable packaging (Independent variable) and Willingness to pay (Dependent Variable)

Heard of Sustainable Packaging * Willingness to pay Crosstabulation

Count

		Willingness to pay		
		Yes	No	Total
Heard of Sustainable Packaging	Yes	75	13	88
	No	7	5	12
Total		82	18	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.175[a]	1	.023		
Continuity Correction[b]	3.513	1	.061		
Likelihood Ratio	4.279	1	.039		
Fisher's Exact Test				.038	.038
Linear-by-Linear Association	5.123	1	.024		
N of Valid Cases	100				

Interpretation: The Chi-Square value is 5.175, with a P-Value of 0.023. the likelihood ratio test also shows a p-value of 0.039, which supports the rejection of the null hypothesis. The linear-by-linear association test shows a p-value of 0.024, further reinforcing the result that there is a significant relationship.

Since P-Value is 0.023, we conclude by accepting alternative hypothesis which says There is a significant relationship between having heard of sustainable packaging and willingness to pay extra for AI-Based sustainable Packaging. This means the people who are aware of sustainable packaging are more likely to pay extra for products with AI-based sustainable packaging.

5. Biggest barrier to AI Sustainable Packaging Vs. Willingness to Pay Extra

H0 (Null Hypothesis): There is no significant relationship biggest barrier to AI Sustainable packaging and willingness to pay extra for AI-Based sustainable Packaging.

H1 (Alternative Hypothesis): There is a significant relationship biggest barrier to AI Sustainable packaging and willingness to pay extra for AI-Based sustainable Packaging.

Variables Used: Biggest Barrier to AI Sustainable Packaging (Independent variable) and Willingness to pay (Dependent Variable)

Biggest Barrier to AI Sustainable packaging * Willing to pay Extra Crosstabulation

Count

		Willing to pay Extra				
		5% More	10% More	15% More	Not willing to pay	Total
Biggest Barrier to AI Sustainable packaging	Lack of Awareness	16	10	0	5	31
	High Cost	21	6	5	7	39
	Limited Availability	5	3	0	0	8
	Doubts About effectiveness	5	5	6	6	22
Total		47	24	11	18	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.660[a]	9	.028
Likelihood Ratio	23.279	9	.006
Linear-by-Linear Association	4.529	1	.033
N of Valid Cases	100		

Interpretation: The Pearson chi-square value of 18.660 with a p-value of 0.028 is less than 0.05, indicating that we reject the null hypothesis. The likelihood ratio test also supports this with a p-value of 0.006, showing strong significance. The linear-by-linear association test has a p-value of 0.033, reinforcing the conclusion of a significant association. So, we are accepting Alternative hypothesis which says There is a significant relationship biggest barrier to AI Sustainable packaging and willingness to pay extra for AI-Based sustainable Packaging. This means that consumers who view cost or doubts about effectiveness as barriers tend to vary more in their willingness to pay.

Association between Education level and preference for Eco-Friendly packaging

H0 (Null Hypothesis): There is no significant relationship between education level and preference for eco-friendly packaging.
H1 (Alternative Hypothesis): There is a significant relationship between education level and preference for eco-friendly packaging.

Variables Used: Education Level (Independent variable) and Preference for Eco-Friendly Packaging (Dependent Variable)

Highest Level of Education * Prefer eco-friendly packaging Crosstabulation

Count

		Prefer eco-friendly packaging		
		Yes	No	Total
Highest Level of Education	High School	10	0	10
	Graduate	42	1	43
	Post-Graduate	47	0	47
Total		99	1	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.339[a]	2	.512
Likelihood Ratio	1.701	2	.427
Linear-by-Linear Association	.316	1	.574
N of Valid Cases	100		

Interpretation: The P-Value here is 0.512, which is much greater than 0.05. this means that the differences in eco-friendly packaging preference are not statistically significant across education levels. So, people with different educational levels (High School, graduate and Postgraduate) seem to have similar attitudes toward preferring eco-friendly packaging – there's no strong evidence of a relationship here.

Since P-Value is greater than 0.05, we fail to reject the null hypothesis. Which means, there is no significant relationship between education level and preference for eco-friendly packaging.

Discussion

Findings of the Study:

1. Urban Consumers know more about AI Packaging:
82% of respondents were aware that AI is being used in sustainable packaging, but rural consumers lag behind. Urban areas are leading the awareness curve. A-chi-square test confirmed a significant relationship (p=0.009) between place of residence and awareness. This highlights a clear urban-rural knowledge gap that businesses and educator need to bridge.

2. Income strongly influences willingness to pay:
Higher-Income groups are more willing to pay extra for AI-Based sustainable packaging. A significant relationship (p=0.037) was found between monthly income and willingness to pay extra. People earning more than Rs. 60,000 per month showed greater openness. Affordability is still a major factor in decision-making for many shoppers.

3. **Urban residents are more ready to pay extra:**People in living gin urban areas showed willingness to pay more for sustainable packaging. The place of residence and willingness to pay were significantly related (p=0.008). urban

consumers are not only more aware but also more willing to act on that awareness-perhaps due to better exposure and accessibility.

4. **Awareness Drives willingness to pay:**
Among those who had heard of sustainable packaging, 85% were willing to pay extra. This strong statistical relationship (p=0.023) shows that knowledge changes behavior. The more people understand what sustainable packaging is, the more likely they are to support it financially.

5. Cost is the biggest Barrier:
39% of respondents said high cost is the main reason they hesitate to support AI-based eco-packaging. Although people want to help the planet, many simply can't afford higher prices. Businesses must find ways to make sustainable options more cost-effective to reach mainstream adoption.

6. Lack of Awareness is the second Biggest Barrier:
31% said they don't know enough about AI-Based sustainable packaging. Despite High general awareness, detailed understanding of how AI contributes to sustainability is still missing for a big chunk of the population – especially in rural or lower-income segments.

7. Consumers trust that sustainable packaging reduces waste.
A strong 95% of people believe sustainable packaging helps in reducing environmental waste. This overwhelming trust creates a huge opportunity for businesses to connect their packaging strategies to consumer values. the public is already mentally on board.

8. **Consumers Prefer Eco-Friendly Packaging:**
An incredible 99% said they prefer eco-friendly packaging. This shows that environmental values are now mainstream. The market is ready for green alternatives – what's missing is pricing, availability, and better communication.

9. **Most Consumers are willing to pay a little extra:**
82% said they are willing to pay extra 5-15% more for sustainable packaging. While there is a price sensitivity, most consumers are open to paying a bit more-especially if they understand the environmental benefits. This opens doors for affordable innovation.

10. **Education level doesn't impact preference:**
The study found no significant relationship (p=0.512) between education and preference for eco-friendly packaging. This is powerful-it suggests that love for the environment cuts across educational levels. Its not just the educated elite who care. Sustainability has become a shared public value.

Suggestions

a. For Businesses

1. Make Sustainable Pakcaging Affordable and scalable:
The biggest barrier for consumer is cost. 39% said higher pricing keeps them away from choosing eco-friendly options. Businesses can use AI to redesign packaging that uses less material while staying strong and attractive. This helps reduce raw material costs and makes sustainable packaging price-competitive. Economies of scale will make this more affordable over time -especially if local suppliers are involved,

2. Show, don't just Tell – Highlight Environmental Benefits clearly:
95% of people in the study believe sustainable packaging helps the planet. So, show how packaging reduces, plastic, cuts emissions, or save trees. Use simple language, icons, or short videos – maybe even a QR code on the package that talks about the brand's sustainability story. This builds trust and reinforces the consumer's decision to choose the product.

3. Bridge the Knowledge Gap with Smart Communication

While many People know the term "Sustainable Packaging", fewer understand how AI is part of it. This is where the marketing can shine. In stores, by using standees, product tags, or short demo screens to show how AI helps reduce waste or optimize materials. This helps build loyalty – especially in young urban consumers who are tech-aware

4. Start in Cities, Expand to rural markets with tailored strategies:

Urban customers are currently more aware and willing to pay extra, but rural areas are catching up, and 38% of your potential market is already there. By using community-driven approaches, like pop-up demos, local influences, or educational retail assistants, to slowly introduce eco-packaging benefits in rural spaces.

5. Collaborate with Startups and Local Innovators:

India's packaging innovation space in booming. Partnering with AI or Sustainable material startups to co-create packaging solutions that are smart, stylish, and eco-conscious. It will help in aligning with India's "Make in India" and "Green India" goals.

b. For Consumers:

1. Need for improved access to information at point of purchase:

The study observed that while awareness of sustainable packaging was relatively high, a significant number of consumers lacked clarity on how AI contributes to such innovations. It was therefore recommended that access to product-related information be improved through clear labeling, in-store materials, or digital tools. Enhances transparency may empower consumers to make environmentally conscious choices more confidently.

2. Encouraging Behavior that Drives market change:

It was reported that consumer preferences have a direct influence on business practices. The widespread inclination toward eco-friendly packaging, as revealed by the findings suggested that individual purchasing choices could collectively steer companies toward adopting sustainable packaging solutions. Promoting such behavior was considered essential for accelerating environmentally responsible innovation within the retail sector.

3. Promoting informal knowledge sharing within communities:

The study further noted the potential of peer influence in expanding awareness. Consumers who are knowledgeable about eco-friendly packaging practices could contribute to broader behavioral shifts by sharing their understanding withing families, peer groups, and local communities. Informal advocacy was identified as a useful complement to formal awareness campaigns, particularly in regions where structured outreach may be limited.

c. For Policymakers:

1. Provision of Financial Incentives to Businesses:

The findings indicated that high implementation costs remained a key barrier to adopting AI-driven sustainable packaging. To address this, it was suggested that government bodies provide financial incentives succah as subsidies, tax relief, or grants to companies investing in eco-packaging technologies. Such support could facilitate broader adoption across both large and small enterprises.

2. **Implementation of National Awareness Campaigns:**

Given that a portion of the population remained unaware of AI applications is packaging, the study recommended the launch of comprehensive public education campaigns. These campaigns could be disseminated through schools, television, social media, and community centers, particularly targeting semi-urban and rural populations to reduce the knowledge gap.

3. **Development of Gradual regulatory frameworks:**As the data revealed strong public support (96%) for mandatory sustainable packaging, it was advised that policymakers consider introducing phased regulations. Initial implementation could begin with urban retailers and be expanded progressively. Standards related to eco-packaging definitions and labelling were also considered necessary to ensure clarity and consistency across the industry.

4. Strengthening of recycling and waste Management infrastructure:
The research acknowledged that even with sustainable packaging materials, the absence of robust recycling systems limits environmental benefits. Policymakers were therefore encouraged to invest in infrastructure that supports collection, segregation, composting, and recycling of eco-packaging, especially in underserved areas. Enhancing this backend system would maximize the impact of front-end sustainable packaging efforts.

Further Scope of Study:

While this study offers valuable insights into consumer awareness and willingness to support AI-Driven sustainable packaging, several areas remain open for further research. Future studies could adopt a longitudinal approach to observe how awareness and willingness to pay evolve over time, especially as exposure to sustainable products increases. It would be useful to explore the gap between consumer attitudes and actual behavior – for example, whether people who say they support eco-friendly packaging consistently follow through with their purchasing decisions. Another important direction could involve brand-specific studies that examine ho the reputation or visibility of a company affects consumer trust and willingness to pay more for sustainable packaging. Finally, researchers could focus more deeply on rural regions, identifying the unique challenges faced in these areas and developing localized strategies for promoting AI-based sustainable packaging in communities that may have lower access to technology or awareness programs. These future efforts would help create a more comprehensive understanding of consumer behavior and support wider adoption of sustainable packaging solutions across India.

Conclusion:

The findings of this study clearly show that Indian Supermarket consumers, especially those in urban areas, are increasingly aware of an open to supporting AI-Driven sustainable packaging. A Majority of respondents not only preferred eco-friendly packaging but also expressed a willingness to pay a little extra for it, indicating a positive shift in consumer values toward environmental responsibility. Importantly, factors such as income level, place of residence, and awareness levels were found to significantly influence this willingness, while education level did not have a strong impact – suggesting that sustainability is becoming a shared concern across different segments of society. The study also highlighted key challenges, including high costs and limited awareness, which need to be addressed for sustainable packaging to reach its full potential. By combining innovative AI Technology with strong consumer education, affordable pricing, and supportive government policies, India has the opportunity to lead in making retail packaging more eco-friendly. The research contributes meaningful insights for Businesses, policymakers, and future scholars who are working to create more sustainable and conscious consumer markets.

References:

1. Boz, Z., Korhonen, V., & Koelsch Sand, C. (2020). Consumer considerations for the implementation of sustainable packaging: A review. *Sustainability, 12*(6), 2192. https://doi.org/10.3390/su12062192

2. Orzan, G., Cruceru, A. F., Bălăceanu, C. T., & Chivu, R.-G. (2018). Consumers' behavior concerning sustainable packaging: An exploratory study on Romanian consumers. *Sustainability, 10*(6), 1787. https://doi.org/10.3390/su10061787

3. Kozik, N. (2020). Sustainable packaging as a tool for global sustainable development. *SHS Web of Conferences, 74*, 04012. https://doi.org/10.1051/shsconf/20207404012

4. Ibrahim, I. D., Hamam, Y., Sadiku, E. R., Ndambuki, J. M., Kupolati, W. K., Jamiru, T., Eze, A. A., & Snyman, J. (2022). Need for sustainable packaging: An overview. *Polymers, 14*(20), 4430. https://doi.org/10.3390/polym14204430

5. Zhu, A. (2024). Design and research of green concept product packaging based on artificial intelligence technology. *Applied Mathematics and Nonlinear Science, 9*(1), 1–14.

6. Hamdi, M. (2024). Sustainable packaging trends in the consumer packaged goods market. *Harvard University*. https://www.researchgate.net/publication/383608198

7. Dobrucka, R. (2024). The future of artificial intelligence in packaging industry. *Management and Quality – Zarządzanie i Jakość, 6*(3), 34–40.

8. Zhang, S. (2022). Research on energy-saving packaging design based on artificial intelligence. *Energy Reports, 8*, 480–489. https://doi.org/10.1016/j.egyr.2022.05.069