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MAPPING DIGITAL DISCOURSES ON BOTTLED DRINKING WATER USING NLP, NETWORK ANALYSIS, AND ZERO-SHOT CLASSIFICATION

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ABSTRACT

This study aims to analyze public discourse on bottled drinking water using a multidimensional social media analytics approach. The study analyzed 531 valid public conversations collected from X/Twitter through the SocialX platform between January and April 2026. The final dataset resulted from a structured preprocessing procedure involving duplicate removal, relevance screening, and text normalization to ensure analytical quality. A multidimensional analytical framework integrating sentiment analysis, emotion analysis, text network analysis (TNA), social network analysis (SNA), trend analysis, and zero-shot classification was employed to examine public discourse from complementary perspectives. To enhance analytical reliability, automated classification outputs were supported by manual validation of a subset of the data. The findings indicate that public discourse was dominated by neutral sentiment and positive emotional expressions. While sentiment analysis showed that most conversations were informational and neutral in tone, zero-shot classification revealed a slightly positive overall perception because many neutral discussions implicitly reflected favorable evaluations of convenience, accessibility, and product usefulness. Network analysis further revealed a decentralized communication structure with multiple influential actors, whereas text network analysis identified dominant themes related to price, product quality, packaging, and sustainability. This study contributes to the consumer behavior, digital communication, and sustainability literature by demonstrating the value of integrating multiple computational social media analytics techniques to capture naturally occurring consumer discourse beyond conventional survey-based approaches. Nevertheless, the findings should be interpreted within the context of a single social media platform and a relatively short observation period.

Keywords: bottled drinking water; consumer perception; natural language processing; social media analysis; sustainability.

INTRODUCTION

Bottled drinking water has developed into one of the most widely consumed products in many countries because it offers practicality, easy access, and a perception of hygiene that aligns with the needs of modern society (Husain et al., 2022; Simanjuntak et al., 2023). Changes in urban lifestyles, increasing public mobility, and the growing demand for ready-to-consumer products have made bottled drinking water an important part of consumers' daily routines (Ajzen, 1991; Aydin, 2025). In the context of the modern market, bottled drinking water is no longer viewed merely as a utilitarian product, but also as a category associated with

convenience, health, and efficiency in everyday activities (Chen et al., 2024).

Nevertheless, the increasing consumption of bottled drinking water has intensified concerns regarding single-use plastic waste and its environmental impact. Growing packaged product consumption contributes to plastic waste generation (Duncan Gillian, 2024; Robin Hicks, 2024), while consumers increasingly consider sustainable packaging when evaluating products (Branca et al., 2024). These concerns are particularly relevant because plastic remains the dominant packaging material for bottled drinking water. In Indonesia, plastic waste management continues to attract public attention (Cindy Mutia Annur, 2023; Gamma Shafina, 2023), alongside broader sustainability challenges associated with packaged products (Gulzar et al., 2024; Rahman et al., 2026). Therefore, bottled drinking water represents an appropriate context for examining consumer behavior and sustainability.

In response to changing market preferences, companies have increasingly adopted environmentally oriented strategies, including recycled materials, plastic reduction, packaging innovation, and green branding (De Canio et al., 2020; Su & Li, 2024). Previous studies consistently show that environmental considerations increasingly influence purchasing decisions beyond price and product functionality. Environmentally friendly packaging has also emerged as an important determinant of sustainable consumer behavior through environmental knowledge, attitudes, and purchase intention (Güngördü Belbağ, 2025). Likewise, environmental knowledge, green consumer trust, and social responsibility strengthen green purchase behavior, particularly among Generation Z (Borah et al., 2024), while moral obligation mediates the relationship between environmental knowledge and green purchase intention (Cui et al., 2024). Consequently, consumers increasingly evaluate products based on both functional and environmental attributes (Al Mamun et al., 2025; Ienna et al., 2022). Nevertheless, positive environmental attitudes and purchase intentions do not always translate into purchasing behavior, indicating the persistence of the intention–behavior gap (Kotyza et al., 2024; Petrescu et al., 2025).

At the same time, digital transformation has changed the way consumers obtain information, form opinions, and interact with brands. Social media has become an open space where users share experiences, reviews,

criticism, and recommendations regarding products (Gunawan et al., 2025; Naaman et al., 2025). Digital information and electronic word-of-mouth have an increasingly strong influence on trust, perceived quality, and consumer purchase preferences (Iliopoulou et al., 2024; Yu et al., 2024). In the context of everyday consumer products such as bottled drinking water, digital conversations can serve as important indicators of how the public evaluates product quality, price, packaging, environmental issues, and brand reputation.

In line with these developments, the use of social media analytics has become increasingly common in marketing and consumer behavior research. This approach enables researchers to utilize naturally generated conversational data through computational methods such as sentiment analysis, emotion analysis, text network analysis, social network analysis, and zero-shot classification (Liu et al., 2025; Song et al., 2024; Sun et al., 2022). These techniques are able to identify dominant themes, emotional tendencies, patterns of relationships among words, and user interaction structures on a large scale (Camacho et al., 2025; Feng et al., 2025). In addition, artificial intelligence-based approaches are increasingly effective in detecting semantic patterns and classifying public opinion in real time (Qi et al., 2025; Shen & Zhang, 2025).

Although previous studies have extensively examined green purchasing behavior, sustainable marketing, and consumer perceptions using theoretical frameworks such as the Theory of Planned Behavior, most have relied on questionnaire-based surveys or experimental designs to explain environmental attitudes and purchase intentions (Borah et al., 2024; Cui et al., 2024; Simanjuntak et al., 2023). More recent studies have begun to investigate digital consumer behavior using computational approaches; however, they generally employ only a single analytical technique, such as sentiment analysis, topic modeling, or social network analysis, resulting in a fragmented understanding of digital public discourse (Camacho et al., 2025; Liu et al., 2025; Song et al., 2024). This limitation is particularly relevant in the context of bottled drinking water, where consumer perceptions simultaneously involve functional value, pricing, environmental sustainability, and public health concerns. Moreover, sustainable consumption and plastic recycling continue to receive considerable public attention in Indonesia (Adi Ahdiat, 2024; Sheany Yasuko Lai, 2025). Therefore, a multidimensional

computational social media analytics approach is required to capture naturally occurring consumer discourse and provide a more comprehensive understanding of public perceptions in real-world digital environments.

Accordingly, this study addresses the identified research gap by integrating sentiment analysis, emotion analysis, text network analysis (TNA), social network analysis (SNA), trend analysis, and zero-shot classification within a single analytical framework. Unlike previous studies that primarily employed survey methods or a single computational technique, this multidimensional approach simultaneously captures emotional tendencies, semantic relationships, interaction structures, temporal dynamics, and perception-based classifications, providing a more comprehensive understanding of consumer perceptions toward bottled drinking water in relation to sustainability, pricing, product quality, health, and everyday consumption.

The study is conceptually grounded in the Theory of Planned Behavior (TPB), which posits that behavioral intention is shaped by individuals' attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991). Within digital environments, these underlying psychological factors are frequently expressed through spontaneous online conversations, opinions, and interactions shared on social media platforms. Consequently, analyzing naturally occurring digital discourse provides an opportunity to capture consumer evaluations and behavioral tendencies in a real-world context, thereby complementing conventional survey-based applications of TPB. By integrating the TPB perspective with multidimensional computational social media analytics, this study extends the application of the theory beyond traditional self-reported measures and offers a richer understanding of how consumer perceptions and sustainability-related narratives surrounding bottled drinking water emerge and evolve in digital public spaces. Therefore, this study contributes not only by advancing methodological applications in computational social media analytics but also by enriching the literature on consumer behavior, digital communication, and sustainability through a multidimensional analysis of real-time public discourse.

Therefore, this study aims to analyze public conversations regarding bottled drinking water through the SocialX platform in order to identify dominant themes, sentiment orientation, emotional

patterns, text-based relationships, social interaction structures, and temporal trends within the digital public sphere. To guide the analysis in a structured manner, this study formulates the following research questions:

RQ1. How is public discourse on bottled drinking water structured and distributed within social media interactions?

RQ2. What are the dominant themes, sentiments, and emotional patterns expressed in public conversations regarding bottled drinking water?

RQ3. Who are the key actors within the social network, and how do they influence the flow and structure of digital conversations?

RQ4. How do temporal dynamics and classification-based perceptions reflect broader consumer attitudes and emerging issues related to bottled drinking water?

LITERATURE REVIEW

Consumer behavior literature explains that purchasing decisions are shaped by a combination of attitudes, subjective norms, perceived behavioral control, and evaluations of expected benefits. The Theory of Planned Behavior emphasizes that intention is one of the most important predictors of actual behavior, although this relationship may be influenced by situational and external factors (Ajzen, 1991). In the context of modern consumer goods, purchasing decisions are not determined solely by functional needs, but are also influenced by brand image, perceived quality, accessibility, and compatibility with consumers' lifestyles (Husain et al., 2022; Simanjuntak et al., 2023). Accordingly, bottled drinking water can be understood as a product category whose market performance is highly dependent on dynamic consumer perceptions and evolving preferences.

As environmental awareness increases, green consumption has become increasingly important in contemporary markets. Green products are designed to minimize environmental impacts while maintaining their functional benefits (Laheri et al., 2024; Su & Li, 2024). Previous studies show that eco-friendly packaging, sustainable materials, and corporate environmental commitments positively influence consumer evaluations and purchase intentions (De Canio et al., 2020; Rukhsar et al., 2025). These sustainability issues are particularly relevant to the bottled drinking water industry because of its dependence on single-use plastic packaging and the resulting environmental burden.

Beyond product attributes, environmental knowledge plays an

important role in shaping consumer attitudes and behavioral preferences. Individuals with greater understanding of environmental consequences are more likely to support environmentally responsible products and sustainable alternatives, including recyclable packaging and circular economy initiatives (Borah et al., 2024; Cui et al., 2024). Nevertheless, environmental knowledge and positive attitudes do not always translate into purchasing behavior because consumers remain influenced by price, convenience, habits, and product availability (Kotyza et al., 2024; Petrescu et al., 2025). This intention–behavior gap is particularly evident in bottled drinking water consumption, where convenience frequently outweighs environmental considerations.

The rapid growth of digital platforms has transformed consumer decision-making, with online reviews, peer recommendations, and digital conversations increasingly influencing brand evaluation and purchasing decisions (Iliopoulou et al., 2024; Yu et al., 2024). Electronic word-of-mouth further shapes trust and perceived quality by rapidly disseminating information to broad audiences (Gunawan et al., 2025; Naaman et al., 2025). In the bottled drinking water industry, digital discourse reflects consumer concerns regarding price, product quality, packaging, convenience, environmental sustainability, and brand reputation.

In recent years, social media has also developed into an important data source for consumer research. Social media analytics enables researchers to examine spontaneous public opinions through methods such as sentiment analysis, emotion detection, topic classification, text mining, and network analysis (Liu et al., 2025; Song et al., 2024). These techniques can provide real-time insights into what consumers discuss, which issues become dominant, and how public attitudes evolve over time (Feng et al., 2025; Sun et al., 2022). Furthermore, social network analysis helps identify influential actors and information diffusion patterns, while text network analysis reveals semantic relationships among concepts discussed in public discourse (Camacho et al., 2025; Z. Tian et al., 2022).

Although studies on green purchasing behavior, consumer perception, and sustainable marketing have expanded substantially, research specifically integrating bottled drinking water issues with multidimensional social media analytics remains limited (Adi Ahdiat, 2024; Sheany Yasuko Lai, 2025; H. Tian

& Liu, 2022). Most prior studies continue to rely on surveys or experiments using structured variables, while naturally occurring digital discourse has received less attention. This limitation is important because online conversations may provide more immediate and authentic insights into how consumers evaluate bottled drinking water in terms of quality, affordability, convenience, sustainability, and trust. Accordingly, this study is positioned within the intersection of consumer behavior, digital communication, and sustainability discourse perspectives. The Theory of Planned Behavior (Ajzen, 1991) provides the theoretical foundation for understanding how attitudes, perceptions, and social evaluations may shape consumer-related discourse and behavioral tendencies regarding bottled drinking water consumption. In addition, social media platforms can be understood as digital public spaces where consumers collectively construct and disseminate opinions through online interactions. Within this context, digital conversations are not merely reflections of individual preferences, but also socially constructed narratives shaped by communication patterns, information diffusion, and public engagement dynamics. Therefore, the present study addresses this gap by utilizing SocialX to comprehensively analyze public conversations surrounding bottled drinking water through a multidimensional computational social media analytics approach

RESEARCH METHOD

This study employed a quantitative exploratory research design using computational social media analytics to examine public conversations regarding bottled drinking water on X/Twitter. The research focused on naturally occurring user-generated content, enabling the capture of spontaneous opinions, interactions, and discourse within a real digital environment. Compared with conventional survey-based approaches, this method provides more dynamic, real-time insights into consumer perceptions, behavioral tendencies, and emerging issues related to bottled drinking water.

The data were collected using SocialX, a web-based big data analytics platform designed for multi-source social media data collection, monitoring, and computational analysis. Although the platform provides access to various digital and social media sources, this study specifically focused on public conversations collected from X/Twitter. SocialX was utilized primarily for data extraction and preprocessing, while the

final analytical decisions, coding framework, validation procedures, interpretation of findings, and theoretical contextualization were independently conducted by the authors. To ensure methodological transparency and analytical rigor, the research workflow, keyword selection, observation period, preprocessing procedures, inclusion and exclusion criteria, duplicate filtering stages, and analytical processes were systematically documented throughout the study.

The observation period covered 1 January 2026 to 25 April 2026. To ensure comprehensive coverage of relevant discussions, the data retrieval process applied the following keyword combinations: “bottled drinking water” OR “packaged drinking water” OR “bottled water” OR “mineral water” OR “plastic bottle.” These keywords were selected to capture not only direct references to bottled drinking water products, but also broader discussions related to packaging, consumption behavior, and environmental concerns. To enhance the transparency and reproducibility of the data collection process, data retrieval was conducted in several sequential stages. First, all publicly available conversations containing the predefined keywords were extracted from X/Twitter through the SocialX platform within the specified observation period. Second, the retrieved dataset was screened to remove duplicate records, spam-like content, promotional or advertising posts, irrelevant conversations, and posts lacking meaningful textual information based on the established inclusion and exclusion criteria. Third, the remaining data underwent text preprocessing, including the removal of URLs, usernames, hashtags, special characters, and other non-informative elements, followed by text normalization and tokenization. These procedures were implemented to improve textual consistency, reduce analytical noise, and ensure that only contextually relevant conversations were retained for subsequent computational analyses.

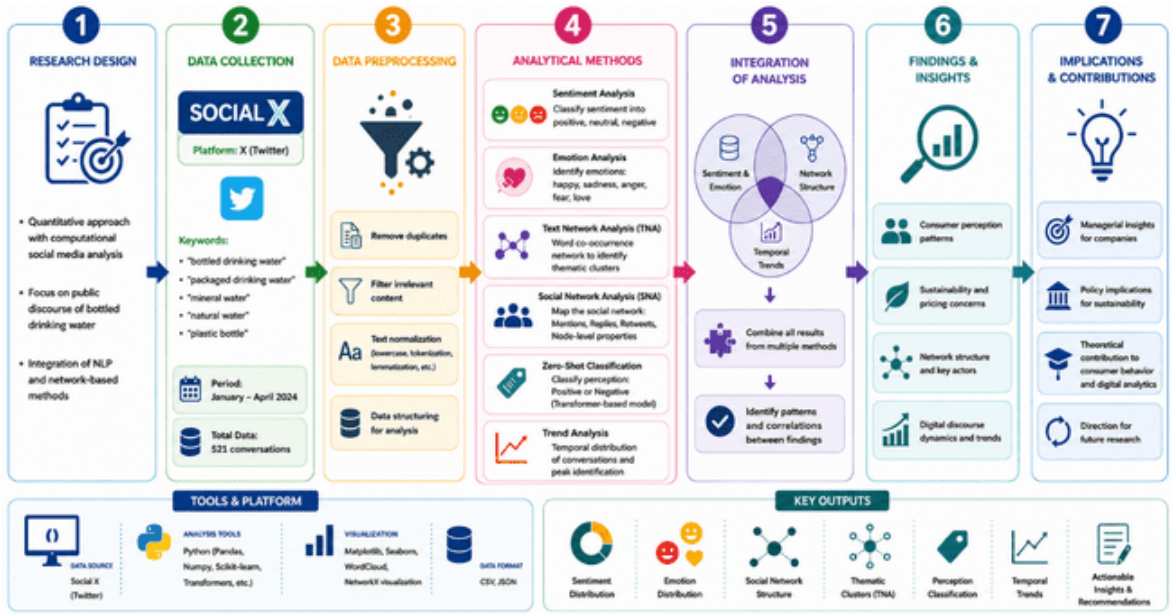


Figure 1. Research Methodology Framework
Source: SocialX analysis (2026).

Following data collection, a data preprocessing stage was conducted to improve data quality and analytical reliability. The initial dataset was screened to remove duplicate entries, irrelevant content, spam-like posts, and records lacking meaningful textual information. Subsequently, text normalization procedures were applied, including the removal of hyperlinks, usernames, special symbols, and non-informative characters, as well as standardization of repeated words and typographical variations. Tokenization and keyword cleaning were also performed to support subsequent text-based analysis. After this process, the final dataset consisted of 531 valid public conversations used in the analytical stage. The final dataset of 531 public conversations was not determined as a predefined sample size but resulted from a systematic data collection and screening process. All publicly available posts retrieved during the observation period using the predefined keywords were initially collected. Subsequently, duplicate records, irrelevant posts, spam-like content, advertisements, and posts lacking meaningful textual information were excluded based on the established inclusion and exclusion criteria. Consequently, the remaining 531 conversations represented the complete set of valid observations that met the analytical requirements of this study. Considering that this research employed an exploratory computational social media analytics approach rather than statistical hypothesis testing, the emphasis was placed on data relevance, content quality,

and contextual richness rather than achieving a predetermined sample size.

To obtain a multidimensional understanding of digital discourse, several analytical methods were applied. Trend analysis was used to identify temporal patterns and fluctuations in conversation volume. Word cloud analysis was employed to visualize frequently occurring keywords and highlight dominant themes. Sentiment analysis classified conversations into positive, neutral, and negative categories, while emotion analysis identified emotional tendencies, including happiness, sadness, anger, fear, and love.

To further explore semantic structures, text network analysis (TNA) was conducted by mapping co-occurrence relationships among keywords to identify central terms and thematic clusters. In addition, social network analysis (SNA) was performed using mention-based interactions among users to examine communication structures, influential actors, and clustering patterns within the network. Metrics including degree centrality, network density, modularity, and connected components were employed to quantitatively evaluate network structure, identify key actors, and examine the overall connectivity and clustering patterns within the conversation network.

This study also employed zero-shot classification, an artificial intelligence–based natural language processing (NLP) approach that enables text categorization without task-specific labeled data. The classification process utilized a pre-trained transformer-based natural language inference model integrated within the SocialX platform, allowing conversations to be categorized into broader perception classes, namely positive and negative orientations toward bottled drinking water, based on semantic similarity between textual content and predefined labels. This approach is particularly suitable for exploratory research with limited labeled datasets because it enables the classification of naturally occurring social media conversations without requiring manually annotated training data. In addition to zero-shot classification, the SocialX platform applies NLP techniques to identify sentiment polarity and emotional expressions by considering contextual language patterns commonly found in Indonesian social media conversations. To enhance analytical reliability, the platform provides confidence scores for classification outputs, allowing researchers to assess the consistency of

model predictions before interpretation. The reliability of the automated classification process was strengthened through a two-stage validation strategy. First, the confidence scores generated by the platform were used as an internal indicator of prediction certainty, enabling the researchers to assess the reliability of each classification output before interpretation.

Furthermore, a manual validation procedure was conducted on a randomly selected subset of the dataset. Independent coders reviewed the contextual appropriateness of sentiment categories, emotional classifications, and zero-shot classification outputs. Discrepancies between automated outputs and manual interpretation were discussed and resolved through consensus-based evaluation. This combination of automated NLP analysis and manual validation was adopted to reduce potential classification bias and strengthen interpretative consistency throughout the analytical framework.

To enhance analytical robustness, an integration of analysis was conducted by interpreting results across multiple methods. Findings from sentiment analysis were compared with emotion patterns, while text network outputs were analyzed alongside word frequency distributions and temporal trends. This triangulation approach reduces reliance on a single analytical technique and enables a more comprehensive interpretation of public discourse.

Because the study relied on publicly available social media data, no direct interaction with individuals was involved. Nevertheless, ethical considerations were maintained by analyzing the data in aggregate form and avoiding the disclosure of sensitive personal information beyond publicly accessible identifiers. The findings are presented solely for academic purposes related to consumer behavior, sustainability, and digital communication research.

RESULT AND DISCUSSION

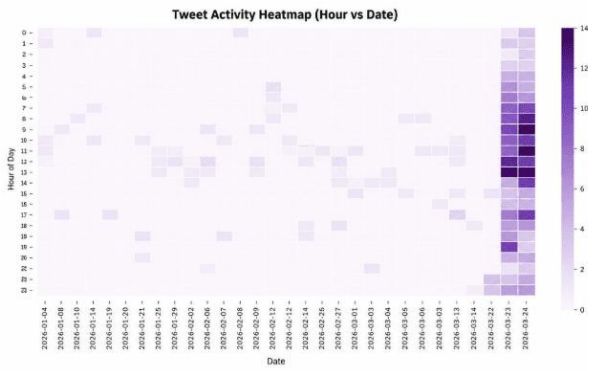
Data Overview

The dataset used in this study consisted of 531 public conversations collected from the X/Twitter platform during the observation period from 1 January 2026 to 25 April 2026. Data retrieval was conducted using a keyword combination consisting of “bottled drinking water,” “packaged drinking water,” “bottled water,” “mineral water,” and “plastic bottle.” The use of multiple keywords was intended to capture a broader range of public discourse, including consumption behavior, product

perceptions, environmental concerns, and practical hydration needs in digital spaces.

Overall, the dataset represents various forms of public responses toward bottled drinking water, including personal opinions, consumer complaints, price-related discussions, product usage experiences, and concerns regarding plastic packaging. Therefore, the collected data were not limited to direct product mentions, but also included conversations associated with broader sustainability and consumption issues.

The temporal distribution demonstrates a progressive growth pattern throughout the observation period. During the early stage of January, conversation intensity remained relatively low, with 10 posts recorded on 4 January 2026, increasing to 17 posts on 15 January 2026. This pattern suggests that public discussion at the beginning of the year was still limited and relatively routine, without major spikes in attention.



Source: SocialX analysis (2026)

Figure 2. Tweet Activity Heatmap (Hour vs Date) on X/Twitter

Entering February, conversation volume increased more steadily. Public activity reached 30 posts on 5 February 2026 and rose to 34 posts on 14 February 2026. This upward movement indicates growing attention toward bottled drinking water topics, particularly in relation to everyday consumption needs, product availability, and practical purchasing discussions. During March, the growth trend continued with stronger intensity. The number of conversations increased to 40 posts on 4 March 2026 and reached 51 posts on 15 March 2026. Compared with previous months, this phase reflects a more active expansion of digital discourse and greater public visibility of the topic.

The most significant increase occurred in April. A sharp rise was observed on 1 April 2026, when conversation volume reached 150 posts, followed by a further increase to the highest peak of 196 posts on 25 April 2026. This substantial escalation indicates intensified public attention during the final stage of the observation period. Yet from a moving average perspective, the overall trend line also shows a continuous upward direction from January to late April. This indicates that the increase in discussion volume was not merely a short-term

fluctuation, but part of a broader and sustained growth pattern in online discourse.

From an interpretative perspective, the stronger discussion activity observed in April may reflect increasing engagement with bottled drinking water topics related to daily consumption, pricing concerns, packaging issues, and environmental awareness. However, this pattern should be interpreted as an observed association within the dataset rather than a direct causal conclusion. Overall, the dataset demonstrates adequate breadth in terms of conversation volume, thematic diversity, and temporal development. With a clear growth pattern and dynamic distribution of discussions, the data are considered suitable for subsequent analyses such as trend analysis, word cloud analysis, sentiment analysis, text network analysis, social network analysis, emotion analysis, and zero-shot classification to better understand public perceptions of bottled drinking water in the digital sphere.

Word cloud Analysis

Word cloud analysis was conducted to identify the most dominant keywords appearing in public conversations regarding bottled drinking water on X/Twitter. This visualization was generated from a subset of 36 relevant textual posts selected from the broader dataset after relevance screening. Posts with clear contextual references to bottled drinking water consumption, packaging, pricing, or related public perceptions were retained, while ambiguous or unrelated content was excluded. The selected data covered the observation period from 1 January 2026 to 25 April 2026, providing a representative overview of discussion themes during the study period.

Source: SocialX analysis (2026)

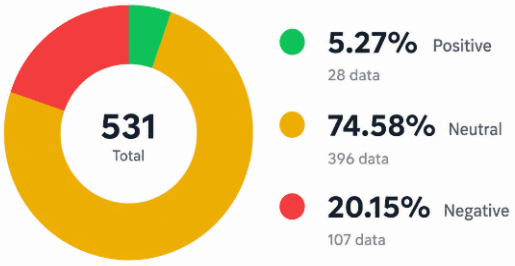
Figure 3. Word cloud illustrating key themes in X/Twitter conversations on bottled drinking water.

The resulting word cloud shows that the term “mineral” appeared as the most dominant keyword in the dataset. This prominence suggests that public conversations frequently associate bottled drinking water with the broader category of mineral water, which is commonly used in everyday language. The finding indicates that many users frame bottled drinking water primarily through its functional role as a practical and accessible source of hydration. Other

highly visible terms include “bottle,” “plastic,” and “drink.” The presence of “bottle” emphasizes that packaging form remains an important component of public discourse, while the appearance of “plastic” suggests growing awareness of packaging materials and environmental consequences. These terms indicate that conversations do not only focus on product consumption, but also extend to sustainability concerns, waste generation, and preferences regarding packaging choices.

Several economically oriented terms also emerged, including “buy,” “price,” and “expensive.” Their presence suggests that affordability and purchasing decisions are meaningful dimensions in public discussions. Users appear to evaluate bottled drinking water not only as a daily necessity, but also in relation to perceived value and price sensitivity. In addition, words such as “glass,” “tumbler,” and “health” were visible in the visualization. The appearance of “tumbler” and “glass” may indicate references to alternative drinking containers or reusable consumption habits that are perceived as more practical or environmentally friendly. Meanwhile, the term “health” suggests that part of the discourse links bottled drinking water to safety, hygiene, and personal well-being.

Overall, the word cloud reveals that public conversations regarding bottled drinking water are multidimensional, combining themes of basic consumption needs, packaging form, pricing considerations, health awareness, and environmental responsibility. While functional consumption remains central, the prominence of sustainability and affordability-related terms suggests that consumer perceptions are becoming increasingly complex in the digital public sphere.



These findings are consistent with previous studies reporting that digital conversations surrounding consumer products commonly extend beyond functional product attributes to include broader sustainability, health, and economic considerations. Recent studies have shown that social media discussions provide valuable insights into how consumers simultaneously evaluate product quality, environmental responsibility, and purchasing decisions within digital environments (Liu et al., 2025; Yu et al., 2024). In the context of

bottled drinking water, the prominence of terms related to packaging, pricing, and environmental issues suggests that consumers increasingly integrate practical and sustainability-related concerns when discussing everyday consumption products. This finding extends previous consumer behavior research by demonstrating that naturally occurring digital conversations can reveal multidimensional consumer evaluations that may not be fully captured through conventional survey-based approaches.

Sentiment Analysis

Sentiment analysis was conducted to examine the overall polarity of public conversations regarding bottled drinking water on X/Twitter. The dataset consisted of 531 public posts, which were classified into three sentiment categories: positive, negative, and neutral. This approach provides an overview of how users generally respond to bottled drinking water topics in the digital public sphere.

Source: SocialX analysis (2026)
Figure 4. Donut Chart Illustrating The Sentiment Distribution Of 531 Public Conversations.

The results indicate that public discourse was dominated by the **neutral** category, with **396 conversations (74.58%)**, followed by **107 negative (20.15%)** and **28 positive conversations (5.27%)**. The predominance of neutral sentiment suggests that bottled drinking water is primarily discussed in informational and routine contexts related to purchasing, availability, hydration, and everyday consumption. In contrast, negative sentiment reflects concerns about prices, affordability, plastic waste, environmental sustainability, and dissatisfaction with consumption experiences, while positive sentiment highlights convenience, accessibility, trusted quality, and product usefulness.

Overall, the findings indicate that bottled drinking water remains a utilitarian product characterized by predominantly neutral discussions, alongside growing public attention to affordability, sustainability, and product value. These results are consistent with previous studies showing that everyday consumer products are typically associated with neutral or informational discourse emphasizing functionality and accessibility (Husain et al., 2022; Simanjuntak et al., 2023). At the same time, the notable proportion of negative sentiment supports recent evidence that environmental concerns and price sensitivity increasingly shape consumer evaluations of packaged

products (Borah et al., 2024; Cui et al., 2024). Unlike survey-based studies, the present findings demonstrate that these concerns emerge organically through naturally occurring digital conversations, highlighting the value of social media analytics as a complementary approach to consumer behavior research.

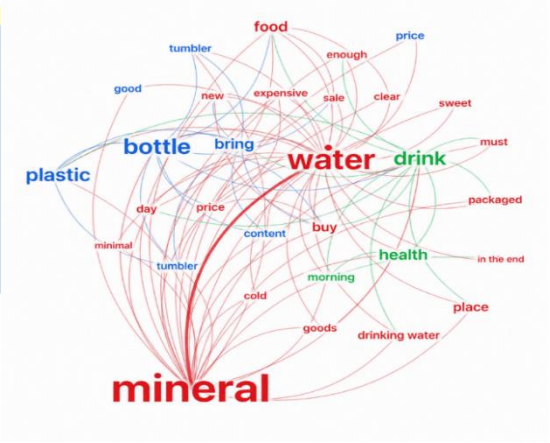
Text Network Analysis

Text network analysis was conducted to examine the semantic relationships among keywords appearing in public conversations regarding bottled drinking water on X/Twitter. The network was constructed based on word co-occurrence patterns, where each keyword represents a node and each connection represents the frequency with which two words appeared together within the same conversational context. This method enables the identification of dominant concepts, thematic clusters, and the structural organization of discourse within the dataset. The resulting network shows that several keywords occupied central positions, particularly "mineral," "water," and "bottle." The larger node sizes of these terms indicate higher frequencies of occurrence and stronger connectivity with other words in the network. Their centrality suggests that public discourse primarily revolves around the core functional identity of bottled drinking water as a packaged hydration product used in everyday life.

Source: SocialX analysis (2026)

Figure 5. Text network of keywords in bottled drinking water conversations on X/Twitter.

A strong connection was observed between the term's "mineral" and "water," indicating that bottled drinking water is primarily discussed in relation to mineral water. Additional links among "water," "bottle," and "drink" further highlight the dominance of practical consumption and everyday product use. Beyond this core cluster, keywords such as "price,"



"expensive," and "buy" indicate that affordability and purchasing decisions were important themes in public discourse.

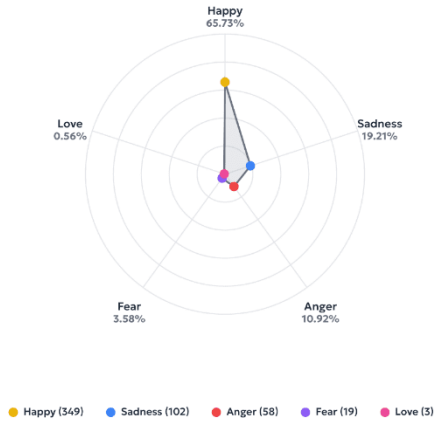
Another cluster centered on sustainability and health, represented by terms including "plastic," "health," and "packaging." These connections suggest growing public attention to plastic waste, packaging, and product safety. Overall,

the semantic network reveals three interconnected themes: consumption utility, economic evaluation, and sustainability-health concerns, demonstrating that consumer discourse extends beyond product functionality to broader economic and environmental considerations.

These findings are consistent with previous studies showing that semantic network analysis identifies central concepts and thematic relationships within large-scale consumer discourse (Schöps & Jaufenthaler, 2024). The prominence of highly connected keywords such as "mineral," "water," and "bottle" reflects dominant consumer associations, while the emergence of affordability and sustainability clusters highlights multidimensional consumer perceptions that are difficult to capture through conventional survey-based approaches.

Emotion Analysis

Emotion analysis was conducted to identify the dominant emotional tendencies expressed in public conversations regarding bottled drinking water on X/Twitter. Unlike conventional sentiment analysis that focuses primarily on positive, negative, or neutral polarity, emotion analysis provides deeper insight into specific affective responses reflected in user-generated content. In this study, five emotional categories were examined: happy, sadness, anger, fear, and love.



Source: SocialX Analysis (2026)
Figure 6. Distribution of five emotion categories in public conversations.

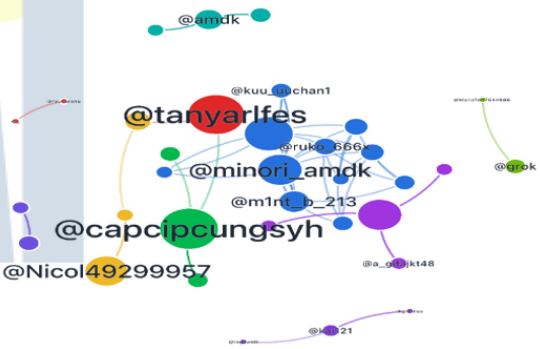
The results indicate that public discourse was dominated by the happy category, with 349 conversations (65.73%), suggesting that bottled drinking water is commonly discussed in positive, casual, and functional contexts related to convenience, hydration, travel, and everyday consumption. Sadness accounted for 102 conversations (19.21%), reflecting concerns about product prices, environmental issues, and dissatisfaction with consumption experiences. Anger represented 58 conversations (10.92%), primarily associated with criticism of pricing, plastic packaging, and environmental responsibility, while fear accounted for 19

conversations (3.58%), indicating limited concerns related to health, water quality, and product standards. Love was the least frequent emotion, with only 3 conversations (0.56%), suggesting that bottled drinking water is viewed primarily as a utilitarian product rather than one that generates strong emotional attachment.

Overall, the emotional distribution indicates that public perceptions are shaped mainly by practical consumption experiences while also reflecting growing concerns about affordability and sustainability. These findings complement the sentiment analysis by showing that, although discussions are predominantly neutral, consumers continue to associate bottled drinking water with convenience and accessibility, consistent with previous studies on utilitarian products (Husain et al., 2022; Simanjuntak et al., 2023). At the same time, the presence of sadness and anger supports recent evidence that environmental sustainability, plastic packaging, and affordability increasingly influence consumer evaluations (Borah et al., 2024; Cui et al., 2024). Thus, emotion analysis provides complementary insights into the affective dimensions of consumer discourse beyond sentiment polarity alone.

Social Network Analysis

Social Network Analysis (SNA) was conducted to examine the interaction structure among users participating in public conversations regarding bottled drinking water on X/Twitter. The network was constructed using mention-based relationships, where each account represents a node and each mention between users represents an edge. This approach enables the identification of influential actors, interaction intensity, community clusters, and the overall structure of information exchange within the digital conversation space.



Source: SocialX analysis (2026)
Figure 7. Mention-based social network of bottled drinking water conversations on X/Twitter

The resulting network indicates a decentralized communication structure in which discussions were distributed across several interconnected accounts rather than dominated by a single actor. Prominent nodes, including @tanyarlfes, @minori_amdk, and @capcipcungsyh,

exhibited high connectivity and served as key interaction hubs within the network.

Network metrics further showed a low-to-moderate density, indicating selective interactions rather than a fully connected community. The presence of multiple community clusters and connected components suggests that discussions were fragmented across several user groups, reflecting diverse topics such as daily consumption, pricing, packaging, and sustainability.

Overall, the findings demonstrate that bottled drinking water discourse evolved through decentralized and participatory communication supported by several influential accounts and smaller communities. This pattern is consistent with previous studies showing that social media interactions facilitate information diffusion through multiple influential actors rather than a single dominant source (Iliopoulou et al., 2024; Yu et al., 2024). The results highlight the role of electronic word-of-mouth (e-WOM) in shaping consumer perceptions and show that social network analysis provides valuable insights into how consumer discourse is socially constructed in digital environments.

Trend Analysis

Trend analysis was conducted to examine the temporal dynamics of public conversations regarding bottled drinking water on X/Twitter during the observation period from 4 January to 25 April 2026. By tracking fluctuations in posting volume over time, this analysis provides insight into changes in public attention and the intensity of digital discourse surrounding bottled drinking water.

Source: SocialX analysis (2026)

Figure 8. Temporal trend of bottled drinking water conversations on X/Twitter.

Trend analysis demonstrated a gradual increase in conversation volume throughout the observation period. Discussion activity remained relatively low in January, increased steadily in February and March, and reached its highest level in April 2026. Conversation volume rose from 40 posts on 4 March to 51 posts on 15 March before increasing sharply to 150 posts on 1 April and peaking at 196 posts on 25 April,

indicating growing public attention toward bottled drinking water.

The moving average also showed a consistent upward trend, increasing from approximately 23 in January to over 110 by late April, suggesting that the rise in discussion volume reflected sustained rather than temporary growth. The increased activity may be associated with greater public interest in affordability, packaging, sustainability, and everyday consumption, although this represents an observed association rather than a causal relationship. Overall, the findings indicate that bottled drinking water became an increasingly prominent topic in digital public discourse during the observation period.

Zero-Shot Classification

Zero-shot classification was applied to all 531 public conversations collected from X/Twitter in order to identify broader evaluative perceptions toward bottled drinking water. This method was selected because it allows text categorization without requiring manually labeled training data, making it suitable for exploratory studies using naturally generated social media discourse. Through the SocialX analytical environment, a transformer-based natural language inference model was used to compare each post with predefined category labels based on semantic similarity.

Source: SocialX analysis (2026)

Figure 9. Distribution of positive and negative perceptions based on zero-shot classification.

Two classification labels were established: **positive perception** and **negative perception**. Positive perception included expressions related to convenience, accessibility, practicality, trust, usefulness, and satisfaction, whereas negative perception reflected concerns about prices, plastic waste, environmental sustainability, dissatisfaction, and product limitations. Each post was assigned to the category with the highest model confidence score.

The results showed that **303 conversations (57.06%)** were classified as positive perception and **228 conversations (42.94%)** as negative perception, indicating that bottled drinking water is generally perceived as a practical product despite persistent concerns regarding affordability and

environmental sustainability. To improve reliability, zero-shot classification outputs were cross-checked with sentiment analysis results and validated through manual review of randomly selected posts. Overall, the findings reveal a dual consumer perspective in which practical benefits remain important while expectations regarding sustainability and responsible packaging continue to increase.

Overall, public discourse surrounding bottled drinking water is shaped by practical consumption needs, affordability, sustainability, and digital interactions. The dominance of neutral sentiment, positive emotional expressions, and central keywords such as *mineral*, *water*, and *bottle* confirms that bottled drinking water is primarily viewed as a utilitarian product, consistent with previous studies (Husain et al., 2022; Simanjuntak et al., 2023) and the Theory of Planned Behavior (Ajzen, 1991). At the same time, concerns regarding plastic waste and pricing support previous findings that sustainability increasingly influences consumer evaluations (Borah et al., 2024; Cui et al., 2024; Laheri et al., 2024). Unlike survey-based studies, this research demonstrates that such concerns emerge naturally through online discourse.

Social network analysis further indicates that public conversations developed through decentralized interaction networks with multiple influential actors, reinforcing the role of electronic word-of-mouth and participatory communication in shaping consumer perceptions (Iliopoulou et al., 2024; Yu et al., 2024). Trend analysis also revealed increasing discussion intensity over the observation period, suggesting growing public attention to sustainability, affordability, and packaging issues (Gunawan et al., 2025; Naaman et al., 2025).

Theoretically, this study demonstrates that naturally occurring digital discourse complements conventional survey-based approaches in consumer behavior and sustainability research. By integrating sentiment analysis, emotion analysis, text network analysis, social network analysis, trend analysis, and zero-shot classification, the study provides a multidimensional framework for understanding consumer discourse and offers practical insights for firms and policymakers in developing sustainability-oriented communication, packaging, and pricing strategies.

CONCLUSION

This study analyzed public conversations regarding bottled drinking water on X/Twitter using a multidimensional social media analytics approach. The findings indicate that bottled drinking water is primarily perceived as a practical and utilitarian product while public discourse increasingly reflects concerns about sustainability, plastic packaging, affordability, and environmental responsibility. The study also demonstrates that digital conversations develop through decentralized communication networks with multiple influential actors and interconnected thematic clusters, suggesting that public perceptions are collectively shaped through online interactions.

Theoretically, this study contributes to consumer behavior and sustainability communication literature by demonstrating the value of naturally occurring digital discourse for understanding consumer perceptions and emerging public issues. Methodologically, it shows the potential of integrating multiple computational social media analytics techniques to capture complex discourse patterns beyond conventional survey-based approaches. Practically, the findings provide insights for producers, marketers, and policymakers to develop sustainability-oriented communication, environmentally responsible packaging, and consumer engagement strategies that better align with evolving public expectations. Overall, this study extends the application of the Theory of Planned Behavior to digital communication contexts and provides a foundation for future research on consumer behavior, sustainability communication, and digital public discourse.

Limitations and recommendations for further research

Although this study provides insights into public discourse on bottled drinking water using multidimensional computational social media analytics, several limitations should be considered. These limitations define the scope of the findings and suggest directions for future research.

First, this study relied exclusively on publicly available conversations collected from X/Twitter. Although the platform provides valuable real-time consumer discussions, its user demographics, communication styles, and engagement patterns may differ from those of other social media platforms. Therefore, the findings should not be generalized to all

online environments. Future studies are encouraged to incorporate multiple platforms, such as Instagram, TikTok, Facebook, Reddit, or online discussion forums, to obtain a more comprehensive understanding of consumer perceptions and digital communication dynamics.

Second, the observation period covered only four months (January–April 2026), providing a cross-sectional snapshot of public discourse. Because consumer discussions are dynamic and may change in response to policy, market, or environmental developments, the findings should be interpreted within the study period. Future research is encouraged to conduct longitudinal analyses over longer observationperiods.Finally, although the SocialX platform employs advanced Natural Language Processing (NLP) techniques, automated text classification may still encounter challenges in interpreting sarcasm, implicit meanings, regional expressions, and contextual language. Although manual validation was conducted to improve reliability, some contextual nuances may remain difficult to capture. Future studies could strengthen analytical robustness by employing fine-tuned transformer models, larger manually annotated datasets, or mixed-method approaches combining computational social media analytics with qualitative content analysis or survey-based research.

REFERENCES

Adi Ahdiat. (2024, May 5). *Kenapa konsumen Indonesia tak beli produk berkelanjutan? Databoks.* https://databoks.katadata.co.id/pendidikan/statistik/e922b7a1c6a8bc8/kenapa-konsumen-indonesia-tak-beli-produk-berkelanjutan-ini-surveinya

Ajzen, I. (1991). The Theory of Planned Behavior. In *ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES* (Vol. 50). https://doi.org/https://doi.org/10.1016/0749-5978(91)90020-T

Al Mamun, A., Yang, M., Hayat, N., Gao, J., & Yang, Q. (2025). The nexus of environmental values, beliefs, norms and green consumption intention. *Humanities and Social Sciences Communications*, *12*(1). https://doi.org/10.1057/s41599-025-04979-6

Aydin, G. (2025). Thresholds of Sustainability: Necessary and Sufficient Conditions for Green Buying Behavior. *Sustainability (Switzerland)*, *17*(11). https://doi.org/10.3390/su17114965

Borah, P. S., Dogbe, C. S. K., & Marwa, N. (2024). Generation Z's green purchase behavior: Do green consumer knowledge, consumer social responsibility, green advertising, and green consumer trust matter for sustainable development? *Business Strategy and the Environment*, *33*(5), 4530–4546. https://doi.org/10.1002/bse.3714

Branca, G., Resciniti, R., & Babin, B. J. (2024). Sustainable Packaging Design and the Consumer Perspective: A Systematic Literature Review. *Italian Journal of Marketing*, *2024*(1), 27–55. https://doi.org/10.1007/s43039-023-00084-1

Camacho, L. J., Banks, M., Sookhai, S., & Concepción, E. (2025). Redimensioning the theory of planned behavior on workplace energy saving intention The mediating role of environmental knowledge and organizational culture. *Sustainability (Switzerland)*. https://doi.org/https://doi.org/10.3390/su17083574

Chen, C., Li, D., Qian, J., & Li, Z. (2024). The Impact of Green Purchase Intention on Compensatory Consumption: The Regulatory Role of Pro-Environmental Behavior. *Sustainability (Switzerland)*, *16*(18). https://doi.org/10.3390/su16188183

Cindy Mutia Annur. (2023, July 5). Inilah Negara Penghasil Sampah Terbesar Dunia, Ada Indonesia? . *Databoks*. https://databoks.katadata.co.id/infografik/2023/07/05/inilah-negara-penghasil-sampah-terbesar-dunia-ada-indonesia

Cui, M., Li, Y., & Wang, S. (2024). Environmental Knowledge and Green Purchase Intention and Behavior in China: The Mediating Role of Moral Obligation. *Sustainability (Switzerland)*, *16*(14). https://doi.org/10.3390/su16146263

De Canio, F., Martinelli, E., & Endrighi, E. (2020). Enhancing consumers' pro-environmental purchase intentions: the moderating role of environmental concern. *International Journal of Retail and Distribution Management*, *49*(9), 1312–1329. https://doi.org/10.1108/IJRDM-08-2020-0301

Duncan Gillian. (2024, September 3). One million bottles of water bought every minute around the world. The National. *The National*, 1–1. https://www.thenationalnews.com/health/2024/09/25/one-million-bottles-of-water-bought-every-minute-around-the-world/

Feng, Y., Feng, Y., & Liu, Z. (2025). The Impact Mechanism of Government Environmental Regulation and Green Consumer Orientation (GCO) on Green Purchase Intention: A Case Study of Zespri. *Sustainability (Switzerland)*, *17*(6). https://doi.org/10.3390/su17062575

Gamma Shafina. (2023). 10 Besar negara dengan buangan sampah plastik ke laut terbanyak pada 2021. *GoodStats*. https://data.goodstats.id/statistic/indonesia-masuk-10-besar-negara-dengan-buangan-sampah-plastik-ke-laut-terbanyak-pada-2021-Wz1MV

Gulzar, Y., Eksili, N., Koksal, K., Celik Caylak, P., Mir, M. S., & Soomro, A. B. (2024). Who Is Buying Green Products? The Roles of Sustainability Consciousness, Environmental Attitude, and Ecotourism Experience in Green Purchasing Intention at Tourism Destinations. *Sustainability (Switzerland)*, *16*(18). https://doi.org/10.3390/su16187875

Gunawan, A. I., Hurriyati, R., Wibowo, L. A., & Monoarfa, H. (2025). Consumers in responsible

consumption: what leads to sustainable behavior? *Urbanization, Sustainability and Society*, *2*(1), 259–283. https://doi.org/https://doi.org/10.1108/uss-09-2024-0056

Güngördü Belbağ, A. (2025). Consumer behavior and sustainability: what role does eco-friendly packaging play in emerging markets? *Journal of Economic and Administrative Sciences*. https://doi.org/10.1108/JEAS-12-2024-0529

Husain, R., Ahmad, A., & Khan, B. M. (2022). The impact of brand equity, status consumption, and brand trust on purchase intention of luxury brands. *Cogent Business and Management*, *9*(1). https://doi.org/10.1080/23311975.2022.2034234

Ienna, M., Rofe, A., Gendi, M., Douglas, H. E., Kelly, M., Hayward, M. W., Callen, A., Klop-Toker, K., Scanlon, R. J., Howell, L. G., & Griffin, A. S. (2022). The Relative Role of Knowledge and Empathy in Predicting Pro-Environmental Attitudes and Behavior. *Sustainability (Switzerland)*, *14*(8). https://doi.org/10.3390/su14084622

Iliopoulou, E., Koronaki, E., Vlachvei, A., & Notta, O. (2024). From Knowledge to Action: The Power of Green Communication and Social Media Engagement in Sustainable Food Consumption. *Sustainability (Switzerland)*, *16*(21). https://doi.org/10.3390/su16219202

Kotyza, P., Cabelkova, I., Pierański, B., Malec, K., Borusiak, B., Smutka, L., Nagy, S., Gawel, A., Bernardo López Lluch, D., Kis, K., Gál, J., Gálová, J., Mravcová, A., Knezevic, B., & Hlaváček, M. (2024). The predictive power of environmental concern, perceived behavioral control and social norms in shaping pro-environmental intentions: a multicountry study. *Frontiers in Ecology and Evolution*, *12*. https://doi.org/10.3389/fevo.2024.1289139

Laheri, V. K., Lim, W. M., Arya, P. K., & Kumar, S. (2024). A multidimensional lens of environmental consciousness: towards an environmentally conscious theory of planned behavior. *Journal of Consumer Marketing*, *41*(3), 281–297. https://doi.org/10.1108/JCM-03-2023-5875

Liu, X., Kim, T. H., & Lee, M. J. (2025). The Impact of Green Perceived Value Through Green New Products on Purchase Intention: Brand Attitudes, Brand Trust, and Digital Customer Engagement. *Sustainability (Switzerland)*, *17*(9). https://doi.org/10.3390/su17094106

Naaman, D., Yeşilada, F., & Aghaei, I. (2025). A Moderated Mediation Analysis of Lebanon's Food Consumers' Green Purchasing Intentions: A Path Towards Sustainability. *Sustainability (Switzerland)*, *17*(4). https://doi.org/10.3390/su17041714

Petrescu, M., Oncioiu, I., Hojda, M. H., Mândricel, D. A., & Uzlău, M. C. (2025). Dual-Process Neurocognitive Pathways Bridging the Intention–Behaviour Gap in Sustainable Consumer Decisions.

Sustainability (Switzerland), *17*(22). https://doi.org/10.3390/su172210141

Qi, S., Niu, M., & Guan, Z. (2025). Promoting Pro-Environmental Behavior Among University Students Through Sustainability Education and Institutional Support: A Mediated Moderation Model. *Sustainability (Switzerland)*, *17*(22). https://doi.org/10.3390/su172210069

Rahman, S., Saha, W., Maysha, T. I., Sarker, P., Datta, T. R., Rahman, S., & Chacrabati, R. (2026). Prevalence and health risks of microplastics in bottled water and beverages: A food safety concern. *Journal of Hazardous Materials: Plastics*, *2*, 100024. https://doi.org/10.1016/j.hazmp.2025.100024

Robin Hicks. (2024, February 20). *B Corp-certified bottled water brand Aqua tops audit of Indonesia's biggest plastic polluters*. Eco-Business. https://www.eco-business.com/news/b-corp-certified-bottled-water-brand-aqua-tops-audit-of-indonesias-biggest-plastic-polluters/

Rukhsar, Yameen, M., & Khanam, Z. (2025). Understanding the consumer purchase behaviour towards green electronic products: using insight from the theory of planned behaviour. *IIM Ranchi Journal of Management Studies*, *4*(1), 31–54. https://doi.org/10.1108/irjms-01-2024-0002

Schöps, J. D., & Jaufenthaler, P. (2024). Semantic network analysis in consumer and marketing research: application areas in phygital contexts. *Qualitative Market Research*, *27*(3), 495–514. https://doi.org/10.1108/QMR-06-2023-0084

Sheany Yasuko Lai. (2025). Indonesia to make plastic recycling mandatory for producers. *Arab News*. https://www.arabnews.com/node/2612415/world

Shen, J., & Zhang, H. (2025). From Values to Policy Understanding: Linking Pro-Environmental Worldviews, Self-Efficacy, and Climate Risk Perceptions to Sustainability Policy in China. *Sustainability (Switzerland)*, *17*(22). https://doi.org/10.3390/su172210002

Simanjuntak, M., Nafila, N. L., Yuliati, L. N., Johan, I. R., Najib, M., & Sabri, M. F. (2023). Environmental Care Attitudes and Intention to Purchase Green Products: Impact of Environmental Knowledge, Word of Mouth, and Green Marketing. *Sustainability (Switzerland)*, *15*(6). https://doi.org/10.3390/su15065445

Song, Z., Hu, M., Leng, M., & Zhu, S. (2024). Exploring the Effects of Low-Carbon Labels on Purchase Intentions for Green Agricultural Products. *Sustainability (Switzerland)*, *16*(17). https://doi.org/10.3390/su16177313

Su, S., & Li, Y. (2024). Exploring the Impact of the Green Marketing Mix on Environmental Attitudes and Purchase Intentions: Moderating Role of Environmental Knowledge in China's Emerging Markets. *Sustainability (Switzerland)*, *16*(24).

https://doi.org/10.3390/su162410934

Sun, X., Tian, Z., Wang, J., & Su, W. (2022). The Impact of Environmental Commitment on Green Purchase Behavior in China. *International Journal of Environmental Research and Public Health*, *19*(14). https://doi.org/10.3390/ijerph19148644

Tian, H., & Liu, X. (2022). Pro-Environmental Behavior Research: Theoretical Progress and Future Directions. In *International Journal of Environmental Research and Public Health* (Vol. 19, Number 11). MDPI. https://doi.org/10.3390/ijerph19116721

Tian, Z., Sun, X., Wang, J., Su, W., & Li, G. (2022). Factors Affecting Green Purchase Intention: A Perspective of Ethical Decision Making. *International Journal of Environmental Research and Public Health*, *19*(18). https://doi.org/10.3390/ijerph191811151

Yu, Z., Rosbi, S., & Amlus, M. H. (2024). Mechanisms of Media Persuasion and Positive Internet Word-of-Mouth Driving Green Purchasing Behavior: Evidence from China. *Sustainability (Switzerland)*, *16*(15). https://doi.org/10.3390/su16156521