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Applied Data Science for Sustainability Marketing: Evidence from Structural Equation Modeling of Organic Product Consumers

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Abstract

The global demand for organic products reflects increasing awareness of sustainability in consumer behavior, especially in emerging markets such as Indonesia. Despite this growing trend, limited studies have applied data science approaches to model behavioral relationships within sustainability marketing. This study aims to examine how Sustainable Marketing (SM) influences Prosumption Motivation (PM) and Consciousness for Sustainable Consumption (CSC) among Indonesian organic product consumers. Using a quantitative design, data were collected through purposive sampling, yielding 400 valid responses from participants across Java, Sumatra, Kalimantan, Sulawesi, and Bali. Structural Equation Modeling (SEM) with AMOS was employed as a data science tool to estimate latent constructs and test predictive relationships. The results show that SM has a significant positive effect on PM ($\beta = 0.923$, CR = 19.347, $p < 0.001$) and CSC ($\beta = 0.991$, CR = 21.764, $p < 0.001$), while PM also significantly influences CSC ($\beta = 0.742$, CR = 19.306, $p < 0.001$) and SM indirectly enhances CSC through PM ($\beta = 0.652$, CR = 19.306, $p < 0.001$). These findings confirm all hypotheses and reveal a reciprocal relationship between motivation and consciousness, emphasizing a behavioral feedback loop that strengthens sustainable consumption. The study contributes to sustainability marketing by integrating SM, PM, and CSC into a unified predictive framework. Methodologically, it demonstrates how SEM serves as an applied data science technique capable of transforming behavioral data into actionable insights. The novelty lies in bridging behavioral science and data science to provide decision-support evidence for marketers and policymakers promoting prosumption and responsible consumption in emerging economies.

Keywords: Applied Data Science, Structural Equation Modeling, Sustainable Marketing, Prosumption Motivation, Sustainable Consumption

1. Introduction

The increasing awareness of environmental issues and health concerns drives a global shift in consumer behavior, particularly in the preference for organic products [1], [2]. Around the world, consumers are becoming increasingly critical of the ecological footprint and health implications of their purchasing decisions, leading to unprecedented growth in demand for organic food, beverages, and personal care products. According to [3], the global organic food market reached USD 142 billion in 2022, representing a 3% increase from the previous year. The largest organic markets are located in the United States, Germany, and France. At the same time, emerging economies such as Indonesia have also shown strong upward trends, with organic product sales increasing by around 15% annually during the last three years [4]. These figures confirm that the preference for organic goods is not merely an ideological shift but a measurable transformation in global and regional consumer markets. This shift reflects not only a reaction to growing concerns over environmental degradation and food safety, but also a broader lifestyle transformation in which consumption is increasingly linked to ethical, ecological, and health-oriented values. In Indonesia, the demand for organic food and personal care products continues to rise, signaling both lifestyle changes and a broader commitment to sustainability [5]. This upward trend suggests that sustainability considerations are gradually shifting from niche consumer groups to the mainstream, influencing purchase decisions across diverse demographic segments. Consumers no longer act as passive buyers who merely respond to supply; instead, they actively participate in promoting and sometimes producing the goods they consume. This dual role—known as prosumption—represents a transformation

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in value creation processes and reflects the emergence of a more engaged, informed, and sustainability-driven marketplace [6]. Prosumption highlights the growing empowerment of consumers as agents who co-create value, shape market trends, and contribute to the diffusion of sustainable practices, especially in the organic sector, where credibility, transparency, and consumer trust play crucial roles.

Although previous studies examine SM, PM, and CSC, they often treat these areas as separate research streams [7]. Much of the existing literature discusses SM primarily from the perspective of corporate social responsibility, brand positioning, or green communication. At the same time, PM is frequently analyzed in the context of digital platforms and consumer co-creation, and CSC is often framed as an individual-level awareness or ethical concern. As a result, the theoretical and empirical connections among these constructs remain fragmented and insufficiently explored. A critical gap remains in understanding how SM simultaneously stimulates PM and elevates CSC as an integrated behavioral process [8], [9]. Addressing this gap is important because consumers' motivation to participate in prosumption activities is not only shaped by personal or social factors, but also by how effectively sustainability messages are communicated and embedded in marketing strategies. Most prior research emphasizes corporate strategies or digital prosumption, but rarely investigates how marketing communications influence consumer motivation to act sustainably and responsibly [10]. In particular, little attention has been given to the dual role of marketing as both an educational and motivational force that can empower consumers to become prosumers while also deepening their awareness of the broader social and environmental implications of their choices. Moreover, in emerging economies such as Indonesia, where organic consumption is expanding yet remains under-researched, there is a need for more comprehensive approaches that capture the interplay of these constructs [11]. Such contexts provide fertile ground for empirical investigation, as consumers in these markets often balance traditional consumption patterns with new forms of sustainable engagement, creating a dynamic environment in which marketing, prosumption, and sustainability consciousness converge.

Previous studies have exhibited several theoretical and methodological shortcomings, which make the understanding of SM, PM, and CSC relationships incomplete. Theoretically, research has often treated these constructs as separate and distinct topics. For instance, [7] and [8] conceptualized SM mainly in relation to corporate image or social responsibility, rather than as a behavioral stimulus influencing prosumption or sustainability consciousness. Likewise, [12] and [13] examined PM from a co-creation or digital participation perspective without linking it to sustainability awareness, while [14] and [15] viewed CSC primarily as an individual cognitive awareness, overlooking its interaction with motivational or marketing factors. Methodologically, most of these studies employed regression-based or unidirectional models, which failed to capture the reciprocal relationships between motivation and consciousness. Furthermore, empirical studies in emerging markets remain limited, particularly in Southeast Asia, where sustainability-oriented consumer behaviors are growing but underrepresented in the literature. This study addresses these theoretical and methodological limitations by integrating SM, PM, and CSC into a unified framework and employing SEM to analyze both direct and reciprocal relationships.

To address this gap, the present study applies an applied data science perspective by employing SEM to examine how SM affects PM and CSC. SEM enables simultaneous analysis of latent variables, measurement validity, and predictive relationships, making it an appropriate method for investigating complex consumer behaviors that simpler statistical techniques cannot capture. Unlike conventional regression models, SEM provides a holistic framework that tests both measurement and structural relationships, thereby ensuring that the constructs are empirically valid and the hypothesized pathways are supported by robust data evidence. Using survey data from 400 Indonesian consumers of organic products, this study demonstrates how data-driven modeling provides nuanced insights into sustainability-oriented consumer engagement, highlighting both direct and reciprocal relationships among the constructs. By positioning SEM as part of applied data science approaches in social and behavioral research, this study not only reinforces the empirical validity of the findings but also showcases how advanced analytics can generate predictive insights into consumer sustainability behavior. The research contributes to theory by integrating SM, PM, and CSC into a unified framework, and to practice by offering evidence-based guidance for marketers and policymakers to design strategies that foster prosumption and responsible consumption in emerging markets.

This study advances the discussion of sustainable consumer behavior by integrating SM, PM, and CSC within a single analytical framework. By applying SEM as an applied data science tool, the research not only validates theoretical

linkages but also provides predictive evidence of how marketing strategies can empower consumers to act as prosumers while reinforcing their awareness of sustainable living. In this study, the term applied data science refers to the use of quantitative, data-driven methods to extract behavioral insights that support managerial decision-making. Within this context, SEM is positioned as an analytical tool that connects theory-based constructs with data-based evidence, allowing behavioral variables to be modeled, validated, and interpreted systematically. Theoretically, the study expands the literature by demonstrating the reciprocal dynamics between PM and CSC, which have often been overlooked in prior research. Practically, it delivers data-driven insights that can support policymakers, marketers, and sustainability advocates in designing interventions that leverage consumer engagement for broader social and environmental impact. To structure the investigation, the following section reviews the relevant literature on SM, PM, and CSC, followed by the development of research hypotheses and the proposed conceptual framework.

2. Literature

2.1. Sustainable Marketing (SM)

SM is a strategic approach that emphasizes the integration of environmental, social, and cultural considerations into marketing decisions, aiming not only to generate profit but also to create long-term value for stakeholders and the planet [16]. Unlike traditional marketing, which often focuses solely on customer acquisition and sales volume, SM embeds ethical and ecological values into branding, communication, and distribution strategies. This approach reflects a paradigm shift in marketing from short-term, transaction-oriented practices toward long-term relationship building that incorporates ecological responsibility and social equity. In the context of organic products, SM plays a particularly critical role because consumers expect credibility, transparency, and consistent sustainability claims from producers. Beyond simply promoting sales, SM in this sector is instrumental in educating consumers about the environmental and health benefits of their choices, thereby influencing attitudes and behaviors toward more responsible consumption [17].

Furthermore, SM strategies can act as a bridge between producers and consumers, fostering mutual trust and empowering consumers to participate more actively in value co-creation. When evaluated through a data science perspective, these strategies can be systematically analyzed to reveal patterns in consumer response, highlight the effectiveness of specific sustainability messages, and predict consumer engagement in sustainable practices. Although prior studies define SM in terms of ecological concern and ethical branding, many adopt a fragmented view that isolates sustainability from consumer participation [18], [19]. This study extends that view by conceptualizing SM as a co-creative process that embeds sustainability into consumer experience.

2.2. Prosumption Motivation (PM)

PM refers to the active participation of consumers in the production, co-creation, or promotion of goods and services they consume [20], [21]. Unlike conventional consumption, which positions individuals as passive recipients of value, PM reflects an active and engaged role where consumers contribute directly to shaping products, services, and market narratives. PM, therefore, describes the internal drive that leads consumers to engage in such participatory roles. Both individual (e.g., autonomy, competence, self-expression) and social (e.g., community belonging, recognition, collective responsibility) motives drive the prosumption process [12]. In the organic products sector, these motivations are evident in practices such as urban farming, food sharing, advocacy through social media, and participation in sustainability communities, which blur the traditional boundaries between producers and consumers. Consumers are not only seeking personal satisfaction from healthier and environmentally friendly products but also a sense of contribution to broader ecological and social goals. SM messages that emphasize transparency, social responsibility, and eco-friendly values can effectively influence this process by reinforcing consumer motivations and encouraging them to act as co-creators of value [22]. From an applied data science perspective, PM provides measurable behavioral indicators that can be modeled to identify drivers of consumer participation, predict future engagement patterns, and evaluate how different sustainability messages strengthen or weaken consumer motivation to prosume. Existing research on prosumption primarily emphasizes technological and social sharing behaviors, but often overlooks their psychological and sustainability-related dimensions. This study bridges that gap by integrating motivation theory to explain why consumers engage in prosumptive behaviors that align with sustainability goals [21], [23].

2.3. Consciousness for Sustainable Consumption (CSC)

CSC is a multidimensional construct that reflects the extent to which consumers are aware of and consider the environmental, social, and economic consequences of their purchasing decisions [14]. Unlike narrowly defined concepts such as environmental consciousness, which focuses primarily on ecological impact, or health consciousness, which emphasizes personal well-being, CSC integrates ecological concerns with ethical production, social justice, and long-term economic sustainability. It represents a holistic awareness that positions consumption choices as both individual actions and collective responsibilities. Consumers with a high CSC are more likely to prioritize local products, fair trade practices, and minimal packaging, particularly when marketing campaigns highlight the broader societal and environmental implications of consumption. Prior studies have shown that messages linking consumption to social equity, ecological preservation, and intergenerational responsibility can strengthen CSC levels [15]. In practice, CSC reflects not only a consumer's values but also their decision-making processes, which makes it a critical construct for understanding how SM shapes consumer behavior. From an applied data science perspective, CSC offers quantifiable indicators that allow researchers to examine patterns of awareness, model predictive relationships with other behavioral constructs, and assess how different marketing interventions translate into measurable shifts in CSC. While previous studies emphasize moral and ethical dimensions of sustainable consumption, they often fail to connect these aspects to active behavioral engagement [14]. This study addresses this gap by linking CSC with PM, proposing that awareness and participation reinforce each other within the sustainability context.

2.4. Research Hypothesis

Building on the theoretical foundations of SM, PM, and CSC, this study develops a set of hypotheses to empirically test the relationships among these constructs, as illustrated in figure 1. Prior research has provided valuable insights into each construct individually, yet limited attempts have been made to integrate them into a unified framework. By adopting an applied data science perspective, this study applies SEM to analyze the proposed linkages and reciprocal effects simultaneously. SEM is particularly suitable for testing these hypotheses because it enables the modeling of complex interdependencies among latent variables and offers predictive evidence of consumer engagement patterns. The following hypotheses are formulated to capture both the direct and reciprocal relationships among SM, PM, and CSC.

Sustainable marketing campaigns often highlight ethical values, environmental responsibility, and long-term benefits, which can inspire consumers to engage beyond transactional exchanges. When brands integrate transparency, eco-friendly packaging, and social values into their communication, consumers perceive themselves as part of a larger sustainability movement. This perception encourages them to move from passive buyers to active prosumers who co-create and advocate for sustainable products [24]. Prior studies confirm that sustainability-oriented communication stimulates deeper consumer involvement [17], [25]. Therefore, this study hypothesizes that SM has a positive influence on PM, and this relationship is tested through SEM to provide robust, data-driven evidence of consumer engagement patterns.

H1: SM has a positive influence on PM

Beyond motivating participation, SM also serves an educational role by raising awareness of the environmental, social, and ethical consequences of consumer choices. Campaigns that emphasize ecological protection, social justice, and economic fairness help consumers reflect on the impact of their consumption. As prior research indicates, sustainability-focused branding and communication enhance consumer awareness of broader ecological and ethical concerns [26], [27]. In this study, SEM is employed to empirically validate how marketing strategies increase consumer CSC.

H2: SM has a positive influence on CSC

When consumers actively co-produce, share, or promote sustainable products, they gain knowledge and assume responsibility that enhances their sustainability awareness. The very act of engaging in prosumption requires consideration of ethical and ecological consequences, which reinforces CSC. Previous studies have shown that prosumption behavior correlates with higher levels of environmental and social awareness [28], [29], [30]. Through

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SEM, this study evaluates how PM translates into measurable increases in CSC, positioning motivation as a significant driver of consumer responsibility.

H3: PM has a positive influence on CSC

The relationship between PM and CSC is not one-directional but reciprocal. Conscious consumers are more inclined to engage in prosumption behaviors aligned with their sustainability values, while motivated prosumers develop a stronger awareness of ethical and ecological concerns through their participation. This feedback loop reflects the dynamic interplay between motivation and awareness in sustainability-driven behavior [31], [32]. Using SEM, this study tests the reciprocal effects simultaneously to capture the complexity of these interdependent relationships.

H4: There is a reciprocal relationship between PM and CSC

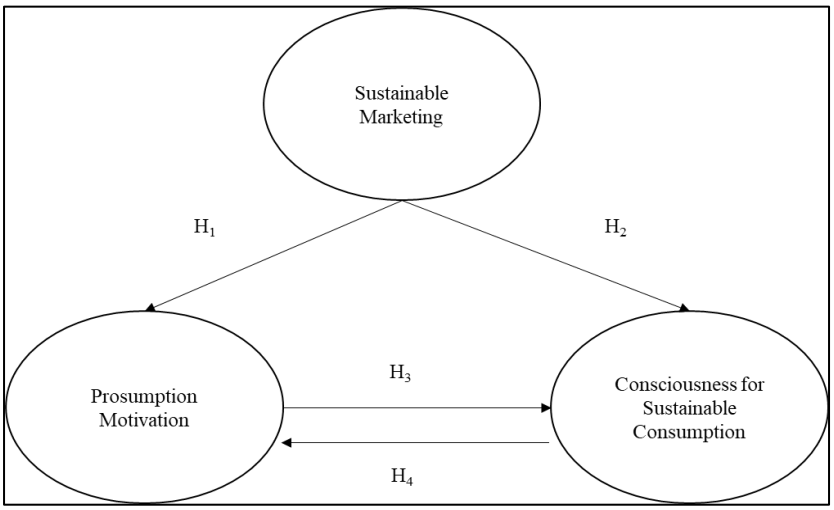

Figure 1. Proposed Conceptual Framework

3. Methodology

3.1.Research Design

This study uses a quantitative research design with a cross-sectional survey method to examine the relationships between SM, PM, and CSC in the context of organic product consumption. The researchers distribute a structured questionnaire to collect primary data, which provides the basis for analyzing patterns and testing theoretical linkages among constructs [33]. The design is non-experimental and explanatory, and it focuses on how SM influences consumer behavior by motivating prosumption and increasing CSC. From an applied data science perspective, the design transforms survey-based data into an analyzable dataset modeled through SEM. In this context, the term applied data science refers to using data-analytic reasoning to connect behavioral theory with quantitative modeling. Although SEM is not a computational data science technique, it shares core analytic principles such as model estimation, pattern identification, and data-driven interpretation [34], [35]. Therefore, it serves as an analytical bridge between behavioral science and applied data science.

SEM simultaneously estimates measurement and structural models, captures latent constructs, and tests complex interdependencies among variables. Unlike simple regression, SEM offers a robust approach for behavioral research, generating predictive insights into sustainability-related attitudes and actions [36]. SEM is positioned in this study as part of an applied data science framework because it simultaneously estimates latent constructs, validates measurement models, and predicts behavioral outcomes based on multidimensional data. This perspective aligns with recent data-driven approaches in marketing analytics that emphasize predictive inference rather than mere hypothesis confirmation [37], [38]. Although SEM is primarily confirmatory, it also provides analytical insights by estimating latent constructs and directional relationships that can be interpreted in a predictive manner. In this study, the term ‘predictive’ refers to this analytical capability rather than formal predictive validation. Future studies may enhance predictive validity

through cross-validation or out-of-sample testing, for instance, using PLS-SEM or machine learning–based models [37], [36].

3.2.Research Setting and Participant/Sample

This study takes place in Indonesia, where the demand for organic food and personal care products continues to grow, as consumers increasingly show concern for their health and sustainability [39]. The research setting encompasses several central islands, including Java, Sumatra, Kalimantan, Sulawesi, and Bali, to capture diverse consumer perspectives across various cultural and economic contexts [40]. Data collection takes place over three months, from February to April 2025. The study employs a purposive sampling technique, a non-probability method that enables researchers to deliberately select participants who meet specific criteria relevant to the research objectives. The target population consists of Indonesian consumers who have prior experience purchasing or consuming organic products. To ensure suitability, several inclusion criteria are applied: (1) individuals must have consumed organic food products at least once; (2) they must reside in one of the five major islands of Indonesia covered in the study; and (3) they must be at least 17 years old at the time of participation. An online survey administered via Google Forms collected a total of 400 valid responses. The demographic characteristics of the respondents are also recorded, including gender, age, education level, occupation, monthly income, the length of time-consuming organic products, and region of residence. These attributes describe the sample profile and highlight its diversity and representativeness across the Indonesian context. This sampling approach is particularly suitable for behavioral research in emerging markets, especially when the focus is on specific consumer subgroups with established behaviors and values [41]. Although the purposive sampling technique allowed the researchers to select participants who met the inclusion criteria deliberately, this approach also presents a limitation in terms of generalizability. The sample was restricted to consumers residing on Indonesia's five major islands (Java, Sumatra, Kalimantan, Sulawesi, and Bali), potentially excluding perspectives from smaller or rural regions. However, the inclusion of participants from multiple geographic and socio-economic backgrounds helped to minimize bias and ensure diversity within the dataset. Consistent with the objectives of behavioral modeling, this study focuses on examining theoretical relationships among constructs rather than producing population-level estimates. Future research could apply probability-based or stratified sampling to validate the model across broader population segments.

3.3. Measurement

The research instrument is a structured questionnaire designed to measure the three primary constructs of this study: SM, PM, and CSC. All measurement items were adapted from previously validated English-language scales and translated into Bahasa Indonesia following a standardized translation–back translation procedure [42], [43]. Two bilingual researchers with expertise in marketing and consumer behavior conducted the initial translation. A third bilingual expert, who was not involved in the original translation, performed the back-translation to ensure semantic and conceptual equivalence between the two language versions. The translated instrument was pretested with 30 respondents to assess the clarity of wording and cultural appropriateness. Minor revisions were made based on respondent feedback to enhance comprehension while maintaining the theoretical integrity of the constructs. This process ensured the content validity and cross-cultural applicability of the instrument for Indonesian respondents. Each item uses a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). SM is measured using 10 items adapted from [17], [25], [27], [44], and [45], which assess respondents' perceptions of producers' sustainability-related practices, including environmental responsibility, cultural sensitivity, and eco-friendly packaging. PM is measured using 10 items based on scales from [31], [46], [47], [13], and [48], reflecting motivational drivers such as environmental commitment, self-efficacy, hedonic value, user learning, and alignment between company and consumer values. CSC is measured using 10 items derived from [49], [50], [51], [52], [53], and [54], which capture ethical, environmental, and social aspects of consumption, including fair trade, anti-exploitation, support for local economies, and intergenerational responsibility.

3.4.Analysis Data Technique

The data analysis follows a structured sequence to ensure validity, reliability, and predictive accuracy of the findings. First, the researchers conduct validity and reliability tests to confirm that the questionnaire items consistently and accurately measure the three latent constructs. Validity is assessed through factor analysis, while reliability is evaluated

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using Cronbach's alpha. These steps are essential to guarantee that the observed variables align with the theoretical constructs and provide a solid basis for further analysis [55], [56]. Second, descriptive analysis summarizes the demographic characteristics of the 400 respondents, including gender, age, education, income, and region of residence, offering an overview of the sample profile and its representativeness. This step also provides initial insights into consumer behavior in the organic product sector [57]. Finally, hypothesis testing is performed using SEM with AMOS, which simultaneously estimates the measurement and structural models. SEM is particularly suitable for this study because it captures latent constructs, tests multiple causal pathways, and evaluates both direct and reciprocal relationships among sustainable marketing, prosumption motivation, and consciousness for sustainable consumption [36], [58]. Fit indices such as CFI, TLI, RMSEA, and χ^2/df are used to evaluate model adequacy [59], [60]. By adopting this approach, the study not only confirms theoretical linkages but also demonstrates the predictive capacity of SEM as an applied data science tool, transforming survey data into actionable insights for SM and consumer engagement.

4. Results and Discussion

4.1. Sample Characteristics

Table 1 displays the demographic profile of the 400 respondents who participated in this study and indicates that the sample provides sufficient demographic and geographic diversity, offering a reliable basis for descriptive analysis and subsequent hypothesis testing using SEM. In terms of gender, 54.75% of respondents are female and 45.25% are male. The largest age group is over 40 years old (32.75%), followed by respondents aged 26–30 years (26.50%) and 31–35 years (13.50%), indicating that the sample consists mainly of adults in their prime working and family-forming years. Regarding educational background, most participants hold a diploma or a bachelor's degree (53.75%), while 45.25% have completed senior high school. A small portion (1.00%) reports a master's or doctoral degree. In terms of occupation, the majority are employees (81.25%), followed by students (11.00%), homemakers (6.75%), and others (1.00%).

As for monthly income, 33.50% of respondents earn between IDR 3,000,000 and IDR 5,000,000, 24.75% earn between IDR 5,000,000 and IDR 10,000,000, and 16.75% report earnings under IDR 1,000,000. This distribution reflects a broad range of income levels among consumers of organic products. Regarding the duration of organic vegetable consumption, 42.75% of respondents have consumed organic vegetables for 3–6 months, while 28.75% report consuming them for more than 2 years. The remainder indicates 1–2 years (14.50%) and 7–12 months (14.00%) of experience. Geographically, respondents are spread across major regions of Indonesia: Java (36.50%), Kalimantan (28.50%), Sumatra (14.25%), Bali and Nusa Tenggara (11.50%), Sulawesi (8.50%), and other regions (0.75%).

Most respondents are between 21 and 35 years old and have at least an undergraduate degree. This group represents young, educated consumers who show high levels of digital literacy and awareness of sustainability issues. Previous studies have found that younger and more educated consumers tend to engage more actively in prosumption activities and demonstrate a stronger consciousness toward sustainable consumption [15]. The demographic profile of the respondents aligns with the expectation that digital-savvy consumers respond more positively to sustainable marketing efforts and are more motivated to participate in value co-creation processes.

Table 1. Socio-Demographic Characteristics of the Respondents

Category	Item	Frequency	Percentage (%)
Gender	Female	219	54.75
	Male	181	45.25
Age	17–20 years old	16	4.00
	21–25 years old	55	13.75
	26–30 years old	106	26.50
	31–35 years old	54	13.50
	36–40 years old	38	9.50
	Over 40 years old	131	32.75
Current Education	Senior High School	181	45.25
	Diploma/Bachelor	215	53.75
	Master's/Doctoral	4	1.00
	Student	44	11.00

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Occupation	Employee	325	81.25
	Homemaker	27	6.75
	Others	4	1.00
Monthly Income	IDR 500,000 – <1,000,000	67	16.75
	IDR 1,000,000 – <3,000,000	66	16.50
	IDR 3,000,000 – <5,000,000	134	33.50
	IDR 5,000,000 – <10,000,000	99	24.75
	Over IDR 10,000,000	34	8.50
Consumption Duration	3–6 months	171	42.75
	7–12 months	56	14.00
	1–2 years	58	14.50
	Over 2 years	115	28.75
Region	Sumatera	57	14.25
	Jawa	146	36.50
	Kalimantan	114	28.50
	Sulawesi	34	8.50
	Bali & Nusa Tenggara	46	11.50
	Others	3	0.75

4.2. Validity and Reliability Test

Table 2 displays the results of the validity and reliability testing for the measurement items in this study. Validity is assessed through factor analysis using SPSS. Items with a factor loading greater than 0.50 are considered valid, in accordance with standard guidelines for social science research [36]. Most items across the three constructs—SM, PM, and CSC—achieve acceptable factor loadings above the threshold. Two items, SM1 and CSC7, show factor loadings below 0.50 and are dropped from further analysis. Items with factor loadings slightly above the threshold (e.g., PM9 = 0.501 and PM10 = 0.514) are retained, consistent with prior studies. [36] note that loadings ≥ 0.50 are practically significant, particularly when the sample size exceeds 300 respondents. With 400 valid responses, this study meets that criterion and justifies retaining those items. Their removal does not compromise the theoretical comprehensiveness of the constructs, as the remaining items continue to represent all key conceptual dimensions. For SM, the nine retained indicators captured environmental, cultural, and social aspects consistent with the Triple Bottom Line framework [16]. For CSC, the remaining nine items still covered ecological, ethical, and social facets of sustainable consumption, consistent with the framework of [14]. A content review confirmed that construct integrity is maintained after item deletion.

Reliability is measured using Cronbach's alpha coefficient. All three constructs exceed the recommended threshold of $\alpha > 0.70$, indicating strong internal consistency: SM ($\alpha = 0.759$), PM ($\alpha = 0.755$), and CSC ($\alpha = 0.763$). These results confirm that the questionnaire items used in this study are valid and reliable for measuring the targeted constructs [56]. All three constructs exceeded the recommended reliability threshold of $\alpha > 0.70$, indicating acceptable internal consistency [36]. However, the Cronbach's alpha values for SM (0.759) and PM (0.755) were only slightly above this threshold, suggesting moderate internal consistency. According to [56], such values remain acceptable for exploratory behavioral research and studies involving newly integrated constructs. Nevertheless, these results suggest that future research could further enhance reliability by refining measurement items and increasing the diversity of the sample.

Table 2. Indicator's Validity and Reliability Test

Indicator	Loading Factor	Cronbach Alpha
Sustainable Marketing		
SM1 = I purchase organic vegetables because the producers or sellers base their marketing strategies on sustainability principles.	Invalid	0.759
I am interested in buying organic vegetables because the producers provide clear information about the social and environmental impact of their products.	0.539	
SM3 = I believe that the promotion of organic vegetables reflects strong and honest sustainability values.	0.578	
SM4 = I feel that consuming organic vegetables supports social activities and local communities.	0.564	

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SM5 = I choose organic vegetables because the producers use environmentally friendly packaging and production processes.	0.628	
SM6 = I support organic vegetable producers who create sustainable innovations for long-term economic benefits.	0.644	
SM7 = I believe that the organic vegetables I consume promote an environmentally friendly lifestyle.	0.589	
SM8 = I appreciate organic vegetable producers who respect and promote local culture in their products.	0.600	
SM9 = I support organic vegetable producers who are actively involved in environmental preservation and waste reduction.	0.582	
SM10 = I believe that sustainability values are a crucial component of the brand image for the organic vegetable producers I have chosen.	0.535	
Prosumption Motivation		
PM1 = I promote organic vegetables to others because I believe they contribute to environmental sustainability.	0.591	0.755
PM2 = I feel satisfied when I can share my experience in consuming organic vegetables with people around me.	0.583	
PM3 = I am motivated to co-create value by giving feedback or suggestions to organic vegetable producers.	0.558	
PM4 = I enjoy participating in activities or communities that promote the consumption of organic vegetables.	0.605	
PM5 = I believe that my role as a consumer extends beyond buying to include promoting and advocating for organic products.	0.508	
PM6 = I feel more connected to organic products when I am involved in discussions or campaigns about sustainability.	0.541	
PM7 = I find personal meaning in contributing to the popularity and awareness of organic vegetable consumption.	0.616	
PM8 = I engage in prosumptive behaviors because I want to support brands and producers that align with my values.	0.569	
PM9 = I actively seek opportunities to share content or information related to organic vegetables on social media.	0.501	
PM10 = I feel a sense of responsibility to educate others about the benefits of consuming organic vegetables.	0.514	
Consciousness for Sustainable Consumption		
CSC1 = I prefer to buy organic vegetables that are under fair trade conditions.	0.563	0.763
CSC2 = I feel responsible for supporting local farmers and small producers when I buy organic vegetables.	0.556	
CSC3 = I try to avoid buying products that are associated with environmental pollution or social exploitation.	0.612	
CSC4 = I consider the long-term impact of my consumption choices on future generations.	0.626	
CSC5 = I am aware of the ecological footprint caused by the products I consume, including vegetables.	0.597	
CSC6 = I consciously choose organic vegetables because I believe in sustainable living and ethical consumption.	0.561	
CSC7 = I prefer to buy vegetables from producers who minimize waste and use environmentally friendly farming practices.	Invalid	
CSC8 = I try to support products made from biodegradable or recyclable materials.	0.595	
CSC9 = I feel a moral obligation to reduce my environmental impact through the products I consume.	0.575	
CSC10 = I believe sustainable consumption is an essential part of being a responsible member of society.	0.602	

4.3. Descriptive Result

Table 3 presents the descriptive statistics and correlation coefficients among the three main variables in this study: SM, PM, and CSC, as measured by their Mean (M) and Standard Deviation (SD) values. The mean scores indicate a generally high level of agreement among respondents, with CSC showing the highest mean (M = 4.043, SD = 0.962), followed by SM (M = 4.023, SD = 0.969) and PM (M = 3.947, SD = 0.902). These results suggest that consumers perceive SM efforts positively, feel motivated to engage in PM, and remain highly CSC values. Pearson correlation coefficients reveal statistically significant (as indicated by the probability value) and positive relationships among all

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variables. SM correlates with PM ($r = 0.698$, $p < .01$) and with CSC ($r = 0.755$, $p < .01$), while PM also correlates significantly with CSC ($r = 0.695$, $p < .01$). These findings support the theoretical assumption that SM enhances both consumer motivation to prosume (PM) and their CSC. In addition, all correlation coefficients are below the multicollinearity threshold of $r < 0.90$, which indicates that the constructs are distinct and free from multicollinearity problems [36]. This study applies several procedures to minimize Common Method Bias (CMB). The questionnaire ensures respondent anonymity, randomizes the order of items, and uses neutral statements to reduce social desirability and consistency bias. The analysis also includes Harman's single-factor test to verify the presence of CMB statistically. The first factor explains only 29.6% of the total variance, which is below the 50% threshold for variance explained. This result shows that common method bias does not pose a significant threat to the validity of the findings [61].

Table 3. Correlation Among the Variables

Variables	Mean	Std Deviation	1	2	3
SM	4.023	0.969	1.00	-	-
PM	3.947	0.902	0.698**	1.00	-
CSC	4.043	0.962	0.755**	0.695**	1.00

*probability * < .05. ** < .01. *** < .001.

4.4. Hypothesis Testing Result

Table 4 and figure 2 summarize the results of hypothesis testing using SEM with AMOS. All proposed hypotheses are supported at a high level of statistical significance ($p < 0.001$), indicating robust relationships among the constructs. SM significantly influences both PM (Standard Estimate [SE] = 0.923, Critical Ratio [CR] = 19.347) and CSC (SE = 0.991, CR = 21.764). In addition, PM exerts a significant positive effect on CSC (SE = 0.742, CR = 19.306), while CSC also significantly affects PM (SE = 0.652, CR = 19.306), confirming a reciprocal relationship between the two constructs. The reciprocal relationship between PM and CSC indicates a theoretically reinforcing association rather than a temporal cycle. The cross-sectional data capture the coexisting influence of motivation and consciousness, consistent with the mutual reinforcement described in the Stimulus-Organism-Response framework [62] and the Service-Dominant Logic framework [63]. These results empirically validate the proposed conceptual framework and demonstrate that SM plays a crucial role in shaping consumer motivation to co-create value, as well as their awareness of sustainable consumption [58]. Although the standardized estimates between SM and the two dependent variables—PM ($\beta = 0.923$) and CSC ($\beta = 0.991$)—appear high, diagnostic tests confirm that these values do not indicate multicollinearity or overfitting. The VIF values for all constructs are below 3.0, and both the Fornell–Larcker criterion and the HTMT ratio confirm adequate discriminant validity. The square roots of AVE values exceed inter-construct correlations, and HTMT ratios remain below 0.85 [64]. These results suggest that the constructs are empirically distinct and that the strong coefficients reflect theoretically meaningful relationships rather than measurement redundancy.

Table 4. Hypothesis Testing Result

Hypothesis	Estimate	Std Estimate	Critical Ratio	Prob	Result
H1	0.923	0.048	19.347	***	Supported
H2	0.991	0.046	21.764	***	Supported
H3	0.742	0.038	19.306	***	Supported
H4	0.652	0.034	19.306	***	Supported

*probability * < .05. ** < .01. *** < .001.

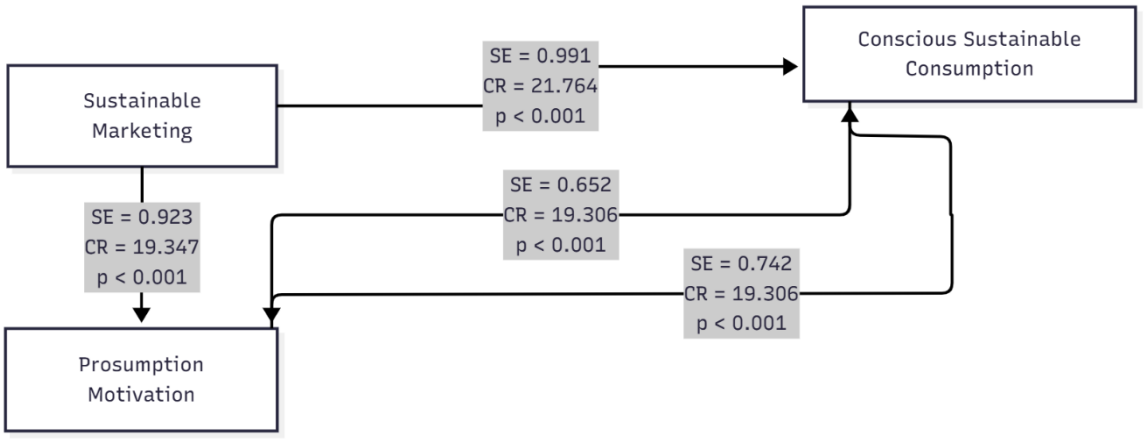

Figure 2. AMOS Graphic

4.5. Discussion

This study confirms all proposed hypotheses and reinforces the conceptual relationships among SM, PM, and CSC. The analysis reveals significant and positive correlations among all variables, validating the model and highlighting the role of sustainability in shaping consumer behavior, as shown in table 4 and figure 2. The use of SEM in this study provides predictive interpretation within an applied data science framework, allowing researchers to translate behavioral constructs into quantifiable relationships. However, since no out-of-sample validation was performed, the findings should be viewed as confirmatory with predictive implications rather than predictive in the strict statistical sense.

For the first hypothesis, the result shows that SM significantly increases PM (SE = 0.923; CR = 19.347). Consumers feel more engaged and motivated to co-create value when they encounter sustainability-driven marketing such as transparent communication, eco-friendly packaging, and community-based initiatives. This finding supports previous research by [6], [65], and [66], who highlight how SM activates consumers' willingness to participate beyond purchasing. One possible explanation is that SM enhances consumer trust and identification with the brand, making them more willing to contribute ideas, share experiences, and promote products. In addition, sustainability messages resonate with consumers' social values and provide opportunities for them to express their ecological and ethical identity, which strengthens intrinsic motivation to engage in prosumption activities. From a behavioral perspective, SM not only informs but also empowers consumers, transforming them from passive buyers into active contributors in the value creation process. This evidence confirms that marketing strategies grounded in sustainability can catalyze consumer participation, reinforcing the central role of prosumption in sustainability-oriented markets.

Furthermore, for the second hypothesis, the result shows that SM significantly increases consumers' CSC (SE = 0.991; CR = 21.764). This finding suggests that sustainability-oriented marketing practices enhance consumers' awareness of the environmental, social, and ethical implications of their purchasing decisions. When exposed to SM initiatives such as transparent communication, eco-friendly packaging, and cultural sensitivity, consumers become more mindful of how their individual choices contribute to broader sustainability goals. This result aligns with previous studies by [45], [65], and [66], who emphasize that SM not only influences consumer attitudes but also raises awareness of long-term sustainability issues. One possible explanation is that SM provides concrete cues that connect abstract sustainability values with daily consumption, making sustainability more relevant and personally significant. As a result, consumers develop stronger CSC and are more likely to integrate these values into their lifestyle choices.

Additionally, the result of the third hypothesis indicates that PM has a significant positive effect on CSC (SE = 0.742; CR = 19.306). This finding suggests that when consumers are motivated to engage in prosumption activities—such as co-creating, sharing, or promoting products—they also develop a stronger awareness of the social and environmental consequences of their choices. Actively participating in prosumption enables consumers to gain experiential learning, deepening their understanding of sustainability and strengthening their sense of responsibility. This result supports previous research by [6], [31], and [13], who show that PM activities enhance consumer knowledge, ecological concern, and ethical reflection. One possible explanation is that PM encourages consumers to align their personal

values with sustainable practices, leading to heightened consciousness about the impact of consumption on society and the environment. By engaging directly in prosumption, consumers not only consume but also become co-creators of sustainability-oriented lifestyles.

Lastly, for the fourth hypothesis, the result shows a significant reciprocal relationship between PM and CSC (PM → CSC: SE = 0.742; CR = 19.306; CSC → PM: SE = 0.652; CR = 19.306). This finding suggests that the two constructs reinforce each other in a dynamic cycle. On the one hand, consumers who are motivated to participate in prosumption activities—such as sharing knowledge, promoting products, or engaging in co-creation—develop greater awareness of the environmental and social consequences of their choices. On the other hand, consumers who are already highly CSC feel more motivated to engage in PM because it aligns with their ethical values and ecological concerns. This reciprocal effect supports previous studies by [22], [47], and [67], who highlight the interplay between consumer awareness and active participation in sustainability practices. One possible explanation is that PM serves both as a driver and as an outcome of sustainability consciousness, creating a reinforcing feedback loop that strengthens consumer engagement with sustainable lifestyles. This evidence underscores the importance of considering bidirectional relationships in sustainability research, rather than limiting analysis to one-way causal effects. The finding of a two-way association between PM and CSC suggests that motivated consumers tend to develop stronger sustainability consciousness, which in turn reinforces their motivation to engage in prosumption. This relationship should be interpreted as theoretical reciprocity supported by behavioral frameworks, not as empirical causality.

Although the findings support the hypothesized relationships, some studies report weaker or inconsistent effects between SM and consumer motivation. [68] note that even consumers who express pro-sustainability attitudes may not actively engage in green behaviors due to situational barriers or skepticism. Similarly, [69] find that ethical concern alone is insufficient to sustain participation in green consumption. These studies highlight the persistent attitude–behavior gap in sustainability research. In contrast, the strong effects observed in this study may reflect Indonesia's collectivist culture and the growing influence of digital communities, which enhance emotional identification and social participation in SM initiatives. This statement suggests that socio-cultural engagement can amplify PM and CSC, providing a unique contextual insight into sustainability behavior in emerging markets.

5. Conclusion

This study confirms that SM plays a critical role in shaping consumer behavior by significantly increasing both PM and CSC. The analysis also demonstrates a reciprocal relationship between PM and CSC, indicating that consumer participation and awareness reinforce each other in a dynamic feedback loop. By applying SEM with AMOS, this study validates the proposed conceptual framework and provides predictive evidence that links SM to consumer engagement. These findings contribute to theory by integrating SM, PM, and CSC into a unified framework, and they offer practical insights for marketers and policymakers who design strategies to encourage prosumption, enhance consumer involvement, and promote responsible consumption in emerging markets.

From a practical standpoint, marketers can prioritize campaigns that encourage consumer participation and co-creation, such as interactive digital storytelling, user-generated content on sustainability, and community-based reward programs. These initiatives strengthen emotional and social connections with brands while enhancing both personal and corporate satisfaction. For policymakers, the findings highlight the importance of developing programs that support eco-label credibility, facilitate digital access to sustainable products, and foster partnerships with community leaders and influencers to promote sustainable consumption awareness. Together, these actions can enhance consumer engagement and accelerate the transition toward sustainable markets.

Despite these contributions, the study has several limitations. It uses a cross-sectional survey with purposive sampling, which restricts causal inferences and may limit generalizability beyond the Indonesian context. Because this study uses a cross-sectional design, it cannot confirm causal or temporal reciprocity between PM and CSC. Future research should employ longitudinal or experimental designs to capture dynamic behavioral changes and verify the cyclical relationship more precisely. At the same time, this study provides valuable behavioral insights; its purposive sampling design limits generalizability beyond Indonesia's major islands. Future research should expand the sampling frame to include smaller

or rural regions to validate and extend the model's applicability. It should apply longitudinal or experimental designs, expand to other emerging economies, or incorporate larger datasets to strengthen external validity.

From a methodological perspective, this study demonstrates how data science approaches—particularly SEM—transform survey-based consumer data into predictive insights. While the present study focuses on confirmatory modeling using SEM, future research could extend this framework by applying predictive analytics or machine learning methods to larger and more diverse datasets. Such approaches can test the stability of behavioral patterns identified here and enable automated detection of sustainability-related behaviors across different contexts. This recommendation represents a conceptual, rather than empirical, extension of the current study and relies on the future availability of longitudinal or multi-source data. By embedding data science into sustainability research, scholars and practitioners can generate deeper, data-driven insights that support both theoretical advancement and practical strategies for SM and consumer participation.

In addition to sampling and design limitations, potential measurement issues should be acknowledged. Although all constructs meet acceptable reliability and validity thresholds, several items show moderate factor loadings, suggesting limited precision in some indicators. Moreover, despite careful translation, back translation, and pilot testing, cultural nuances may still influence how respondents interpret certain statements. Future research should employ multi-group or cross-cultural validation to confirm the robustness of the measurement model and minimize potential cultural bias in interpretation. Another limitation is that the reliability coefficients for SM and PM, although acceptable, indicate moderate internal consistency. Future studies could refine the measurement scales or include additional items to enhance construct reliability.

6. Declarations

6.1. Author Contributions

Conceptualization: S.F.W., T.A.M., S., U.S., and I.F.; Methodology: I.F.; Software: I.F.; Validation: S.F.W., T.A.M., and U.S.; Formal Analysis: S.F.W., S., and U.S.; Investigation: T.A.M.; Resources: U.S.; Data Curation: S.F.W.; Writing Original Draft Preparation: S.F.W., T.A.M., and I.F.; Writing Review and Editing: S., and I.F.; Visualization: S.F.W.; All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

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6.4. Institutional Review Board Statement

The study was conducted in accordance with the ethical standards of the Universitas Negeri Jakarta Research Ethics Committee. Ethical clearance was obtained through the internal review process of the Institute for Research and Community Service (LPPM) prior to data collection.

6.5. Informed Consent Statement

All participants were informed about the purpose of the research, confidentiality of their responses, and their right to withdraw at any time. Participation was voluntary, and informed consent was obtained from all respondents before completing the survey.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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