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A Comprehensive Study of Customer Awareness and Perception towards Bamboo-Based Packaging

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Abstract:

Sustainable packaging refers to the use of materials and design methods that minimize negative environmental impact and maximize long-term economic and social benefits. Now the world has started paying attention towards the use of green packaging material which have the characteristics of being reusable, recyclable, biodegradable, renewable, and easily waste management and low energy consumption.

Since ages, Bamboo has proved to be an efficient and effective sustainable raw material offering multiple applications for the rural communities. As per the Guinness book of record, certain species of Bamboo are the fastest growing plant in the world which makes it an excellent tool in mitigating climate change by absorbing CO2 from the atmosphere, thereby reducing greenhouse gas levels. It can sequester around 12 tons of CO2 per hectare per year and releases about 20% more oxygen than an equivalent hardwood trees. This is because bamboo requires minimal water supply, almost no pesticides, grows very fast and regenerates rapidly after being harvested.

For conducting this research, Primary data has been collected through the use of structured questionnaire through the google form. In the research study, five-point Likert-type scale is used, anchored by “Not at All Aware” to “Extremely Aware” for studying the customer awareness and another Likert-type scale anchored by “Strongly Disagree” to “Strongly Agree” for understanding their perception towards the bamboo-based packaging. For Secondary data collection various literature sources have been referred.

As per the data analysis, it was found that most of the respondents are not aware of the inherent potential characteristics of Bamboo plant. As the customers are being made aware of characteristics of bamboo, most of them showed their interest towards the use of bamboo as a raw material for packaging which will be a good replacement for the non-biodegradable materials like plastic.

Hence, as a researcher I would say that further studies about the properties of this plant leads to more opportunities unwrapping further ecofriendly innovations in various fields, including packaging.

Keywords: Bamboo, Packaging, Ecofriendly, Customer Perception,

1. Introduction:

Bamboo is a fast-growing, highly renewable and sustainable resource that has been used for centuries and is gaining popularity in various applications due to its eco-friendliness and the availability of bamboo in abundance in our country. It is being considered as the Green Gold for the unique characteristics it possesses.
Bamboo-based packaging offers several advantages, including biodegradability, durability, and versatility. Bamboo packaging can be made from bamboo fibers, pulp, paper, or composite materials, and can offer advantages such as biodegradability, recyclability, lightness, strength, and aesthetic appeal. This research report aims to explore the customer awareness and their perception towards the bamboo-based packaging.
Bamboo-based packaging is becoming increasingly popular due to its numerous unique benefits, including its eco-friendliness, biodegradability, renewability, durability, and versatility and its potential to replace traditional packaging materials such as plastic, paper, and metal.

2. Literature Review:

(Pratima, J., & Purrahoo, A., 2022) explored the production of paper from bamboo biomass and its physical and mechanical characteristics. It also shows how to produce value added materials, such as envelopes, paper bags, and holders, from bamboo paper. The paper uses the different process as the chemical pulping method and evaluates the properties of the paper, such as thickness, bursting index, water absorbency, and crease recovery.

(Borowski et al., 2022) investigated the use of bamboo in different industrial sectors, including construction and energy, to highlight its mechanical properties, resources, and innovative use through information gathered from Ethiopia, Guinea, and Georgia (Caucasus) as study cases. The paper also discusses the challenges and opportunities for bamboo development, such as policy, regulation, and governance, as well as the environmental and social benefits of bamboo.

(Kalpana, S., et al., 2019) discussed the latest trends and applications of intelligent packaging in the food industry. It covers the use of advanced technology to improve the safety, quality, and shelf life of food products. The potential benefits of intelligent packaging in reducing food waste and providing real-time information to consumers are also explored. Overall, the article provides insights into the potential impact of intelligent packaging on the food system.

(Dhiman, G., Sharma, D., & Sharma, A, 2023) The article discusses the latest trends and applications of intelligent packaging in the food industry. It covers the use of advanced technology to improve the safety, quality, and shelf life of food products. The potential benefits of intelligent packaging in reducing food waste and providing real-time information to consumers are also explored. Overall, the article provides insights into the potential impact of intelligent packaging on the food system.

(Pande, S. K., & Pandey, S. 2008) The research paper discusses the potential of bamboo as a sustainable resource for the 21st century. It is being seen as a sustainable and versatile material that can be used in various industries and applications. The focus is on utilizing bamboo's potential for its strength, flexibility, and eco-friendly properties to address current and future challenges.
Bamboo is one of the fastest growing plants and can play an important role in addressing issues like global warming, poverty and sustainable development. Bamboo grows widely in many parts of the world and has potential to provide both economic opportunities and environmental benefits.

(Kruschwitz, N. 2012) Dell has introduced environmentally-friendly packaging by utilizing bamboo and mushrooms. This new packaging approach aims at reducing the company's carbon footprint and is part of Dell's commitment to sustainability. The use of bamboo and mushrooms as packaging material allows for reduced reliance on traditional plastic packaging, thereby contributing positively to the environment.

(Cai, N. N. 2012) The article discusses the feasibility of using bamboo as a material for green packaging. It explores the advantages of bamboo, such as its renewability, biodegradability, and strength, making it a suitable alternative to traditional packaging materials. The study also examines the potential environmental impact and economic feasibility of using bamboo for packaging. Overall, the article aims to highlight the potential of bamboo as a sustainable solution for green packaging.

(Xu, D., He, S., Leng, W., Chen, Y., & Wu, Z. 2023) highlighted that bamboo-fiber-reinforced polymer composites offer a promising sustainable solution for various applications, leveraging the eco-friendly properties of bamboo while addressing the need for greener materials in various industries. Bamboo is being explored as a sustainable solution for food packaging due to its abundance, rapid growth, and biodegradability. It offers a strong and flexible material that is also naturally antimicrobial, making it a great option for protecting food products. As the world seeks more eco-friendly alternatives, bamboo presents itself as a promising option for the future of food packaging.

(Zhang, X., & Dong, F. 2020) reviewed 47 studies published between 1990 and 2014 that examined factors influencing consumers' green purchase decisions and as per the findings, Attitudes is significant predictor of green purchase intentions and behaviors. Consumers with more positive environmental attitudes were more likely to make green purchases.
Perceived consumer effectiveness, which is the degree to which consumers believe their actions can make a difference, also impacted green purchase decisions. Socio-demographics like age, income and education influenced green purchases in some studies. Younger, richer and more educated consumers tended to buy more green products. Perceived quality and performance risks with green products prevented some consumers from purchasing them. Consumers were unwilling to pay higher prices for environmental benefits alone.

3. Research Methodology

3.1 Need/importance of the study

The importance of using green material for packaging is to bring sustainability in packaging that caters to the needs of the present requirements without compromising the existence of future generations to meet their own needs.
Bamboo is one of the fastest-growing plants, with some species growing up to 91 cm in 24 hours. It can be harvested within 5-7 years compared to hardwood trees, which take up to 20-30 years to mature. Bamboo can regrow after being harvested, making it a highly sustainable resource. It is biodegradable, compostable, and renewable and has a lower carbon footprint compared to other packaging materials like plastic and paper. Its unique features make it an ideal choice for packaging, and more companies are turning to it as an alternative to traditional packaging materials. Bamboo-based packaging is an ideal choice for food packaging as it is naturally anti-bacterial and can keep food fresh for longer periods. Additionally, bamboo-based packaging can be used for cosmetics packaging as it is eco-friendly and can be easily recycled. Bamboo-based shipping boxes are also gaining popularity as they are durable, lightweight, and can be easily transportable.

Hence, it provides an eco-friendly, versatile, durable, cost-effective, and sustainable option for packaging products.

3.2 Objectives of the study

To study the consumer awareness for the use of Bamboo Based packaging.

To analyze the customer perception towards the use of bamboo-based packaging.

3.3 Sampling Design

Descriptive research design and non-probability-based convenience sampling method has been used for data collection.

3.4 Methods of Data Collection

For conducting this research, a structured questionnaire was designed to collect the responses and sample of 106 respondents has been taken for data analysis. The structured questionnaire poses a set of questions designed to assess consumer awareness and their perception towards bamboo-based packaging.

3.5 Research Tools

Microsoft Excel and Jamovi has been used to analyze and interpret the data. Descriptive studies and factor analysis have been performed to understand the consumer awareness and their perception towards bamboo-based packaging.

4. Data Analysis:

4.1 Demographic profile of the respondents:

Age	15yr-20yrs	6	5.7%
	21yrs-30yrs	25	23.6%
	31yrs-40yrs	41	38.7%
	Above 40 yrs	34	32.0%
Gender	Male	42	39.6%
	Female	64	60.4%
Marital Status	Single	24	22.6%
	Married	82	77.4%
Educational Qualification	Upto 12th std	12	11.3%
	Graduation	44	41.5%
	Post Graduation	47	44.3%
	others	3	2.9%
Family Monthly Income	Below 35000	32	30.2%
	Rs 35001-Rs 55000	16	15.1%
	Rs 55001-Rs 75000	14	13.2%
	More than Rs 75000	44	41.5%
Frequency of purchase of bamboo-based products	Weekly	3	2.8%
	Monthly	7	6.7%
	Yearly	26	24.5%
	Rarely	70	66%

4.2 Customer Awareness towards the use of Bamboo as a Packaging Material based on the Likert scale item values:
1 Not At all Aware (0%) 2 Slightly Aware (25%) 3 Somewhat Aware (50%) 4 Moderately Aware (75%) 5 Extremely Aware (100%)

Figure 4.2 Consumer Awareness towards use of Bamboo based packaging

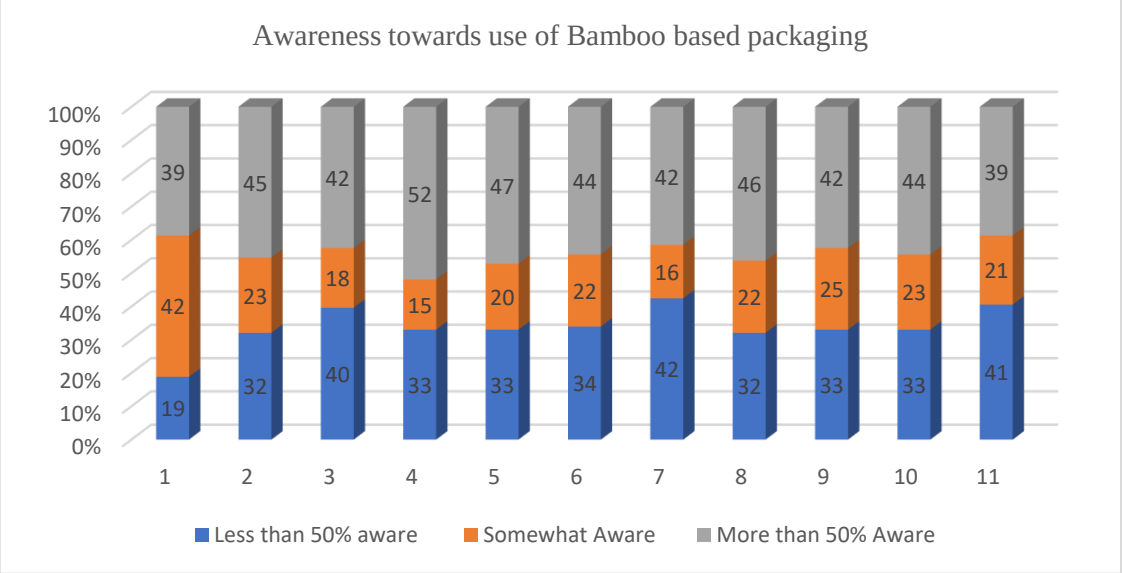


Table 4.2 Consumer Awareness towards use of Bamboo based packaging

Likert Item (in %)	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11
Less than 50% awareness	19	32	40	33	33	34	42	32	33	33	41
Somewhat 50% Aware	42	23	18	15	20	22	16	22	25	23	21
More than 50% Awareness	39	45	42	52	47	44	42	46	42	44	39

As per the data collected in Table 4.2 and corresponding Figure 4.2, following results have been interpretated for the different questions asked to the respondents:

B1: Are you aware of use of Bamboo as a packaging material. 81% of the respondents are moderately aware of the use of bamboo as a packaging material.
B2. Do you know India is the 2nd largest producer of bamboo. 55% of the respondents express their views that they are hardly somewhat aware of India being the 2nd largest producer of Bamboo.
B3: Bamboo belongs to fastest growing plants in the world which grows very rapidly up to 1 inch every 40 minutes. Towards this question, 58% of the respondents have less knowledge regarding the given fact.
B4: Bamboo as a packaging material is eco-friendly and biodegradable.
B5: Bamboo is a renewable, regenerative and self-replenishing source which grows for approx. 75 yrs again and again even once it is harvested.

As the Table 4.2, Majority of the respondents (about 67%) expressed their awareness towards the acceptability of use of bamboo as an eco-friendly packaging material and are aware of its unique characteristics.
B6: 66% of the respondents has awareness towards the knowledge of Bamboo can proved to be an economical way of packaging because of easy availability.
B7: Bamboo takes 4-5 years to mature while trees take at least 20 years to grow
B8. Bamboo takes 2-6 months to decompose while plastics takes hundreds of years for decomposition
B9: Bamboo does not require pesticides, less water for irrigation or replanting to achieve growth i.e. why have minimum maintenance cost
More than 40% respondents are moderately aware of the unique properties of Bamboo as mentioned in the likert items B7, B8 and B9.
B10: 56 % of the respondents are hardly aware of the fact that Bamboo releases 35% more oxygen and absorbs 5 times more carbon-dioxide than that of by same volume of trees
B11: Bamboo is becoming the best choice for packaging in Asian markets and rapidly entering the western markets. 39 % of the respondents were aware and 41% still have less awareness towards the increasing global demand of bamboo as a packaging material

4.3 Consumer Perception towards the use of bamboo as a packaging material based on the above understanding of characteristics of bamboo

1 Strongly Dis Agree 2 Dis Agree 3 Neutral 4 Agree 5 Strongly Agree

Figure 4.3: Consumer Perception towards the use of bamboo-based packaging

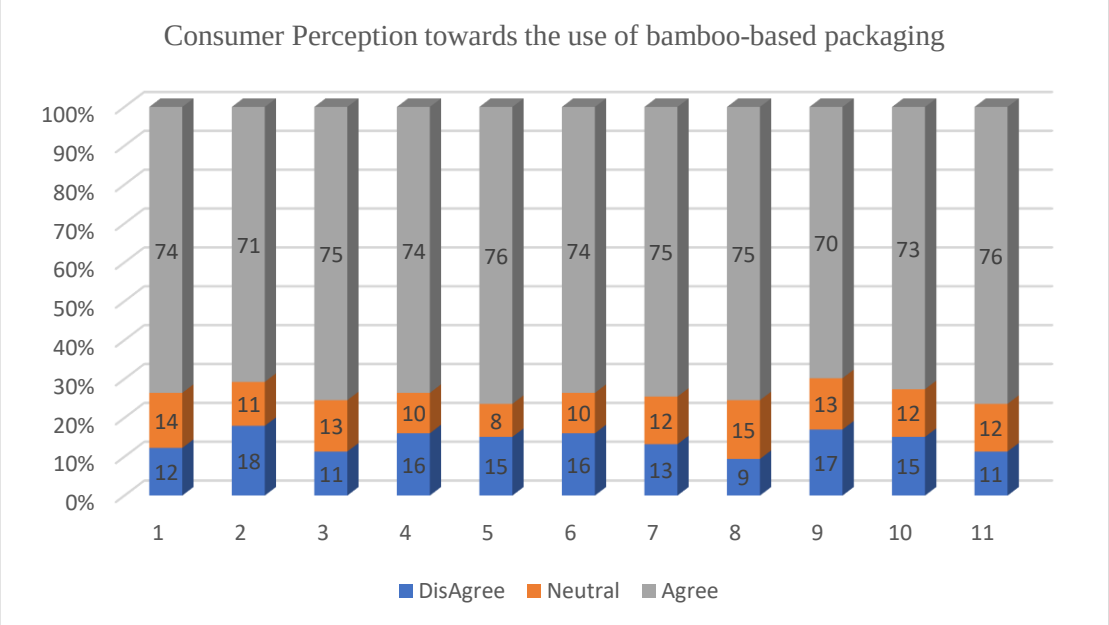


Table 4.3: Consumer Perception towards the use of bamboo-based packaging

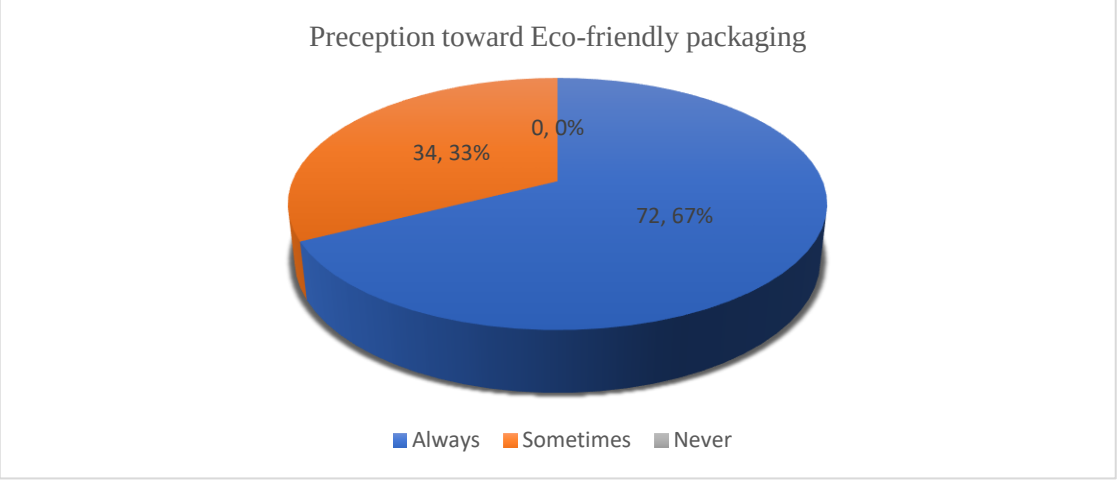
Likert Item (in %)	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11
DisAgree	12	18	11	16	15	16	13	9	17	15	11
Neutral	14	11	13	10	8	10	12	15	13	12	12
Agree	74	71	75	74	76	74	75	75	70	73	76

As per the data collected in Table 4.3 and corresponding Figure 4.3, following results have been interpretated for the different questions asked to the respondents:

U1: 74% of the respondents prefer to use Bamboo in food packaging industries as a substitute of packages made of plastic, wax etc.
U2: 71% of the respondents suggest the use of Bamboo in making eco-friendly catering supplies like Disposable plates, glasses, spoons, bowls etc
U3: Use of Bamboo as reusable Bottles for water storage
U4: Use of Bamboo Straw in place of non-biodegradable single-use plastic made straws.
In the study, 75% and 74% of the respondents recommends the use of bamboo-based bottles and straw as an eco-friendly alternative to plastics etc.
U5: 76% of the respondents agree towards the "Use of bamboo as an eco-friendly replacement for plastic-made toothbrushes, tongue-cleaner etc".
U6: Use of Bamboo as a cosmetic packaging material which can be reuse-recycle.
U7: Use of Bamboo as a packaging material for making paper bags.
U8: Use of packaging material made of biodegradable bamboo-fabric.
U9: Use of Bamboo for making food storage containers.
In the study, 74%, 75%, 75% and 70% of the respondents agree towards the use of bamboo as a packaging material for cosmetics, for making paper bags, for cloth bags and food storage containers.
U10: 73% of the respondents recommend the use of Bamboo as a sustainable packaging material to prevent ecological degradation.
U11: 76 % of the respondents believe and suggest commercial plantation of bamboo for promoting it as an eco-friendly packaging material.

4.4 Do you think of buying products which supports eco-friendly packaging?

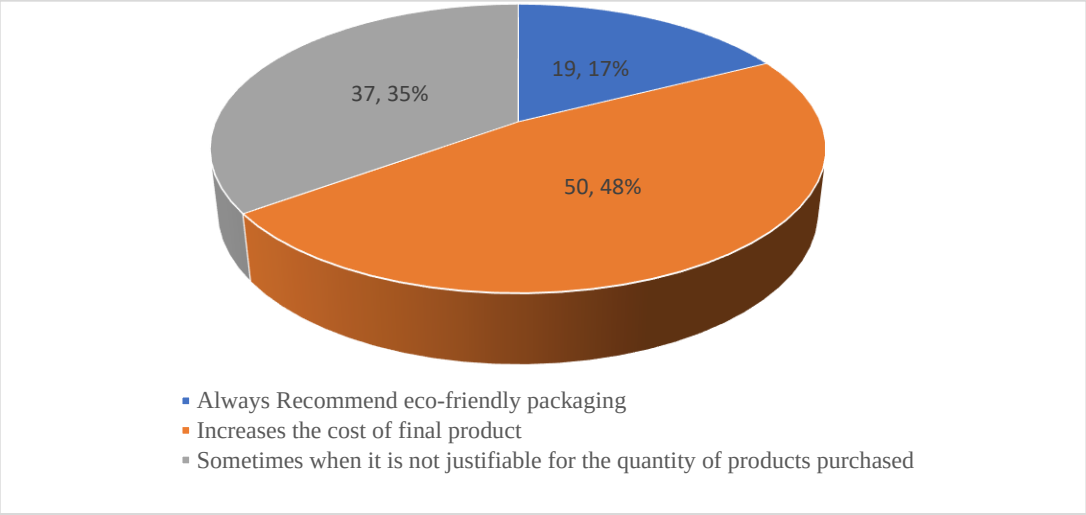
Figure 4.4



As per the analysis result depicted in the Figure 4.4, it was found that 67% of the respondents prefer to buy products which supports eco-friendly packaging. Such respondents are more concern about following the go-green model to attain environment sustainability by the use of eco-friendly products.

4.5 Do you feel eco-friendly packaging is the extra cost added for the final product price

Figure 4.5



As per the analysis result depicted in the Figure 4.5, it was found that 48% of the respondents feel that eco-friendly packaging increases the cost of final product. Their buying behaviour can be shifted towards green products if the cost factor of packaging is lowered down. While 35% of the respondents give more emphasis to the quality and quantity of the products what they purchased. 17% respondents are the environment conscious users who always prefer to recommend green packaging.

4.6 Reliability Analysis

Cronbach's alpha is a measure used in statistics to assess the internal consistency reliability of a set of scale or test items.
In the research study, value of Cronbach's alpha of at least 0.7 indicate higher reliability or internal consistency among the items.

Table 4.6.1

Scale Reliability Statistics

	Mean	SD	Cronbach's α	McDonald's ω
scale	4.05	0.659	0.796	0.798

A Cronbach's alpha value of 0.798 suggests good internal consistency among the items in the scale.

Table 4.6.2

Item Reliability Statistics

			If item dropped	
	Mean	**SD**	**Cronbach's α**	**McDonald's ω**
U1	4.01	1.13	0.775	0.777
U2	3.94	1.19	0.775	0.778
U3	4.09	1.13	0.776	0.780
U4	4.07	1.19	0.775	0.778
U5	4.11	1.14	0.797	0.798
U6	3.99	1.21	0.783	0.785
U7	4.10	1.15	0.789	0.791
U8	4.18	1.07	0.779	0.781
U9	3.96	1.19	0.778	0.780
U10	3.94	1.15	0.770	0.772
U11	4.17	1.09	0.782	0.784

In the Table 4.6.2, Item Reliability Statistics of Cronbach's alpha values are more than 0.07 which suggests good internal consistency of the items in the scale.

4.6.3 Assumption Checks

Table 4.6.3

Bartlett's Test of Sphericity		
χ^2	**df**	**p**
229	55	< .001
KMO Measure of Sampling Adequacy (Overall) 0.835		

If the p-value associated with Bartlett's Test of Sphericity is low (typically below a significance level like 0.05), it indicates that the variables are significantly correlated, supporting the rejection of the null hypothesis which suggests that the data is suitable for factor analysis.

A Kaiser-Meyer-Olkin (KMO) value closer to 1 suggests that the variables in the dataset are highly suited for factor analysis. In Table 4.6.3, KMO value is equal to 0.835 which suggests that the variables in the dataset are suited for factor analysis.

4.7 Principal Component Analysis

Table 4.7.1 Component Loadings

	Component		
	1	**2**	**Uniqueness**
U8	0.737		0.454
U10	0.686		0.471
U6	0.646		0.572
U11	0.635		0.582
U1	0.571		0.587
U9			0.635
U3		0.760	0.404
U4		0.699	0.471
U5		0.607	0.631
U2		0.520	0.597
U7			0.733

Note. 'varimax' rotation was used

The component loadings of Principal Component Analysis reflect the contribution of each original variable to the construction of the principal components. In Table 4.7.1, Higher absolute values of component loadings (more than 0.5) indicate a stronger contribution of the variable to that particular principal component. Variables U1, U6, U8, U10 and U11 contribute towards 1st factor while variables U2, U3, U4 and U5 contribute towards 2nd factor.

Variables U7 and U9 have been discarded as they failed to meet the criteria of component loadings of Principal Component Analysis.

The First Factor has variables U1: Use of Bamboo in food packaging industries as a substitute of packages made of plastic, wax etc., U6: Use of Bamboo as a cosmetic packaging material which can be reuse-recycle, U8: Use of packaging material made of biodegradable bamboo-fabric, U10: Do you recommend use of Bamboo as a sustainable packaging material to prevent ecological degradation U11: Do you suggest commercial plantation of bamboo for promoting it as an eco-friendly packaging material

The Second Factor has variables U2: Use of Bamboo in making eco-friendly catering supplies like Disposable plates, glasses, spoons, bowls etc, U3: Use of Bamboo as reusable Bottles for water storage, U4: Use of Bamboo Straw in place of non-biodegradable single-use plastic made straws., U5: Use of bamboo as an eco-friendly replacement for plastic-made toothbrushes, tongue-cleaner etc.

Table 4.7.2 Component Statistics

Summary

Component	SS Loadings	% of Variance	Cumulative %
1	2.59	23.6	23.6
2	2.27	20.6	44.2

4.8 Confirmatory Factor Analysis

Table 4.8.1 Factor Loadings

Factor	Indicator	Estimate	SE	Z	p
Factor 1	U8	0.617	0.109	5.65	< .001
	U10	0.796	0.115	6.91	< .001
	U6	0.637	0.126	5.05	< .001
	U11	0.604	0.112	5.38	< .001
	U1	0.627	0.116	5.41	< .001
Factor 2	U2	0.597	0.131	4.57	< .001
	U3	0.756	0.116	6.50	< .001
	U4	0.844	0.124	6.83	< .001
	U5	0.419	0.125	3.36	< .001

The significance of factor loadings is determined by the p-values. In the Table 4.8.1, factor loadings have low p-value (usually below a significance level like 0.05 or 0.01) which suggests that the relationship between the indicator and the latent factor is likely not due to random chance but represents a real association.

Factor Covariances

		Estimate	SE	Z	p
Factor 1	Factor 1	1.000 [a]			
	Factor 2	0.647	0.104	6.24	< .001
Factor 2	Factor 2	1.000 [a]			

[a] fixed parameter

5. Conclusion:

The respondents have been asked about their views regarding the promotion of bamboo as a packaging material and their views have been summarized. It has been concluded that customers must be made aware of benefits and the characteristics of bamboo being used a packaging material but at the same time final packaging cost must be controlled to support affordable pricing and adjusted within the reach of common user. Bamboo-based packaging has the potential to revolutionize the packaging industry due to its unique properties and eco-friendliness. Bamboo-based packaging is an environmentally friendly, sustainable, and versatile alternative to traditional packaging materials. It is cost-effective, durable, and has numerous health benefits. Better promotion and advertising strategies should be encouraged to raise awareness among the environmental and socio-economic benefits of bamboo packaging. It has been suggested by the respondents that there should be smooth production and transportation of bamboo from rural area to urban area to make it available for processing.

The bamboo-based packaging industry is still in its nascent stage, with a limited number of industries operating in the market. More industries should be established for eco-friendly production of packaging material by the use of bamboo as a raw material. However, the demand for sustainable packaging solutions has been increasing rapidly, driven by growing environmental concerns and changing consumer preferences. According to a report by Grand View Research, the global bamboos market size was estimated at USD 59.30 billion in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 4.5% from 2022 to 2030.

In conclusion, the data analysis of bamboo-based packaging shows that it is a sustainable, cost-effective, and environmentally friendly option for packaging. There is a need to collaborate with stakeholders, including bamboo farmers, producers, and retailers, to develop a sustainable supply chain for bamboo-based packaging.

6. Recommendations and Suggestions:

With the increasing demand for sustainable packaging, bamboo-based packaging is a viable option for businesses looking to reduce their environmental impact and socio-economical upliftment of the poverty driven community. The bamboo-based packaging industry has significant growth potential, driven by the increasing demand for sustainable packaging solutions. However, the industry faces several challenges, including the lack of awareness among consumers, the high cost of production, and the underdeveloped supply chain. There is a need to increase awareness among consumers, businesses, and policymakers about the benefits of bamboo-based packaging. This can be achieved through generating awareness among the customers through use of effective promotion and marketing strategies.

There is a need to promote research and development activities, enhance innovation in design modules and develop better infrastructure for production and processing of bamboo-based products. This can be achieved through proper investment as well as mutual collaboration between government, businesses, and NGOs.

7. Limitation & Scope of the Study:

The high cost of bamboo-based packaging compared to traditional packaging materials is still a barrier to its adoption. The supply chain for bamboo-based packaging is not yet well-developed, which leads to inconsistencies in quality, availability and ignorance towards the applicability of bamboo-based packaging. Another major problem is the lack of awareness and knowledge among consumers about the benefits and applications of bamboo-based products. There is a need for more research and development to improve the quality and performance of bamboo-based packaging.

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