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The study on the dissemination of waste sorting policies on social media and the public's feedback attitudes: a text analysis based on comment data of policies in 46 key cities in China

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This study investigates the dissemination of major waste sorting policies and public feedback attitudes across 46 key Chinese cities using data from the Weibo social media platform. The research employs a Latent Dirichlet Allocation (LDA) topic model to identify and mine themes from comment texts, extracting multiple core discussion topics. The results show that although negative sentiments slightly outweighed positive sentiments in public comments, there was no significant difference in the focal points of attention between positive and negative sentiments. Negative sentiments primarily centered on policy specifics and implementation methods, with key concerns including details of policy execution and operational challenges. Cities such as Shanghai, Beijing, Nanjing, and Hangzhou exhibited higher volumes of policy-related discussions, indicating greater public engagement in these regions. Analysis of IP address distribution revealed pronounced regional concentration, particularly among residents in developed eastern coastal areas. Finally, the study proposes strategic recommendations for optimizing information dissemination on social media to enhance public willingness to participate in waste sorting initiatives.

KEYWORDS

waste sorting, social media, official policy, text analysis, public feedback attitudes, latent dirichlet allocation model

Highlights

The study covers the waste sorting policies in 46 key cities across China, with data collected through the Sina Weibo platform, providing representative public feedback.

Utilizing text mining techniques, including sentiment analysis and the LDA model, the study conducts an in-depth analysis of public comments, uncovering the public's cognition and attitudes towards waste sorting policies.

The study identifies specific reasons for the public's dissatisfaction with waste sorting policies, providing policymakers with precious insights to improve policy design, optimize promotional strategies, and enhance public participation.

The article highlights the regional concentration of waste sorting policy discussions, particularly the high level of resident engagement in the developed eastern coastal areas, offering a reference for policy dissemination.

1 Introduction

As the pace of global urbanization accelerates and the demand for environmental protection increases, the issue of waste management in China has become increasingly severe. Waste sorting has emerged as one of the crucial measures to alleviate the pressure of urban waste disposal (Zhang et al., 2010). However, despite the implementation of waste sorting policies by local governments across China in recent years, the actual outcomes have not been entirely satisfactory, with a persistently low rate of active participation among residents. Confronted with this challenge, effectively promoting public participation in waste sorting has become a focal point for policymakers and researchers. The rapid development of the internet and social media, particularly the widespread use of platforms such as Weibo, WeChat, and Douyin, has provided a new pathway to address this issue (Wu and Zhang, 2023). These platforms not only have the advantage of disseminating policy information but also facilitate public interaction, enhancing the awareness and action of waste sorting.

The policy of waste sorting originated from the environmental governance experience of developed countries. Since the mid-20th century, countries such as Europe and Japan have been the first to implement systematic waste sorting and recycling mechanisms, which have achieved significant results (Hara and Yabar, 2012). The successful experiences of these countries indicate that waste sorting can significantly reduce the environmental burden of waste disposal and effectively recycle resources, promoting the development of the green economy. However, the implementation of waste sorting largely depends on the cooperation and participation of the public (Yang et al., 2021). Therefore, how to enhance the public's environmental awareness and actual participation rate has become the key to the success of the policy.

In China, the implementation of waste sorting policies came relatively late, with the government only officially launching a comprehensive waste sorting system in 2017. This plan was issued by the National Development and Reform Commission (NDRC) and the Ministry of Housing and Urban-Rural Development, requiring the 46 key cities to essentially establish a legal framework and infrastructure for waste sorting by 2020 (Table 1).

According to the plan of China's Ministry of Housing and Urban-Rural Development, by 2025, the waste sorting coverage rate in all cities across the nation will reach 100%, encompassing the waste sorting and disposal systems in urban residential communities (Xinhua News Agency, 2023). These policies signify a significant step forward for China in waste sorting and solid waste management, aiming to enhance resource utilization rates through recycling and sorted disposal, and to reduce environmental impact. Despite the initiation of these policies, the implementation of waste sorting remains less than ideal due to

reasons such as weak environmental awareness among residents and incomplete supporting facilities (Zhang D. et al., 2024). There exists substantial societal opposition to waste sorting policies, while formal resource recyclers and non-governmental organizations (NGOs) demonstrate limited operational capacity (Guo and Chen, 2022). Against this backdrop, researching how to leverage emerging technological means—particularly the internet and social media—to promote the implementation of waste sorting policies has become an important topic in current environmental governance studies (Chen et al., 2023).

The advancement of the internet, particularly the prevalence of social media, has significantly altered the modalities through which the public accesses information and engages in social affairs. Platforms such as Weibo, WeChat, and Douyin have introduced novel channels for the dissemination of policies. Utilizing these platforms, the government is capable of rapidly and extensively conveying policy-related information to the public and gaining insights into public feedback through interactive mechanisms. Furthermore, social media offers a venue for the public to articulate opinions and share experiences, thereby transcending waste sorting from a mere level of policy promotion to an ingrained behavioral norm in the daily lives of the populace (Xu et al., 2023). The integration of a “top-down” policy promotion model with a “bottom-up” public feedback mechanism has significantly enhanced the enforceability of policies and the enthusiasm of the public for participation.

In recent years, an increasing number of studies have demonstrated that the role of social media in the promotion of environmental policies cannot be overlooked. Environmental information disseminated through online networks significantly enhances public environmental awareness and policy acceptance. In the implementation of waste sorting policies, social media serves not only as a tool for information dissemination but also as a crucial bridge between the public and the government. Internet usage has a significant positive impact on the willingness of rural households to engage in waste sorting. After accounting for individual choice biases, this result remains robust, with mobile internet emerging as the primary channel for promoting waste sorting. Research indicates that internet usage influences residents' willingness to sort household waste; residents who use the internet are more inclined to engage in waste sorting than those who do not. Compared to computer usage, the impact of mobile internet usage on the willingness to sort waste is even more pronounced (Wang et al., 2024). Discussions, interactions, and sharing behaviors on social media platforms have gradually turned waste sorting into a topic of widespread public concern.

Traditional policy evaluation and public opinion research often rely on methods such as surveys and interviews. While these methods can provide reference data, they often suffer from issues like small sample sizes and lagging information. In contrast, social media platforms offer a vast amount of data that is real-time and comes from a wide range of sources, encompassing users of different ages, professions, and regions. This makes the use of social media data for policy evaluation and public opinion research an important and valuable tool (Adams-Cohen, 2020). For instance, Weibo, as one of the primary social media platforms in China, boasts a substantial

TABLE 1 Forty-six key cities in China for waste sorting and their major policies.

City	Main waste sorting policies	City	Main waste sorting policies
Shanghai	Shanghai municipal waste management regulations	Tai'an	Tai'an Municipal waste sorting management regulations
Beijing	Beijing municipal waste management regulations	Ningbo	Ningbo municipal waste sorting management regulations
Nanjing	Nanjing municipal waste management regulations	Changchun	Changchun municipal waste sorting management regulations
Chengdu	Chengdu municipal waste management regulations	Yichun	Yichun municipal waste sorting management regulations
Hangzhou	Hangzhou municipal waste management regulations	Shijiazhuang	Shijiazhuang waste sorting management regulations
Shenzhen	Shenzhen municipal waste sorting management regulations	Lanzhou	Lanzhou urban waste sorting management measures
Nanning	Nanning municipal waste sorting management regulations	Handan	Handan urban waste sorting management measures
Wuhan	Wuhan municipal waste sorting management methods	Hohhot	Hohhot municipal waste sorting management methods
Jinan	Jinan municipal waste reduction and sorting management regulations	Guangzhou	Guangzhou urban waste sorting management interim provisions
Tianjin	Tianjin municipal waste management regulations	Dalian	Dalian municipal waste sorting management regulations
Xiamen special economic zone	Xiamen special economic zone waste sorting management methods	Harbin	Harbin municipal waste sorting management regulations
Suzhou	Suzhou municipal waste sorting management regulations	Urumqi	Urumqi urban waste sorting management measures
Qingdao	Qingdao municipal waste sorting management methods	Hefei	Hefei municipal waste sorting management regulations detailed implementing rules
Nanchang	Nanchang municipal waste sorting management regulations	Yinchuan	Yinchuan municipal waste sorting management regulations
Zhengzhou	Zhengzhou urban waste sorting management methods	Kunming	Kunming municipal waste management regulations
Taiyuan	Taiyuan waste sorting management regulations	Tongling	Tongling municipal waste sorting management regulations
Xi'an	Xi'an municipal waste sorting management regulations	Yichang	Yichang municipal waste sorting management methods
Shenyang	Shenyang municipal waste sorting management methods	Guangyuan	Guangyuan urban waste sorting work implementation plan
Chongqing	Chongqing municipal waste sorting management methods	Lhasa	Lhasa urban waste sorting management methods
Fuzhou	Fuzhou municipal waste sorting management regulations	Deyang	Deyang municipal waste sorting management methods
Guiyang	Guiyang urban waste sorting management regulations	Xianyang	Xianyang municipal waste sorting management regulations
Haikou	Haikou municipal waste sorting management methods	Xining	Xining municipal waste sorting management regulations
Changsha	Changsha municipal waste management regulations	Shigatse	Shigatse municipal waste sorting management methods

user base. The behaviors and interactions of users on this platform can reflect the public’s cognition and emotional changes regarding waste sorting policies (Liu and Zhou, 2011).

The application of text mining technologies has made the analysis of large-scale social media data feasible. By automating the analysis of waste sorting-related content on platforms such as Weibo, WeChat, and Douyin, researchers are able to uncover the genuine attitudes, emotional inclinations, and behavioral intentions of the public towards policies (Irfan et al., 2015). Specifically, through sentiment analysis, it is possible to identify public support and opposition sentiments towards waste sorting policies, as well as how these emotions evolve over time. This provides a deeper insight into the public’s concerns and doubts. Such information is of great significance for refining policy design, optimizing promotional strategies, and enhancing public participation.

2 Literature review

Social media has emerged as a critical instrument for the dissemination of policies, particularly within the domain of environmental governance. Governmental entities should harness the potential of social media platforms such as Weibo to enhance the propagation of environmental policies, augment public engagement with policy issues, and intensify involvement in environmental management efforts. The content of policy dissemination ought to prioritize the welfare interests of the populace. Utilizing a public discourse system that is accessible and comprehensible is essential to reinforce the interaction between the public and policy content, and to motivate a diverse array of societal actors to participate in the dissemination of policies (Gong et al., 2022). Numerous studies investigating government social media use for crisis communication have predominantly focused on popular platforms such as Twitter

and Facebook (Ahmed and Rasul, 2023). Text analysis, as an effective research method, enables a deep understanding of public sentiment and attitudes reflected in social media data. Various Deep Learning (DL) methods have developed rapidly, and they have proven to be successful in many fields such as audio, image, and natural language processing (Peng et al., 2022).

2.1 Study on the Public's attitude towards waste sorting

Research on public attitudes toward waste sorting has gradually become a focal point in the field of environmental management. Utilizing social media platform data, Huang et al. analyzed public perceptions of waste sorting and found that while discussions predominantly exhibited positive sentiments, negative attitudes emerged regarding specific policy implementation challenges, such as ambiguous classification guidelines, time-consuming procedures, and inadequate regulatory oversight. Additionally, their study revealed divergent concerns across city types: key cities prioritized rural waste sorting fee structures, whereas developed cities focused more on residential environmental impacts (Huang et al., 2023). Through sentiment analysis, Sun et al. demonstrated that public dissatisfaction primarily stems from unclear sorting rules, inconveniences caused by mandatory use of specialized waste bags, and insufficient supporting infrastructure (Sun et al., 2023). The heightened public attention to environmental hazards of plastic pollution reflects rising environmental consciousness, yet practical participation remains constrained by infrastructural deficiencies. Zhang et al. further identified education level and income as critical determinants of waste sorting compliance, with highly educated groups showing stronger adherence to sorting protocols (Zhang Z. et al., 2024). Residents' positive attitudes contribute to the successful implementation of waste sorting initiatives. Subjective norms and perceived behavioral control indirectly influence behavioral intentions and actual behaviors through the mediation of attitudes (Liu et al., 2023). Despite broad public acceptance and enthusiasm for waste sorting, persistent implementation barriers—including rule ambiguity, inadequate infrastructure, and accessibility limitations—require systematic optimization to enhance participation rates and satisfaction.

2.2 Research on the online dissemination of environmental policies

Studies on waste sorting policies have shown that social media enhances public engagement and feedback mechanisms, presenting an important opportunity for the modernization of China's environmental governance capabilities. Social media provides a flexible channel for policy advocacy at all levels of government (Chenghao et al., 2020). At the same time, research has also indicated that the use of the internet can motivate individuals to sort household waste. The willingness of Chinese residents to engage in waste sorting is significantly influenced by their use of the internet via smartphones. The dissemination of waste sorting information through internet media, particularly smartphones, is of great

importance (Ma and Zhu, 2021). For the environment issue, the social media agenda of parties is more predictive of the traditional media agenda than vice-versa. These findings underscore how closely different agendas are tied together, but also show that advocacy campaigns may play an important role in both constraining and enabling parties to push their specific agendas (Gilardi et al., 2022). These studies collectively demonstrate that social media effectively enhances public participation in and feedback on waste sorting policies. The use of the internet, particularly smartphones, has significantly increased residents' willingness to engage in waste sorting, while the agenda-setting function of social media further advances the modernization of environmental governance.

2.3 Research on the interaction between policy and the public

In terms of public feedback, two-way communication and the public's potential willingness to discuss waste sorting policies create possibilities for environmental construction. Within this context, the government and the public are no longer clearly defined opposing entities but rather a community that needs to fulfill the obligation of waste sorting and co-create a clean and tidy living environment (Li et al., 2023). In the matter of waste sorting, current government new media policy dissemination exhibits multiple trends of interaction. This includes action-based interaction, topic-based interaction, and discourse-based interaction on government new media platforms. The government deepens its interaction with the public at various stages of public policy proposal, formulation, announcement, implementation, and feedback, aiming to enhance understanding and expand participation (Zhemin and Fu, 2020). Since 2015, the term "classification" has begun to emerge in the semantic network. By 2016 and 2017, discussions about "garbage treatment" and "waste sorting" became more prominent than "incineration." This shift originated from the anti-garbage incineration movement, where the government successfully shifted the focus to "waste sorting." Official and mainstream media framed waste sorting as a solution to the pollution caused by incineration, and civil actors gradually embraced this perspective. A consensus was formed between the official and civil sectors that waste sorting is beneficial for reducing pollution emissions (Jia and Chenghao, 2020). Social media plays a significant role in shaping public opinion and influencing economic decision-making. Through social media platforms, individuals and groups interact, share information, and engage in discussions, thereby forming collective perspectives on diverse issues (Ausat, 2023). These studies collectively demonstrate that bidirectional interactions and sustained communication between the public and government have fostered a collaborative environmental governance community. This synergy promotes the effective crystallization of public opinion and co-governance of environmental agendas.

Although existing research has emphasized the role of social media in the dissemination of waste sorting policies, the specific mechanisms of impact on public attitudes and feedback require further exploration. Social media plays a significant role in enhancing the communication and feedback loop of waste

sorting policies. Through textual analysis methods, it is possible to delve deeper into the public's cognition and sentiment towards policies, thereby addressing the gaps in current research. By systematically analyzing the content of social media discussions, we can gain a better understanding of how the credibility of information and the effectiveness of communication channels influence public attitudes. Future research should continue to focus on public behavior in the social media environment, exploring how social media can be utilized to optimize policy dissemination and public engagement, thereby providing more effective support for the implementation of waste sorting policies. Future studies should further apply textual analysis techniques to investigate the complexity of these influencing factors, thereby enhancing the effectiveness of policy communication.

3 Innovation and research significance

Despite the research that has explored the application of the internet and social media in environmental policies, studies specifically focusing on waste sorting policies are still relatively scarce, particularly in relation to social media discussions, which await further supplementation. For instance, there is a lack of systematic analysis and empirical research in the existing literature on how to enhance public participation and optimize the dissemination effects of policies through social media. Consequently, this study targets the online dissemination of policies in 46 key Chinese cities with waste sorting initiatives. It involves the collection and analysis of dissemination data on Weibo, including posts, comments, reposts, and likes, to conduct an in-depth textual analysis.

3.1 Innovation of research

- (1) Innovation in Data Sources and Research Methods: This study breaks through the limitations of traditional questionnaires and interviews by using web crawling technology to collect a large amount of user comment data on Weibo and employs text mining techniques for analysis. This approach provides a more comprehensive and objective reflection of the public's real attitudes and emotional tendencies towards waste sorting policies. The study uses the LDA topic model for thematic analysis of the text data, revealing hot topics of public concern, such as "garbage bins," "fines," and "kitchen waste," offering policymakers a deeper understanding.
- (2) Innovation in Research Perspective: The study focuses on the public's feedback attitudes towards policies. Through the analysis of public attitudes, it provides a basis for policymakers to improve policies. The study also reveals regional differences in public discussions, with higher participation in eastern coastal developed areas and lower participation in central and western regions, offering references for the formulation of more targeted local policies.
- (3) Implications for Policy Making: The study finds that the public's negative emotions towards waste sorting policies mainly focus on the details of policy implementation and

execution processes, such as considerations of time and convenience. This provides policymakers with directions for improvement, such as optimizing the timing and locations of waste sorting and enhancing the training of waste sorting personnel. Additionally, the lack of public knowledge about waste sorting is one of the reasons for negative emotions, suggesting that the government should conduct educational activities on waste sorting knowledge through a combination of online and offline methods.

3.2 Significance of research

- (1) Methodological Contribution. By applying big data and text mining techniques to the field of policy research, this study provides new perspectives and methodologies, promoting the scientific and modernization of policy research.
- (2) Guidance for Environmental Protection Practice. The research results offer scientific evidence for government departments to optimize the dissemination strategies of waste sorting policies, helping to increase public acceptance and participation in policy implementation and promoting the effective implementation of waste sorting policies.
- (3) The study reveals the complexity of the public's attitudes towards waste sorting policies. Although the public generally supports environmental causes, there are concerns and dissatisfaction with the specific content and execution methods of the policies. This ambivalence provides important insights for policymakers.

The structure of the remaining parts of this paper is as follows. First, a literature review of social media and waste sorting policies is conducted, followed by a detailed description of data collection, processing methods, and text mining. Next, the paper succinctly introduces the public's focus points, the results of sentiment analysis, and the discussion and analysis of waste sorting policies. Finally, conclusions are drawn, and suggestions for the formulation or improvement of waste sorting policies are proposed.

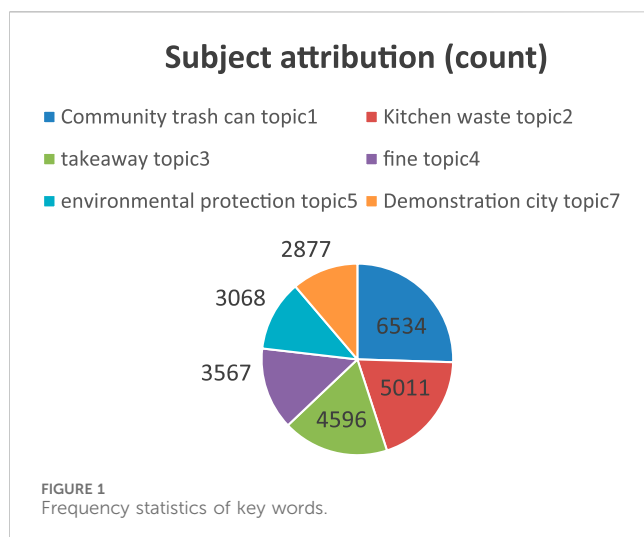
4 Research methodology

4.1 Data source

The data for this study is sourced from the Weibo social media platform. In the era of big data, web crawling information retrieval technology can intelligently and efficiently collect information, providing assistance for scientific research (Jian and Qin, 2022). The web crawler program is capable of accessing thousands of pages per second, and it includes a high-performance failure manager that can operate independently of the platform or in a platform-dependent manner. Additionally, it can adapt to a variety of configurations without the need for additional hardware. This flexibility and efficiency make the crawler suitable for large-scale data collection tasks in diverse environments (Desai et al., 2017). Through web crawling technology, public interaction and feedback information regarding urban waste sorting policies on Chinese

TABLE 2 Keywords of topics.

Topic1: community trash can		Topic2: fine		Topic3: kitchen waste		Topic4: demonstration city		Topic5: takeaway		Topic6: environmental protection	
Support	2.48%	Forward	7.85%	Trash	15.71%	Beijing	2.23%	Tableware	3.33%	Trash	6.01%
Go	2.30%	Shanghai	2.87%	Sorting	11.95%	Shanghai	2.20%	Takeout	2.61%	Sorting	4.86%
Trash bin	2.25%	Trash	2.79%	Throw	1.80%	Nationwide	2.08%	Provide	2.54%	Feel	1.91%
Throw	2.18%	Sorting	1.73%	Divide	1.33%	Go	1.70%	Chopsticks	2.40%	Protect environment	1.57%
Community	1.89%	Fine	1.35%	Kitchen waste	0.92%	People	1.65%	Eat	2.34%	Up	1.51%
Bags	1.58%	Good	1.34%	Garbage truck	0.89%	Promote	1.24%	Environmental protection	1.90%	Environment	1.44%
Buy	1.51%	No	1.14%	Trash bin	0.85%	Do	1.16%	Plastic bags	1.88%	Small	1.22%
Trash	1.27%	Chengdu	1.10%	Dump	0.77%	Like	1.03%	People	1.66%	Everyone's responsibility	1.21%
Think	1.18%	Think	1.03%	Dispose	0.77%	Fraud	0.96%	Charge	1.33%	Recyclable	1.11%
Good	1.12%	City	0.99%	Good	0.69%	Hope	0.91%	Will	1.15%	Good	1.11%
Will	0.93%	Now	0.97%	Beijing	0.69%	Netinfo	0.77%	Bring	1.04%	Should	0.96%
Things	0.90%	People	0.94%	Life	0.59%	Cannot	0.73%	Don't use	1.03%	Dry	0.95%
Know	0.86%	Throw	0.84%	Shanghai	0.58%	Say	0.72%	Don't want	0.82%	Very	0.88%
Japan	0.77%	Community	0.80%	Should	0.57%	Pioneer	0.66%	No	0.73%	Environmental protection	0.88%
At home	0.76%	Divide	0.75%	People	0.56%	Up	0.62%	Supermarket	0.72%	Do	0.82%
No	0.75%	Know	0.74%	Start with me	0.54%	Group	0.60%	Hotel	0.65%	No	0.80%
Ask	0.72%	Fast	0.70%	Harmful	0.53%	City	0.55%	Buy	0.65%	Need	0.71%
Garbage bag	0.71%	Trash bin	0.70%	Up	0.51%	Place	0.55%	Hand	0.61%	Support	0.69%
Bring	0.69%	Dry/Wet	0.68%	Will	0.49%	Finance	0.53%	Good	0.61%	Standard	0.68%
Turn	0.66%	Hangzhou	0.63%	See	0.48%	Unified	0.51%	Merchant	0.61%	Reduce	0.62%



internet platforms can be collected. Web crawlers are generally divided into four types based on differences in target objects, system architecture, and implementation technology: general-purpose web crawlers, focused web crawlers, incremental web crawlers, and deep web crawlers. This paper mainly employs focused web crawler technology to collect the required information. Focused web crawler technology is a type of web crawler designed for specific subject demands, and it filters content during the crawling process, attempting to only collect relevant information from web pages (Akbari Torkestani, 2012). Hence, this paper employs the focused web crawling method. During data crawling, comments were collected based on Weibo posts that explicitly mentioned policy/regulation names (Table 1). Data were collected from Weibo comments from June 2019 to October 2024, yielding a total of 56,841 comments. The implementation principle and workflow are as follows.

To search for the target theme focusing on the main policies of 46 key cities in China for waste sorting, a web crawler program was designed, including functions such as topic identification, content filtering, and link tracking. The program collects the content of each blog post, comments, likes, forwards, as well as information of registered and verified users (such as username, region), etc. The web crawler is written in Python 3.9 programming language to implement the functions of a focused web crawler, collect information, and export it to an Excel file.

The study employs the DrissionPage module as an automated web page interaction tool. The process involves the following steps:

4.1.1 Keyword search and pagination

A loop traversal method is used to search for each keyword in sequence.

The browser's built-in functions are utilized to perform pagination, ensuring comprehensive coverage of relevant content.

4.1.2 Article link extraction and storage

During the traversal process, the article links from each page of search results are extracted and stored in a file named detail_href for subsequent access.

4.1.3 Article link reading

The stored article links are read from the detail_href file to prepare for individual article content access.

4.1.4 Article access

The browser accesses each article link read from the file to obtain the required information.

4.1.5 Article information scraping and storage

While accessing the articles in the browser, key information such as article content, like counts, and comment numbers are scraped and stored in a detail_json file for data analysis.

4.1.6 Article information reading

The stored article information is read from the detail_json file to provide data support for subsequent comment scraping.

4.1.7 Revisiting articles

Based on the read article information, the browser revisits the article pages one by one.

4.1.8 Comment acquisition

Browser operations are used to scroll down the page and click the "More" button to trigger the loading of all comments, thus completing the capture of comment data.

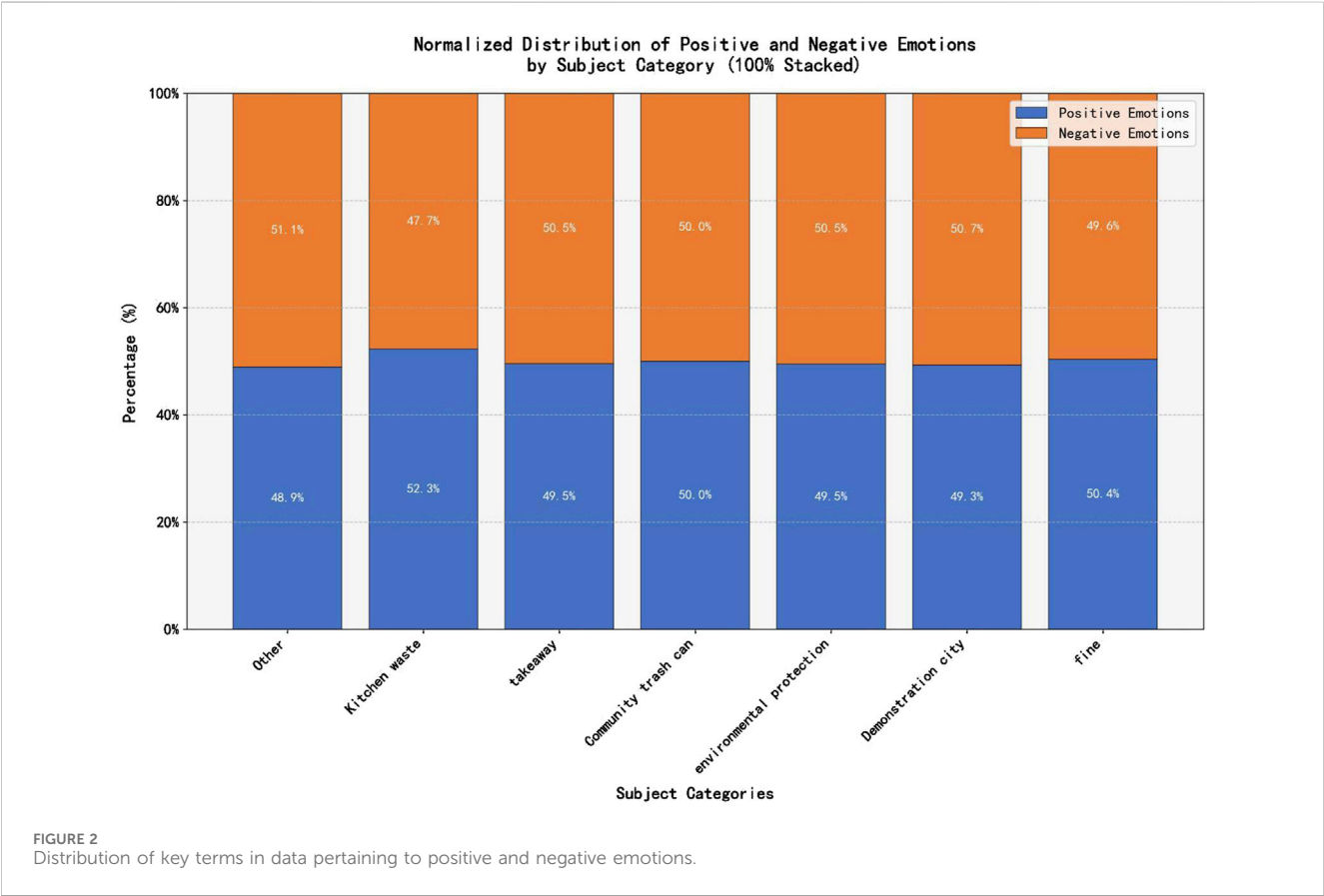
This systematic approach ensures that the web crawler efficiently collects and stores the necessary data for analysis, focusing on the interaction and feedback related to urban waste sorting policies.

4.2 Text mining analysis

Social media provides a new data source for investigating community opinions on a specific subject or event (Sun et al., 2020). The combination of text mining and web crawling technologies for the collection and processing of unstructured data is more objective and efficient than the traditional methods used in social science research (Wang et al., 2019). Therefore, this paper employs sentiment analysis to dissect the public's attitudes towards waste sorting. Unsupervised sentiment analysis primarily combines sentiment dictionaries and semantic rules to determine sentiment polarity. This method generally operates at the sentence level and is suitable for fine-grained short texts. It offers a short analysis time and generally produces accurate results. Since Weibo posts are short texts, this paper opts for unsupervised sentiment analysis (Huang et al., 2015). This investigation utilizes the SnowNLP module to conduct sentiment analysis on each comment. SnowNLP has been tailored for Chinese language corpora, particularly excelling in the realm of sentiment analysis, where it demonstrates a superior understanding of Chinese semantics and emotional expression. SnowNLP incorporates a sentiment analysis model based on the Naive Bayes classifier, which has been trained on a substantial dataset of Chinese sentiment data, including both positive and negative reviews. This model is immediately applicable, and sentiment scores can be rapidly obtained either by using the model as-is or by training with one's own annotated data. The study employs a stop words list to filter out semantically insignificant words. The jieba toolkit is used

TABLE 3 Distribution of emotional tendency of public comments.

Sentiment	Sentiment	Percentage	Examples of positive and negative comments
neg	17,074	48.75%	Garbage sorting is too strict
pos	15,133	43.21%	I classify them meticulously every time



for the segmentation of each comment into words. The study iterates through the segmentation outcomes, examining each word against the stop words list and excluding it if present, while also tallying the occurrence of each word and sorting them by frequency in descending order. Through this process, the sentiment analysis and word frequency statistical analysis of the comments are completed. After a thorough text preprocessing of the comment content, a total of 35,021 pieces of comment data were consolidated from the 56,841 comments retrieved, with sentiment scores ranging from 0 to 1, where a score closer to one indicates a more positive sentiment.

4.3 Latent Dirichlet Allocation Model

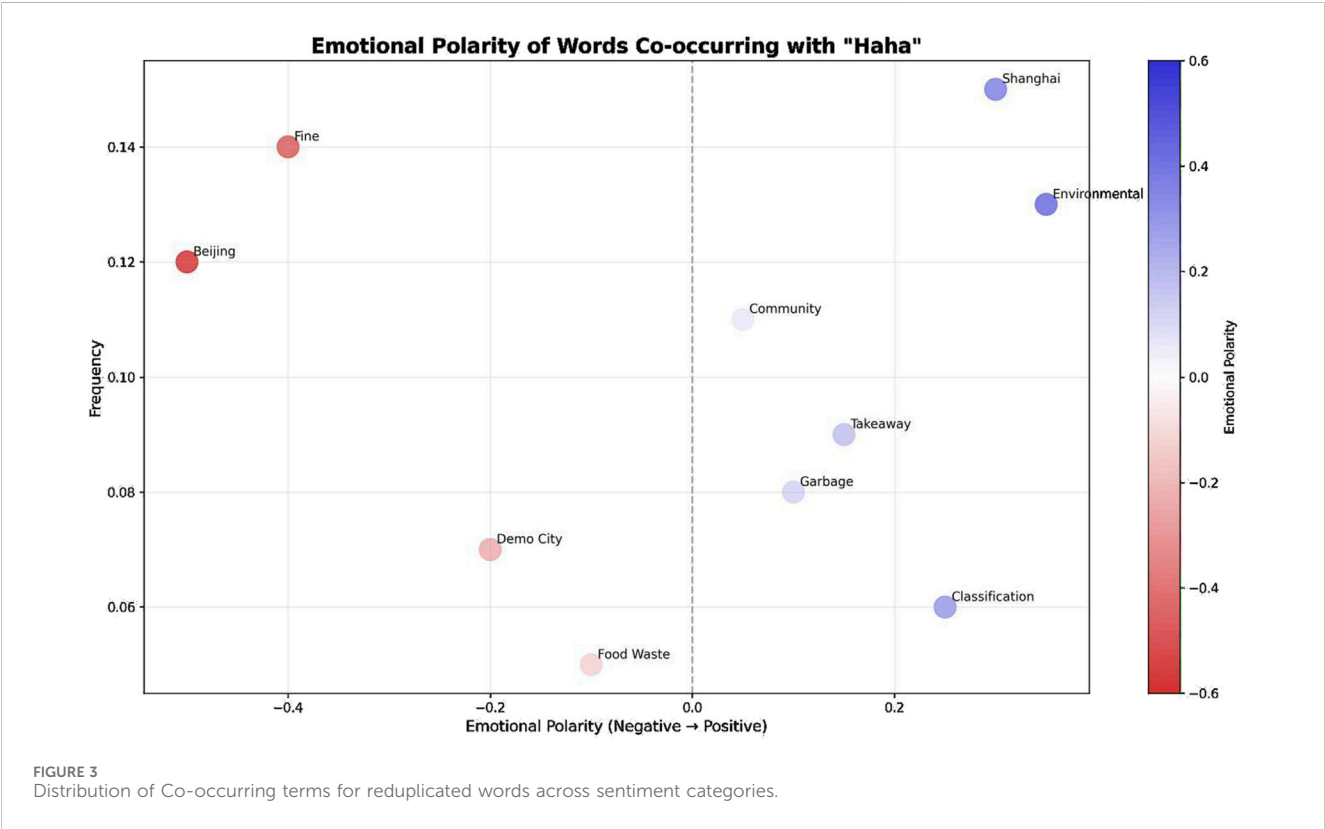
Latent Dirichlet Allocation Model employs unsupervised learning to generate “document-topic” and “topic-word” probability distributions, thereby identifying latent thematic information within large collections of documents (Tang and Xiang, 2014). LDA not only possesses excellent data

dimensionality reduction capabilities but also has good model scalability, and it has been widely applied in the field of natural language processing (Yang et al., 2020). The application of LDA in text sentiment classification was thoroughly evaluated, and it was found to perform well in alleviating the issues of high-dimensional feature space and feature sparsity, significantly improving the classification results (Onan et al., 2016).

This paper employs the Python programming language and the LDA algorithm to conduct topic modeling on textual data, and visualizes the analysis results for intuitive presentation. Table 2 displays the probability distribution of the main topic keywords, with the public’s most concerns focusing on “garbage bins” and “fines”. Some topics (such as Topic_3 and Topic_4) concentrate on the practices of specific cities and communities, while other topics (such as Topic_5 and Topic_6) are more focused on the enhancement of environmental awareness. The study also conducts a detailed of the frequency of topic words (Figure 1), presenting the distribution of different topics within the overall data, which provides strong support for further understanding and mining of the textual content. This objectively reflects the

TABLE 4 The ten most common keywords in positive and negative emotions and their frequency of occurrence.

Positive sentiment keywords	Negative sentiment keywords
Forward weibo (479 times)	Forward weibo (508 times)
Waste classification (276 times)	Waste classification (244 times)
Support (187 times)	Support (180 times)
Start from me (81 times)	Protect the environment (99 times)
Forward (80 times)	Start from me (90 times)
Protect the environment (74 times)	Everyone responsible (77 times)
Hahaha (73 times)	Haha (73 times)
Everyone esponsible (57 times)	Hahaha (72 times)
Waste classification Together (56 times)	Waste classification Together (65 times)
Support policy (53 times)	Forward (60 times)



naturally emerging focus of public discussions. Such quantitative visualization of keyword weights provides data-driven evidence of public cognition for formulating subsequent policy recommendations.

5 Results and discussion

This study meticulously collected and analyzed the dissemination of key policies on waste sorting from 46 pilot cities in China on the Weibo platform. The research focused on the comment sections of popular Weibo posts, which were identified

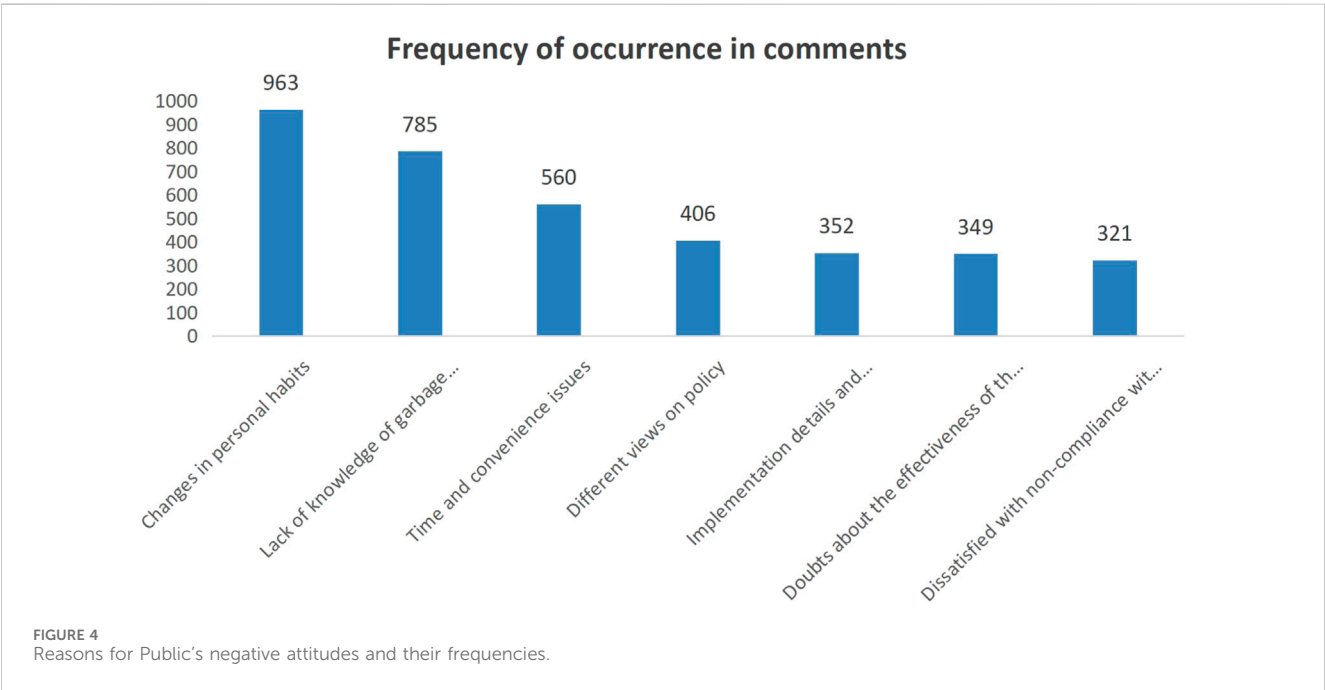
based on their high ranking resulting from interactive metrics such as likes, views, comments, and retweets, indicative of significant public engagement and open discourse. Utilizing Weibo’s “Settings” feature, we precisely pinpointed these trending posts.

5.1 Sentiment orientation analysis

After conducting a sentiment analysis on the comment data gathered from Weibo, this study employed the NLPiR-Parser platform for in-depth exploration. Following meticulous text

TABLE 5 Linguistic samples of attitudinal expressions in positive and negative emotions.

Emotional type	Comment sample 1	Comment sample 2	Comment sample 3	Comment sample 4	Comment sample 5
Positive emotion	Retweeting this weibo, let us support garbage classification together, protect the environment from me, everyone is responsible! Hahahaha, let's work together on garbage classification to make our Earth more beautiful!	Strongly support environmental protection policies, garbage classification is the responsibility of each of us, come on!	Seeing so many people participating in garbage classification is really great, hahaha, we can definitely do it!	Let us join hands to strive for green living, starting with garbage classification, I will start, adding a touch of green to the earth!	Environmental action starts with small things, garbage classification may be small but its significance is huge, jointly guarding our beautiful home!
Negative emotion	Retweeting this weibo, garbage classification is good, but it's too difficult to implement, haha, am I the only one who feels this way?	Support environmental protection, but can policy-making be more down-to-earth? Garbage classification is too complicated, haha	Protecting the environment is everyone's responsibility, but is not the fine policy too excessive? Haha, it feels like extortion	The idea of garbage classification is good, but actually doing it is really headache-inducing, haha, is there an easier way?	Can fines alone solve environmental problems? This approach seems too rough, haha, should there be better solutions?



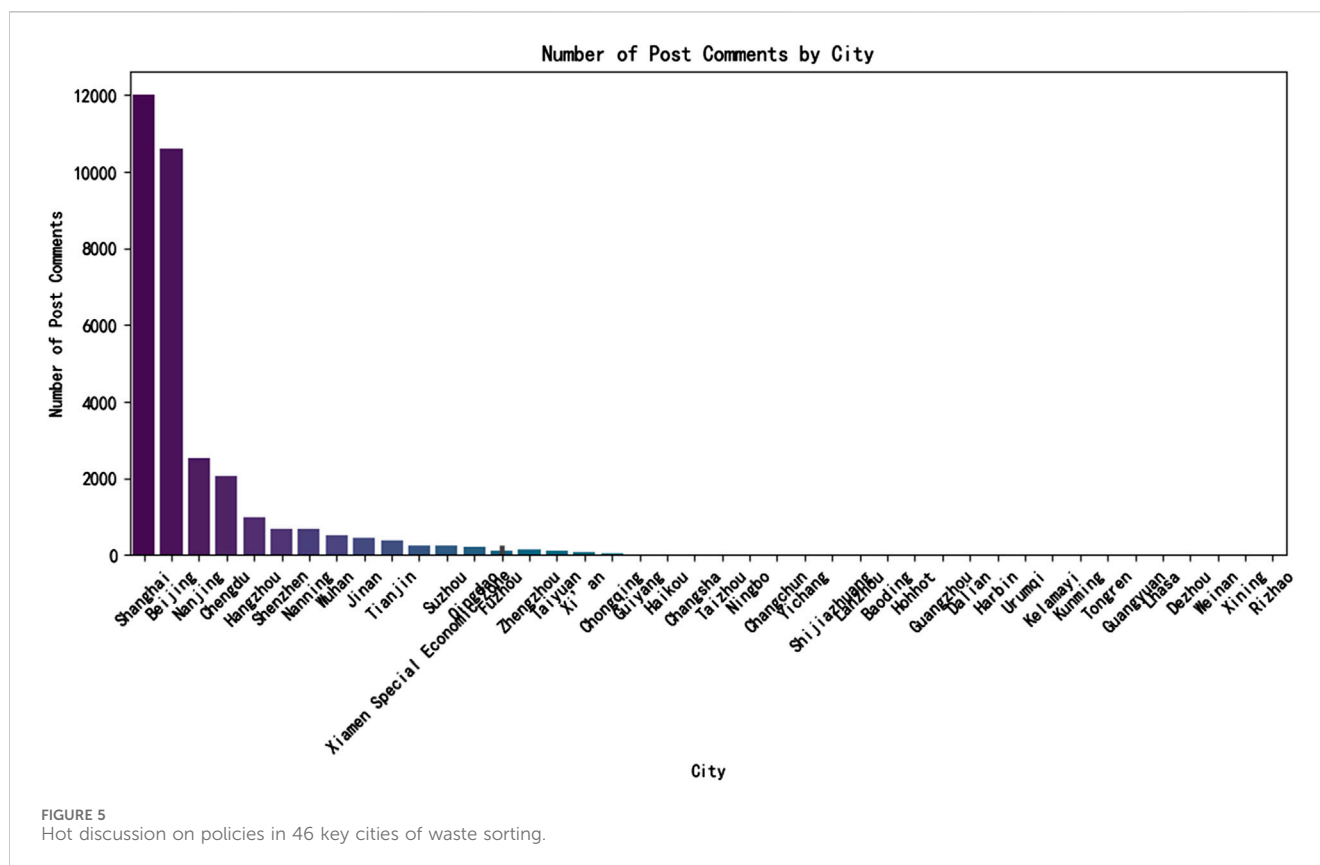
preprocessing and the removal of trivial vocabulary, the results revealed (Table 3) that there were a total of 15,133 comments expressing positive sentiments, accounting for approximately 43.21% of the total comments, while 17,074 comments expressed negative sentiments, making up about 48.75% of the total. Negative comments exceeded positive comments by approximately 5.54 percentage points. The remaining approximately 8.31% consists of comments with undetermined or unrecognized sentiments. These comments primarily consist of ambiguous statements, emoji-based interactions, or extremely brief responses.

5.2 Analysis of emotions and policy support

Upon conducting an in-depth analysis of the data, it was found that there is no significant difference in the focus of positive and

negative emotions. Examining the structure of the grouped data, one can observe the counts of positive (pos) and negative (neg) emotions associated with different thematic categories. Utilizing these data, an unstacked pivot table was created to compare the distribution of positive and negative emotions across various themes. Figure 2 illustrates the standardized distribution results. From these data, it can be observed that the distribution of positive and negative emotions across different thematic categories is relatively uniform, with no pronounced discrepancies.

This study further examines the content of blog posts within the dataset that pertain to positive and negative emotions, seeking the usage of key terms, extracting these keywords, and comparing their frequency of occurrence in both positive and negative emotional contexts. By comparing the key terms associated with positive and negative emotions, it can be observed that there is a certain degree of overlap in the usage of keywords between the two (Table 4). These



keywords appear frequently in both emotional contexts, indicating common concerns among the public with differing attitudes. To address the issue of overlapping positive and negative sentiment keywords in the sentiment analysis results, this study further conducted co-occurrence mining analysis on reduplicated words (e.g., “hahaha,” “haha”) found in the comments. Specifically, advanced co-occurring vocabulary following these reduplicated words was extracted, and the emotional relationships and contextual meanings of these terms were analyzed to explore potential sarcastic usage in both sentiment categories. The findings revealed that co-occurring words associated with the high-frequency reduplicated “ha” exhibited distinct emotional correlations. The contextual usage of reduplicated words demonstrated significant diversity, potentially expressing positive encouragement, public controversy, or neutral teasing sentiments, depending on their subsequent co-occurring terms and expressive contexts (Figure 3). The likely reason for this phenomenon is that the public holds a supportive stance towards environmental protection causes, yet there are some disagreements with the content and implementation of the policies (Table 5).

Through the analysis of keywords and context in negative sentiment blog posts, we can summarize the reasons for the public’s negative attitude towards garbage classification. We identified and extracted frequently occurring keywords from negative sentiment blog posts. Subsequently, we calculated the frequency of these keywords in negative sentiment blog posts to measure the impact of various reasons on public sentiment. The following are the keywords related to each reason and their

frequency of occurrence in negative sentiment blog posts (Figure 4), focusing on seven aspects:

Implementation Details and Execution Issues: Many negative comments focus on the implementation details and execution issues of the garbage classification policy. Some blog posts mention problems such as inappropriate placement of garbage sorting points and littering of garbage bags.

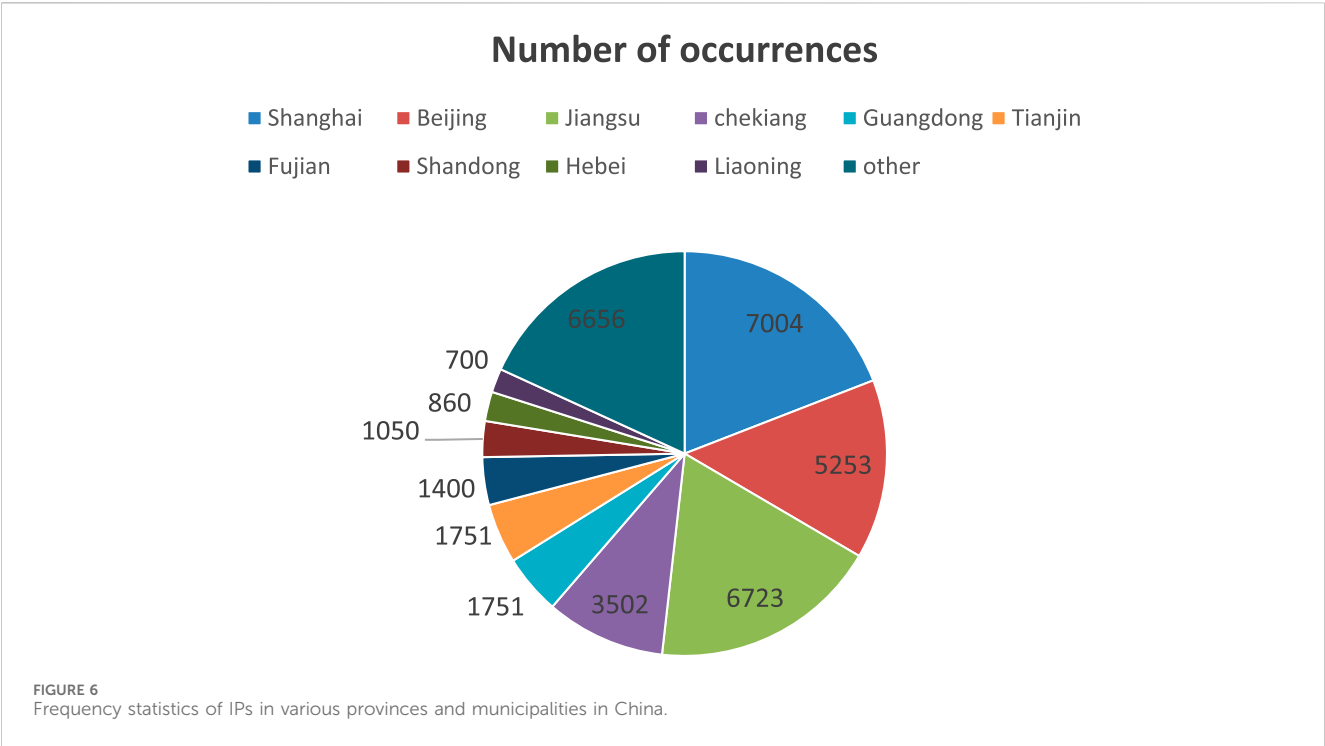
Time and Convenience Issues: Some blog posts mention that garbage classification restricts the time for waste disposal, which inconveniences the public who need to dispose of garbage outside of peak commuting hours on weekdays.

Divergent Views on the Policy: There is a divergence in the public’s views on the garbage classification policy. Some blog posts express skepticism about the garbage classification policy, arguing that there is no need to completely emulate the timed waste disposal practices of foreign countries.

Discontent with Non-compliance: The public expresses discontent with behaviors that do not comply with garbage classification regulations. For example, some blog posts mention neighbors or upstairs tenants not sorting or improperly discarding garbage bags, which may exacerbate public dissatisfaction.

Lack of Knowledge on Garbage Classification: Some blog posts refer to confusion over garbage classification standards, reflecting the public’s lack of knowledge about garbage classification and the need for more guidance and publicity.

Change in Personal Habits: Garbage classification requires the public to change long-standing living habits, which may take some time and an adaptation process, leading to a negative attitude from some members of the public.



Skepticism about Policy Effectiveness: Some blog posts express skepticism about the effectiveness of the garbage classification policy, questioning whether it can truly solve environmental problems and suggesting that its impact remains to be seen.

5.3 Analysis of attention across different cities

In the discussions regarding garbage classification policies, different cities have shown varying levels of participation

enthusiasm (Figure 5). First and foremost, Shanghai tops the list with 12,007 comments, demonstrating the residents' high level of attention to garbage classification policies and an active discussion atmosphere. This may be related to the strict implementation of Shanghai's Domestic Waste Management Regulations and its close connection to residents' daily lives. Beijing follows closely with 10,517 comments, also reflecting a strong interest in the topic of garbage classification among its residents. Nanjing, Chengdu, and Hangzhou are next in line with 2,525, 2,053, and 970 comments, respectively. The participation of residents in these cities in the discussion of garbage classification policies is relatively lower, but still shows a certain level of attention.

According to statistical analysis of the data, the distribution of IP addresses also shows clear regional concentration (Figures 6, 7). Specifically, IP addresses from Shanghai appear most frequently, followed by Beijing, Jiangsu, and Zhejiang. These data reflect the significant advantage of the eastern developed regions in internet usage and also indicate that internet activities are still widely distributed across the country. In terms of the heat of discussion on garbage classification policies, the participation of cities in central and western China is relatively low. Overall, there is considerable room for improvement in the discussion of garbage classification policies in central and western cities, which also suggests that policymakers and environmental promoters need to increase their efforts in these areas to encourage nationwide participation in garbage classification.

6 Conclusions and recommendations

The study on the internet dissemination effect of waste sorting policies holds significant importance. This research conducted an in-depth analysis of the online dissemination of major waste sorting policies in 46 key cities in China. Specifically, we collected public comment data on household waste sorting policies through the platform of Sina Weibo and utilized text mining techniques to explore residents' attitudes towards these policies. The main conclusions of the study are summarized as follows: (1) Negative public sentiment is prominent in policy comments, indicating the presence of factors leading to public dissatisfaction in the dissemination and implementation of waste sorting policies. (2) Although there is no significant difference between positive and negative sentiments in terms of focus, it is evident that the public generally supports environmental protection initiatives. Negative emotions are directed towards specific content and implementation methods of the policies, with some dissenting opinions expressed by the public. (3) The main reasons for public negative sentiment can be attributed to several aspects: firstly, issues with policy implementation details and the execution process, such as considerations of time and convenience; secondly, differing views on policy content; thirdly, dissatisfaction with non-compliance behaviors; additionally, the lack of waste sorting knowledge and the difficulty of changing personal habits are also significant factors contributing to negative sentiment. (4) In the discussions on waste sorting policies, cities like Shanghai, Beijing, Nanjing, Chengdu, and Hangzhou have a higher number

of comments, reflecting their active participation in policy discussions. Moreover, the distribution of IP addresses shows a clear regional concentration, particularly in the eastern coastal developed areas, indicating a higher level of resident engagement and a more fervent focus on waste sorting policies in these regions.

This study, through textual analysis of waste sorting policy dissemination across 46 key Chinese cities, reveals that while most citizens conceptually support waste sorting, implementation deficiencies—particularly insufficient policy refinement—undermine behavioral compliance. To bridge the “concept-practice” gap, we propose human-centric implementation pathways across three dimensions: institutional design, communication strategies, and educational paradigms. (1) Embed Flexible Governance and Dynamic Adjustment Mechanisms in Policy Design. Maintain unified classification standards while establishing adaptive implementation frameworks. Integrate public deliberation into policy iteration cycles through a “proposal-hearing-feedback” workflow for regulatory revisions. (2) Develop Stratified Communication Narratives and Precision Targeting Systems. Move beyond unidirectional policy advocacy. For younger demographics, employ short videos depicting daily-life scenarios; for older residents, enhance operational clarity via community bulletin boards using “sorting flowcharts + common mistake case studies”. (3) Cultivate Civic Participation Networks. Implement school-based sorting practicums to facilitate youth-led family education. Establish intergenerational learning communities by mobilizing senior sorting experts for peer mentoring within neighborhoods. (4) Promote Regional Coordination through Gradual Scaling and Knowledge Transfer. In eastern metropolises like Shanghai, advance smart infrastructure integration (e.g., the “Green Account” point system). For central/western cities, prioritize baseline infrastructure while adopting eastern management models via city-pairing mechanisms, avoiding resource misallocation from technological overreach.

This study contributes to both the academic and practical realms. Academically, the research provides a new perspective and methodology for the policy research field by utilizing big data and text mining techniques. Practically, the findings offer a scientific basis for government departments to optimize the dissemination strategies of waste sorting policies, which can help increase public acceptance and participation, and promote the effective implementation of these policies. Furthermore, the study reveals regional differences in public discussions, providing a reference for the development of more targeted local policies, and achieving an effective integration of academic research with social practice.

7 Methodological limitations

The study also has its limitations. Firstly, data collection was mainly confined to the Sina Weibo platform, which may not have fully covered public discussions on other social media or online forums. Secondly, the research did not consider the impact of cultural and economic development level differences between cities on the dissemination effect of waste sorting policies. Future research is advised to overcome these limitations.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

LC: Data curation, Software, Writing – original draft, Writing – review and editing. LH: Software, Writing – original draft, Writing – review and editing. WM: Writing – original draft, Writing – review and editing. SM: Writing – review and editing, Writing – original draft. YL: Investigation, Writing – original draft, Writing – review and editing.

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Conflict of interest

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