On Public Sentiments Toward Waste Incineration Facilities and How to Disarm People's Psychology of "Not-In-My-Back-Yard" Text Mining Analysis Based on Online Public Opinion Data from 2019 to 2020

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Abstract—During the 14th Five-Year Plan period, the serious challenges of "Not-In-My-Back-Yard" caused by waste incineration facilities still need to be dealt with properly. The research collected online public opinion data on "Waste Incineration" in Chinese from 2019 to 2020, carried out a program to measure public sentiments towards waste incineration using the emotional dictionary method, and then evaluated and analyzed the public's attitude towards waste incineration facilities after a series of special rectification actions taken by the Ministry of Ecology and Environment. Based on the above investigations, the reasons behind the problem of "Not-In-My-Back-Yard" caused by waste incineration facilities were analyzed by combining TF-IDF keywords extraction with manual identification method. Our research found that the public's attention to "waste incineration" is gradually increasing and most people began to cherish positive sentiments toward it. Compared with 2019, the proportion of positive sentiments of the public increased by about 16%, while that of negative sentiments decreased by more than 11% in 2020. In addition, Although the public's reasons for opposing "waste incineration" and the number of complaints have all gradually decreased, the speculation that waste incineration will discharge toxic emissions to the environment and be detrimental to the ecosystem is still prevalent among the public. This research can help relevant authorities to better grasp the public's opinions and demands on the problem of "Not-In-My-Back-Yard", and provide some assistance and scientific decision-making support in guiding online public opinions when dealing with it.

Keywords- Waste Incineration, Public Opinion, Sentiment Measurement, Text Mining

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1 INTRODUCTION

Waste incineration has become the main approach to dealing with household waste as it is harmful to the environment, easy to compress the waste volume, can recycle the waste resources, and occupies small space [1]. Although it can improve people's quality of life [2], there may exist environmental risks, causing negative externality to residents around the waste incineration facilities [3, 4]. As people's awareness of environmental protection is reviving, potential cost bearers around the waste incineration facilities have stronger motivations and higher organizational capabilities to oppose and protest their construction [5, 6], which sometimes leads to project failures [7, 8], resulting in the problem of "Not-In-My-Back-Yard" [9]. In order to prevent the occurrence of this problem, the Ministry of Ecology and Environment of China and other relevant departments had actively adopted and implemented a series of special rectification actions, and been dedicated to information disclosure during the 13th Five-Year Plan period (2016~2020). Since 2020, the Ministry of Ecology and Environment has carried out many innovative measures in addition to the special rectification actions, issuing a series of documents such as Regulations on the Application and Management of Automatic Monitoring Data for Domestic Waste Incineration Plants [10], and launching a national website to automatically monitor data [11], in which the pollution discharge data is disclosed to the society, and the automatic monitoring data is used as law enforcement evidence. Besides, an environmental vertical management mode was established in which the working condition indicator monitoring method is adopted to ensure each issue is solved completely. In this context, quite a few problems related to waste incineration facilities have been effectively resolved.

Since 2020, there mainly appear the following characteristics regarding waste incineration: 1) The environmental pollution caused by the domestic waste incineration power generation industry has essentially been solved. After analyzing 1.6 million pieces of gas monitoring data (including five conventional pollutants), it was found that the compliance rate of 519 domestic waste incineration power plants nationwide from 2019 to 2020 reached 99.79% [11]. 2) In the next 10 years, the number of waste incineration plants in China will continue to its peak. According to the Urban Domestic Waste Classification and Treatment Facilities Development Program [12] of the 14th Five-Year Plan (2021-2025), the national urban domestic waste incineration capacity during the 14th Five-Year Plan period will increase by 38% compared with that of the 13th Five-Year Plan period. According to different versions of Medium and Long-term Special Scheme for Power Generation through Domestic Waste Incineration issued by 20 provinces and cities in China, 892 domestic waste incineration power generation projects (including new construction and expansion projects) are planned to be built nationwide from 2021 to 2030. 3). People's requirements for a beautiful ecological environment are constantly increasing, while the tolerance for the negative impact caused by waste incineration power generation projects is constantly decreasing. And now not only those projects' potential threats to people's health, but also their impact on quality of life, culture, and psychology are taken seriously by the public.

Does the series of special rectification actions taken by the Ministry of Ecology and Environment have a positive effect? Under the background of the new era, has the problem of "Not-In-My-Back-Yard" cherished by the public towards waste incineration facilities improved? And what are the specific reasons for it? Traditional analysis on this problem often relies on

statistical data and social surveys, which is not only restricted by the sample size of the survey, but also has other disadvantages such as long cycles, high costs, and strong subjectivity. At present, new media has become an important channel for the public to express their opinions [13], and a large amount of information from it provides valuable public opinions and attitudes for relevant authorities. Based on online public opinion data, this research carried out a two-year (2019~2020) experiment in which the public's sentiments toward waste incineration facilities were monitored to evaluate the implementation effects of a series of special rectification actions taken by the Ministry of Ecology and Environment. Besides, it also analyzed the changing attitudes of the public to waste incineration facilities. On this basis, it further analyzed the main reasons causing those negative sentiments, trying to find a suitable solution to the problem of "Not-In-My-Back-Yard". And it finally put forward detailed suggestions for preventing and resolving it during the 14th Five-Year Plan period. This research is helpful for relevant authorities to timely discover the omissions in the current policy, grasp the public's opinions and demands on the problem of "Not-In-My-Back-Yard", and provide some assistance and scientific decision-making support in guiding online public opinions when dealing with it..

2 DATA AND METHODOLOGY

2.1 Research Data

This research is based on the data of the entire network at home and abroad, mainly including two types, namely Weibo and Media. Weibo includes Sina.com, Tencent and Twitter, and Media includes News, News APP, Digital News, Forums, Blogs, WeChat Public Accounts, Videos, Facebook, Encyclopedias, Q&A, etc., all of which are related to either original posts, reposts, or comments. The keyword taken in the research is "Waste Incineration" in Chinese, whose release time is from January 1, 2019, to December 31, 2020, with a total of 1.56 million pieces of data; every piece of data obtained is comprised of user name, content, publication date, forwarding volume, etc. Figure 1 indicates the proportion of media platforms involved in Waste Incineration projects from 2019 to 2020.

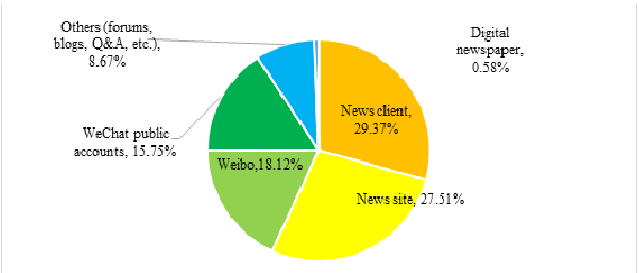


Figure 1. Proportion of different media platforms from 2019 to 2020.

From 2019 to 2020 (except from June to August 2019), the trend of public opinion was greatly irregular, forming an obvious peak, but the volume of public opinion fluctuated relatively smoothly in the remaining months. The main reasons for the sharp increase in the volume of public opinion since June 2019 include the following two aspects. On the one hand, a series of laws and regulations were successively promulgated, including the Revision Draft for Solid Waste by the Ministry of Ecology and Environment and the Notice on Comprehensively Launching Waste Classification in All Cities by nine ministries including the Ministry of Housing and Urban-Rural Development, bring about a climax for waste disposal and a huge amount of information related to waste incineration in the media. On the other hand, some waste incineration projects triggered a lot of online discussions, such as the modern incineration plant (phase II of a renewable energy utilization center) in Shanghai Laogang that aims to realize waste recycling, volume-reduction, and harmlessness to the environment, the newly-constructed waste incineration plant (it was strongly opposed by the local people) in Chenjiachong, Wuhan Yangluo, Hubei, etc. Those negative events increased the volume of public opinion in July 2019, reaching the highest (nearly 190, 000) in the entire period. Since 2020, the public's attention to "waste incineration" has gradually increased, and the volume of information in 2020 increased by about 100,000 compared with that of 2019. The monthly trend of public opinion from 2019 to 2020 is shown in Figure 2.

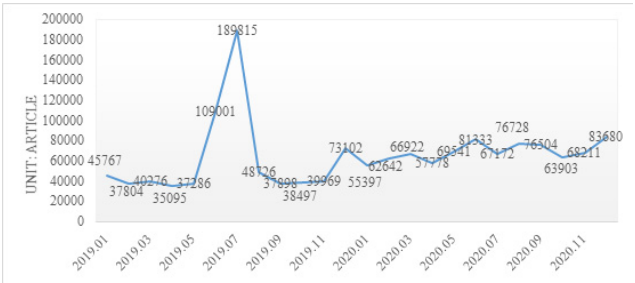


Figure 2. Proportion of different media platforms from 2019 to 2020.

2.2 Research Method

The texts collected in the research will be pre-processed, and the specific operations include noise processing [14], Chinese words segmentation [15], deletion of stop words [14], etc.; secondly, the sentiment dictionary is used to measure public sentiments [16]; finally, based on the forwarding volume of TOP1000 articles with negative sentiments, the causes for the problem of "Not-In-My-Back-Yard" related to waste incineration is conducted by combining the manual identification method with the TF-IDF keyword extraction method [17].

2.2.1 Data Preprocessing.

In order to ensure the accuracy of public opinion data analysis, all the data needs to be preprocessed before analysis, including removing the noise data in the text, performing text segmentation, and locating stop words, so that the data has the expected structure to lay a

proper foundation for subsequent analysis. The details are as follows: 1) The noise processing of data mainly includes the deletion of special symbols, such as web links (http (s): …), forwarding and reply symbols (//@Username:), punctuation and numbers (?123), etc., as well as invalid information such as advertisements. 2) Text segmentation refers to the process of segmenting a text with words as the basic unit and then dividing a complete sentence into word sequences according to the semantics. In this research, the widely used JIEBA Segmentation [17] is taken as the analysis tool. 3) Stop words generally include prepositions, conjunctions, modal auxiliary words, etc. The HIT Stop Word List is used in the research to filter stop words.

2.2.2 Sentiment Tendency Measurement.

This research conducted a textual analysis of the public's online opinions about "waste incineration" based on sentiment analysis. Besides, sentiment dictionaries such as HowNet were used to perform manual identification. The measurement and classification of sentiment scores based on sentiment dictionaries are as follows:

$$Score(S_i) = Max(\sum_{j=1}^{n} Score(S_{ij})_x) \quad (1)$$

Where S_{ij} is the result of the j word segmentation in the document i ; $Score(S_{ij})_x$ is the corresponding sentiment score of x (including both positive and negative sentiments) with respect to the sentiment type S_{ij} . Check whether S_{ij} is a sentiment word in the sentiment dictionary and if it is a sentiment word, give it a value of 1; $Score(S_i)$ is the text sentiment score of documents i . Compare the positive and negative sentiment scores, and select the highest-scoring sentiment type as the final result of sentiment tendency. If the maximum sentiment score among all types is 0, the text sentiment is considered neutral.

2.2.3 Keyword extraction and theme recognition.

The commonly-used weight-calculating algorithm TF-IDF was used in the research to extract text keywords, and its classic formula is as follows:

$$w_{ij} = tf_{ij} \times idf_j = tf_{ij} \times \log(N / n_j) \quad (2)$$

Where tf_{ij} is the word frequency of the text, indicating the ratio of the number of times the word j appears in the document i to the total number of words; idf_j is the inverse frequency of text, namely the reciprocal of the number of the word j in the document; N represents the total number of documents; n_j is the number of documents where the word j appears. If a word appears more frequently in a certain document i, but less frequently in the corpus, the weight value calculated by the algorithm tends to be higher. In this case, the word can represent the theme of the document to a certain extent.

3 RESULTS AND DISCUSSION

3.1 Changes in Public Sentiments

Judging from the sentiment trend from 2019 to 2020 (Figure 3), the positive sentiment is higher than the negative and neutral sentiment in each month, and all the sentiments reached their peak in July 2019. The main reason for the peak of positive sentiment is that the pilot work of waste classification began to be implemented in Shanghai and other places in July 2019, which made the public continue to discuss topics related to waste incineration, finally leading to a huge volume of information in supporting waste incineration, spreading popular science about waste incineration knowledge, and praising the advanced technology used in waste incineration. The peak of negative sentiment was mainly due to the strong criticism of the construction of waste incineration plants in Yangluo, Wuhan, Hubei by the local people, which continued to ferment until July of that same year. However, the volume of public opinion immediately returned to the normal level after August 2019. In addition, the volume of positive public opinion has shown a continuous increase since 2020.

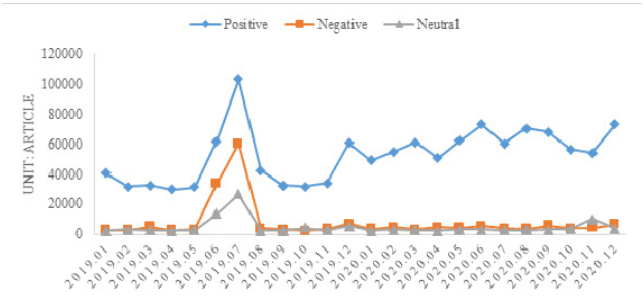


Figure 3. Sentiment trend from 2019 to 2020.

Judging from the data of public opinion sentiment in a different category related to the “waste incineration” on the entire network from 2019 to 2020, the proportion of positive, negative, and neutral sentiment is 80.93%, 11.77%, and 7.30% respectively, which indicates that the overall public opinion is relatively positive with positive sentiment dominant. The positive sentiment (88.34%) in 2020 increased compared to that of 2019 (72.54%), while the negative sentiment in 2020 (6.47%) decreased compared with that of 2019 (17.77%). Those facts indicate that the series of new measures taken by the Ministry of Ecology and Environment since 2020 has helped the implementation of ‘Internet + supervision’, and promoted the concepts of precise pollution control, scientific pollution control, and pollution control in accordance with the law, winning praise from the public. In addition, the approach of ‘putting people first’ adopted by local governments has gradually gained the trust of the masses, making the “waste incineration” project gain more and more public understanding and support.

3.2 Analysis of Emotion Loading Buzzwords

By analyzing the positive buzzwords in 2019 and 2020, it is found that there are 78 positive buzzwords repeated, such as “construction”, “development”, “power generation”, “dealing with” and “advancing”. Their repetition rate is relatively high, with the words “construction”, “development”, and “power generation” registering the highest repetition frequency among the positive buzzwords in these two years. On the one hand, judging from the repetition frequency of the positive buzzwords in 2019 and 2020, the popularity of related buzzwords in 2020 is generally higher than that in 2019, for example, the word “construction” topped throughout 2019 and 2020, with a high repetition frequency of 2.4 million and 3.6 million respectively. Driven by the dual forces of policy and market, the market of waste incineration is ushering in its rapid development period, and the “waste incineration” project is gradually concerned and discussed by more and more people. On the other hand, judging from their categories, the positive buzzwords in 2019 and 2020 relatively fall into certain major categories of construction management (comprised by such words as “construction”, “development”, “advancing” and “engineering”) and ecological and environmental protection (composed of such words as “dealing with”, “management”, “environmental protection” and “ecology”), with similar repetition frequencies in general. It indicates that relative policies in the industry of power generation through waste incineration have been gradually improved in China. Under strict government supervision, enterprises have intensified their refined management, continuously advanced technological innovation, and constantly improved the production processes and environmental protection treatment methods of power generation through waste incineration, thereby gradually gaining the public’s understanding.

There are 13 repeated words in related negative buzzwords in 2019 and 2020, such as “pollution”, “hazardous waste”, “causing” and “dioxin”. The repetition rate is relatively low, with the words “hazardous waste”, “Yangluo” and “Pollution” registering the highest repetition frequency among the negative words in these two years. On the one hand, judging from the number of the repetition frequency of the negative buzzwords in 2019 and 2020, the popularity of related buzzwords in 2020 is generally lower than that in 2019. The negative emotions of the public towards the “waste incineration” project have gradually decreased, making the number of buzzwords gradually decrease. On the other hand, judging from the categories of the negative buzzwords in 2019 and 2020, there is a certain difference in the major categories. In 2019, the negative buzzwords are mainly related to individual typical “Not-In-My-Back-Yard” cases (such as the waste incineration project in Yangluo, Wuhan). In contrast, the negative buzzwords in 2020 mainly fall into the major category of ecological and environmental protection, including such words as “hazardous waste”, “pollution”, “impact” and “risk”. It indicates that the rights protection protest has been declining since 2020, but some people still have certain prejudices against the “waste incineration” projects. As a result, the buzzwords in the major category of ecological and environmental protection are still in high popularity. See Figure 4 for the emotion-loading buzzwords in 2019 and 2020.

a) the positive buzzwords in 2019 b) the negative buzzwords in 2019

c) the positive buzzwords in 2020 d) the negative buzzwords in 2020

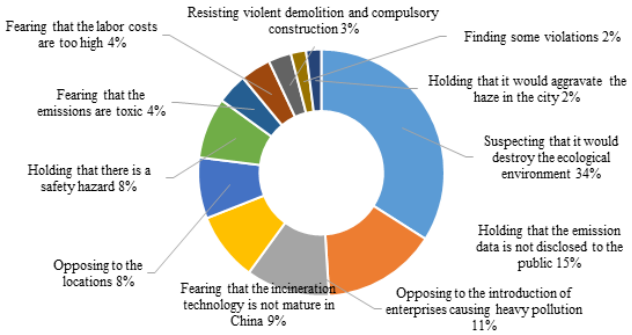
Figure 4. Pictures of Emotion Loading Buzzwords in 2019 and 2020 (omitting the searching term of "garbage incineration").

3.3 Analysis of the Reasons for Negative Emotions

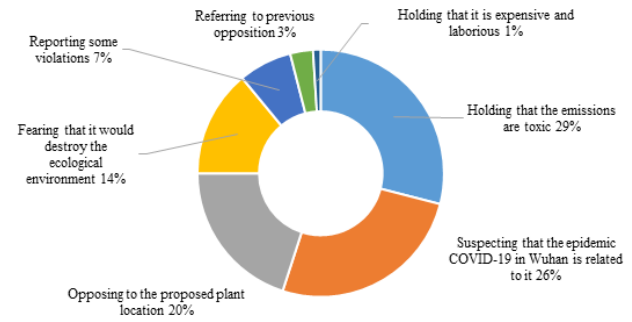
By analyzing the data related to the "waste incineration" project in 2019 and 2020, we have obtained 10 and 7 reasons for why the public opposing the project respectively. Judging from the opposition reasons in 2019 and 2020, the main opposition reasons are causing environmental damage, toxic emissions, and unacceptable plant locations, respectively accounting for 28%, 12%, and 11% of the opposition reasons in these two years. Through comparison (see Figure 5), it can be found that such reasons as "holding that the emission data is not publicly disclosed", "opposing to the introduction of enterprises causing heavy pollution", "doubting whether the incineration technology in China is mature" and "holding that there is a potential safety hazard" in 2019 are no longer the main reasons for the public opposing to waste incineration in 2020. Therefore, it indicates that the continuous decrease of the opposition reasons in 2020 and the solution of some of the opposition can be owed to the fact that, with the implementation of a series of such policies as the supervision team's rectification and enterprise self-inspection in 2020, relevant government departments can fully take the public's opinions and their rights to know, participate and supervise environmental protection into consideration and thereby soothe the public's resistance emotions by changing their role from "public participation" to "joint decision-making".

Although the negative emotions have also decreased from 2019 to 2020, the "Not-In-My-Back-Yard effect" caused by relevant major opposition voices is still worthy of vigilance and careful response. By analyzing the reasons for the public's opposition to the "waste incineration"

project in 2020, it is found that the reason that the emissions are suspected to be toxic accounts for the highest proportion of 29% because the public's fear of waste incineration is triggered by some netizens who reported that they were suffering from odorous toxic gas and black smoke emitted by their surrounding waste incineration plants in Shenzhen, Chongqing, Zhongshan, Wuhan, etc. and argued that the sulfur dioxide and dioxins emitted by the waste incineration has made the surrounding residents vomiting seriously, which would seriously harm the health of the residents. The reason that the public speculated that the epidemic COVID-19 in Wuhan was related to the waste incineration accounts for 26%. Due to the outbreak of the epidemic COVID-19 in Wuhan in 2020, some netizens thought that there must be some relation between the epidemic and the waste incineration project in Wuhan, making other netizens more fearful of other "waste incineration" projects. The reason for objecting to the proposed plant location accounts for 20%, because some netizens were dissatisfied that some of the proposed waste incineration plants were planned to locate near their communities, villages, and schools, surrounding subways, etc., fearing that they would harm their health and devalue their property, and thus resisted the project. The reason for fearing the destroying of the ecological environment accounts for 14%, because some netizens feared that the illegal discharge of toxic and harmful pollutants of the waste incineration in some areas would disrupt and destroy the ecosystem, leading to the extinction of some birds and fish. It can be seen from these opposition reasons that there is still much work to do in the field of waste incineration in China, for instance, the public still has insufficient trust in the government and project construction subjects and still lacks correct knowledge and information.



a)2019



b)2020

Figure 5. The Proportion of Opposition Reasons in 2019 and 2020.

4 CONCLUSIONS AND SUGGESTIONS

In general, the paper finds that the public's attention to the "waste incineration" project has gradually increased, with the amount of information in 2020 rising by about 100,000 pieces compared with that in 2019. Furthermore, with the release of the Regulations on the Application and Management of Automatically Monitored Data of Domestic Waste Incineration Plants by the Ministry of Ecology and Environment, the regular announcement of sanctions and penalties for environmental violations of domestic waste incineration plants and the introduction of other measures, enterprises have intensified their refined management and continuously promoted technological innovation to earn the public's understanding gradually. Therefore, the proportion of positive emotions increased by about 16% and the proportion of negative emotions decreased by more than 11% in 2020 compared with those in 2019. In addition, the reasons for the public's opposition to the "waste incineration" project have gradually diminished and the number of rights protection protests has continued to decrease. However, speculation of waste incineration destroying the ecological environment and fearing toxic emissions are still the important reasons for the public to oppose waste incineration.

To further prevent the "Not-In-My-Back-Yard" issues of the waste incineration project in the new period, it is suggested that during the "14th Five-Year Plan" period:

First, continue to carry out routine monitoring of big data and further improve the disclosure of environmental information. On the one hand, we should, by making full use of scientific and technological means, make the supervision and law enforcement more targeted, scientific, and timely to achieve precise law enforcement in high quality and efficiency, and continue to severely crackdown on illegal activities, thereby forming a high-pressure deterrence. On the other hand, it is suggested to focus on the weak links of industry supervision and shift the focus of environmental supervision to other pollutants that are of public concern and impose a greater impact on human health, such as bad smells and dioxins.

Second, scientifically plan and deploy the project of power generation through domestic waste incineration and pay attention to their risk prevention and control. The "14th Five-Year Plan" period will still see the rapid development of waste incineration projects. The government should enhance the location selection planning of waste incineration facilities, actively respond to the public's demand for "opposing to the proposed plant location", and take the public's worrying of the short distance from the project to the residential areas, schools, environmentally sensitive areas, and other endangered areas into full consideration. It should establish a set of scientific and systematic location selection methods and mechanisms and at the same time intensify the guidance to improve the ability to prevent and resolve risks of new waste incineration facilities, the "Not-In-My-Back-Yard" ones.

Third, further advance the popularization of science on the green transformation for the project of power generation through domestic waste incineration. At present, the public still has a certain cognitive bias on the project of power generation through domestic waste incineration. Under the background of accelerating the green transformation and upgrading of the project of power generation through domestic waste incineration, it is suggested to carry out targeted scientific publicity for the industry of power generation through domestic waste incineration to make the public know more about the environmental science and the project to earn their support for the project. Through active public opinion guidance, we will gradually get rid of the

previous “stigma” from the public’s impression, thereby facilitating the risk prevention and solution of the “Not-In-My-Back-Yard” issues.

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