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Sentiment Analysis of Public Opinion on the Palestinian-Israeli Conflict using Support Vector Machine and Naïve Bayes Algorithms

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ABSTRACT

The Palestinian-Israeli conflict, particularly in Rafah City, Gaza Strip, has drawn global attention due to escalating violence, prompting widespread responses on X social media. This study analyses public sentiment on the topic 'Eyes on Rafah' using 403 tweets, with 306 classified as positive and 94 as negative. This study aims to analyses the world's response to the prolonged conflict to evaluate these sentiments, Text Mining techniques were applied, comparing the performance of Support Vector Machine (SVM) and Naïve Bayes algorithms. SMOTE optimizations was implemented to address data imbalance and enhance algorithm performance. Findings reveal that the SVM algorithm achieved superior results with 97% accuracy, precision of 97%, recall of 100%, and F1-Score of 98%, compared to Naïve Bayes with 86% accuracy, precision of 100%, recall of 75%, and F1-Score of 85%. These results highlight the effectiveness of SVM in analyzing sentiment and the critical role of SMOTE in improving classification accuracy for both algorithms.

Keywords: *Rafah, Support Vector Machine, Naïve Bayes, SMOTE, Sentiment Analysis*

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INTRODUCTION

The Palestinian city of Rafah in the Gaza Strip has become a major international concern. The region has witnessed a sharp escalation of conflict between the Israeli military and Palestinian militant groups in recent months. Airstrikes carried out by Israel have caused massive damage to homes and civilian infrastructure in Rafah, costing many lives among civilians. The world's focus on Rafah reflects global concern for the situation there, as the city is the last bastion of Hamas military battalions and its surviving leaders. This war has caused several opinions to emerge, especially through social media, namely X or Twitter. This social media is used as a forum in the form of expression carried out by several users to get some news or information in an up to date and unlimited manner, users interact with each other by giving their respective opinions to produce different views. On this platform there are several opinions or views that are separated in 2 camps,

both those who have pro and contra views, views and roles towards the community are a valuable resource in changing a new form of perception besides that, the actions of users are very diverse, namely the existence of one hatred for one party, this can cause divisions in various social media users (society). As a result, sensitive issues related to conflicts or wars that are happening arise.

Many people express their views, both in direct discussions and through social media such as Twitter. Twitter, which has now changed its name to the X platform, is a social media platform that allows users to send short messages or 'tweets' with a limit of 280 characters (Dimas Lutfiyanto & Setiawan, n.d.). Users utilise this platform to share information, as well as engage in online conversations about various current news, and actual issues (Normawati & Prayogi, 2021). therefore, sentiment analysis is needed to determine the direction and intensity level of positive and negative sentiment of the community towards the event.

Sentiment analysis is an important part of the text mining process. Text mining is the process of extracting valuable information from unstructured text using algorithms and natural language analysis to uncover patterns and important information hidden in the text. (Duei Putri et al., 2022). The classification method is used in this research in performing the sentiment analysis process. Classification in text mining is the process of classifying documents or text into certain classes or categories based on certain characteristics contained in the text. (Sari & Suryono, 2024). These classification methods are often used to analyse text on a large scale, such as sentiment classification, topic classification, or spam identification in emails. Classification algorithms such as Naïve Bayes and Support Vector Machine (SVM), are often used in text mining to predict the correct category or label for each document based on features extracted from the text. (Singgalen, 2022)

Support Vectore Machine is a robust classification algorithm, suitable for linear and non-linear data, and tends to produce optimal decision boundaries. (Sihombing & Yuliati, 2021). Naive Bayes is a classification algorithm in machine learning based on Bayes' Theorem. It is considered 'naive' due to its assumption of simplicity and independence between features, even though in the real world features may be interrelated (Hanafiah et al., 2023) Naïve Bayes is one of the simple yet effective classification algorithms, often providing satisfactory results especially in cases with a relatively large number of features compared to the number of samples (Oktaria Sihombing & Arif Dermawan, 2021). By utilizing features extracted from text, they can provide accurate sentiment prediction. In previous research on Indonesian public opinion regarding the Mandalika International Circuit through the Twitter platform using the Naïve Bayes method. The analysis results show that positive sentiment is the most dominant in public opinion regarding the Mandalika International Circuit, the accuracy is 78%, precision in the positive class is 84% and in the negative class is 73%, recall in the positive class is 70% and in the negative class is 86%, and the F1-Score is 76% in the positive class while in the negative class has a value of 79% (Mujahidin et al., n.d.).

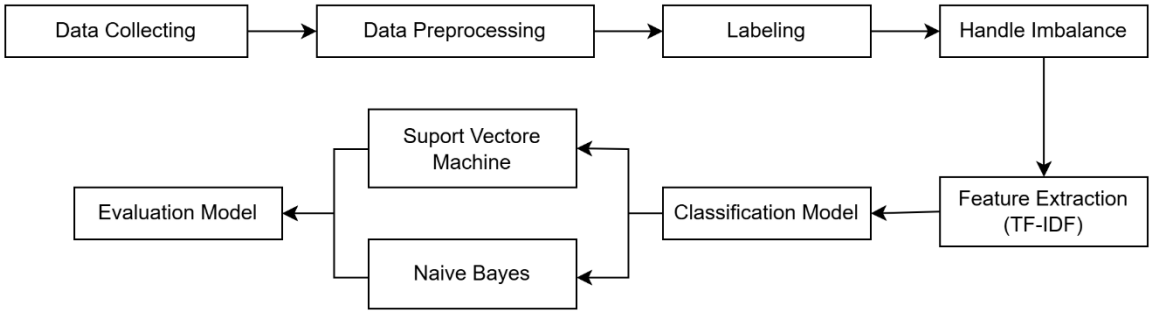
In other studies that discuss sentiment analysis of the popularity of Moodle and Edmodo applications with the use of the Support Vector Machine algorithm. It can be concluded that users tend to give higher positive sentiments towards the Edmodo application than the Moodle application. The percentage of positive sentiment on Edmodo is 67%, with 83.7% accuracy, 93% precision, 82% recall, and 87% f1-score. While Moodle, the percentage of negative sentiment is 67%, with an accuracy of 81.6%, precision 79%, recall 100%, and f1-score 88% (Yolanda et al., 2022). From the results of some previous findings, it can be seen that previous sentiment analysis research only uses one method, and does not use SMOTE optimization to overcome data imbalance, therefore the current research compares both SVM and Naïve Bayes algorithm methods.

This research aims to analyses public sentiment towards the genocide committed by Israel in Rafah, Palestine. In this study, a comparison between SVM and Naïve Bayes algorithms combined with Synthetic Minority Oversampling Technique (SMOTE) is used to overcome the problem of data imbalance. This research also seeks to identify the most optimal classification algorithm by evaluating the accuracy, precision, recall, and F1-Score of the two algorithms.

METHOD

This research uses a quantitative approach, in the topic of sentiment analysis, data samples are obtained from the twitter platform using the keyword ‘eyes on rafah’. Researchers will explore the diverse perspectives, and views reflected in user tweets. The flow in this research includes 7 stages, namely Data collection, Data preprocessing, Labelling, then future extraction with TF-IDF, Handle imbalance by applying SMOTE optimization, then Classification Model using Naïve Bayes and Support Vector Machine and the last stage is the Evaluation Model. Figure 1 is a scheme of this research.

Figur 1. Scheme of The Research



This experiment, the dataset is obtained through the crawling process from the twitter social media platform using the Harvest library by utilising the Python programming language. Data in the form of user tweets using Indonesian with the keyword ‘eyes on rafah’. Data collection starts from the time range of June 2024 with the amount of data obtained as much as 403 tweet data. After the data is obtained, the next step in data analysis is preprocessing. This stage includes various actions such as data cleaning which serves to clean data from punctuation marks, symbols, Uniform Resource

Locator (URL), duplicate data, and empty data. Case folding serves to break a sentence into small units or tokens. Filtering is used to filter out a word that is not needed, and the last process in preprocessing, stemming, is the process of removing prefixes or suffixes in a word so that only the basic form or base word remains (Hendrawan et al., 2022). After going through the preprocessing stage, the data will be given a category in the form of a label.

The data labelling process using the TextBlob library produces two types of sentiment labels, namely positive and negative. From the labelling results, there are 94 data with negative sentiment and 306 data with positive sentiment. This data imbalance requires further handling, so the Handle Imbalance method using SMOTE is performed. SMOTE is a technique used in machine learning to overcome class imbalance in data (Hidayatullah & Umaidah, 2023). In the next stage to assess the importance of a word in a document, a feature extraction process is carried out using the Term Frequency-Inverse Document Frequency (TF-IDF) method. The TF IDF method gives greater weight to words that appear frequently in a document but rarely in the entire document collection. This helps determine the most important words in a document by taking into account both factors (Rahayu et al., 2022). In the model classification process, Support Vector Machine and Naïve Bayes algorithms are used.

SVM is a classification modelling algorithm that separates two classes by forming a hyperplane that has the maximum margin between them in the feature space. The algorithm operates by determining the best hyperplane that maximizes the distance between the closest data points of the two classes, known as support vectors. This algorithm is effective in handling high-dimensional datasets and can work well in cases where the number of features is greater than the number of data samples. Furthermore, the Naive Bayes algorithm is a classification algorithm based on Bayes' theorem with the assumption of independence between features. (Saputra & Noor Hasan, 2023). Naive Bayes utilizes probability calculations to predict the class of data based on the probability distribution of its features.

The final stage of this research evaluates the performance of the classification model, using a confusion matrix to compare the model's predictions with the actual values of the test data. Using the confusion matrix, researchers were able to measure various evaluation metrics such as accuracy, precision, recall, and F1-Score, which provided a more holistic understanding of the model's ability to classify various classes.

FINDING AND DISCUSSION

RESEARCH RESULT

The data used in this study were obtained from tweets of Twitter social media users using the crawling method using the keyword ‘eyes on rafah’. A total of 403 tweets were collected from the time span of June 2024. Furthermore, the data obtained will enter the preprocessing stage. Table 1 shows the results of the data preprocessing process which involves several stages. Data cleaning is the stage of removing punctuation marks, symbols and URLs, then case folding converts all letters into lowercase letters, then the

tokenizing stage breaks sentences into individual words, then the filtering stage which removes words that are not important in tokenizing and finally the stemming stage which removes affixed words and becomes basic words. After going through the preprocessing process, the text data can be more structured, clean, and ready for the sentiment analysis process. This helps improve the quality and accuracy of the analysis results as well as efficiency in data processing.

Table 1. Preprocessing Result

Stages	Results
Data Tweet	@khirariffin Cukup Ya Allah Situasi Terkini di Rafah Palestina
Data Cleaning	Cukup Ya Allah Situasi Terkini di Rafah Palestina
Case Folding	cukup ya allah situasi terkini di rafah palestina
Tokenizing	['cukup', 'ya', 'allah', 'situasi', 'terkini', 'di', 'rafah', 'palestina']
Filtering	['cukup', 'allah', 'situasi', 'kini', 'rafah', 'palestina']
Stemming	cukup allah situasi kini rafah palestina

After going through all the stages, then in the study with a total data of 403 tweets. Of these, there are 306 tweets classified as positive sentiment and 97 tweets as negative sentiment. With these results, the imbalance of data between positive and negative sentiments can result in algorithmic models such as Support Vector Machine and Naïve Bayes tending to be better trained to recognize words that are negative in nature. This can improve classification accuracy and performance for negative sentiment. Therefore, in this research, optimization is carried out using the SMOTE method to balance the amount of data between positive and negative sentiments, so that the model does not tend to dominate one particular sentiment. By applying SMOTE optimization, the amount of minority data will be enlarged so that it is balanced with the amount of majority data. The following image shows the results of the classification comparison with SMOTE optimization.

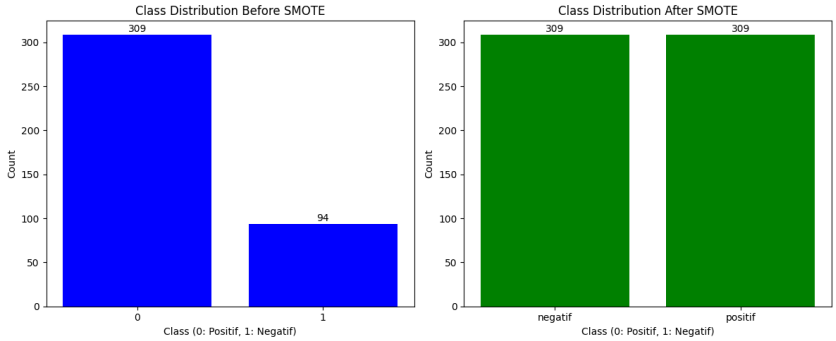


Figure 2. Sentiment Classification Comparison

Based on the results seen in Figure 2, the classification of sentiment data before SMOTE optimization and after SMOTE optimization. Before the application of SMOTE

optimization, the negative sentiment results were 97 data and Positive sentiment was 304 data, after the use of SMOTE optimization the number of sentiments will be the same, namely 304 data. This causes the algorithm model to be more balanced in learning sentiment, without any majority or minority data. In the testing phase of this research, a comparison between the SVM and Naive Bayes algorithms is carried out by using 80% as training data and 20% as testing data. The data used includes two conditions, namely before and after SMOTE optimization to find the best algorithm performance. The following is a table of results from the comparison of SVM and naïve bayes classification with SMOTE and without SMOTE.

Table 2. Classification Results

Report	Support Vector Machine				Naïve Bayes			
	Before SMOTE		After SMOTE		Before SMOTE		After SMOTE	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Accuracy	0,83		0,97		0,77		0,86	
Precision	0,86	0,75	0,95	1,00	0,81	0,56	1,00	0,77
Recall	0,95	0,47	1,00	0,95	0,94	0,26	0,75	1,00
F1-Score	0,90	0,58	0,98	0,97	0,87	0,36	0,85	0,87

In Table 2, the experimental results of the comparison of the two algorithms show that the effect of SMOTE optimization on model performance has increased. in the SVM algorithm there is an increase in the accuracy value of 83% to 97% after the application of SMOTE. On the other hand, the naïve bayes algorithm also experienced an increase in the accuracy value of 77% to 86% after the application of SMOTE.

The SVM algorithm with positive sentiment also increased in terms of precision value from 86% to 97%, recall value from 95% to 100%, and F1-Score value from 90% to 98%. While the naïve bayes algorithm experienced an increase in the precision value of 81% to 100%, but there was a decrease in the recall value of 94% to 75% and the F1-Score value of 87% to 85%. In addition, in the research experiment, there is also a confusion matrix comparison between the two algorithms to further understand the extent of the model's performance in classifying sentiment.

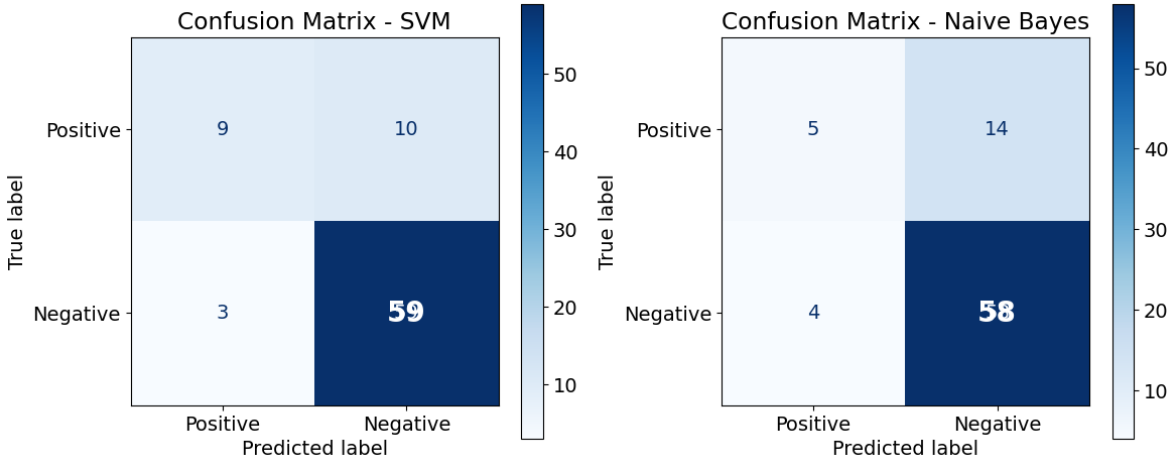


Figure 3. Confusion Matrix Before SMOTE

It can be seen in Figure 3 that before the application of SMOTE optimization both algorithms are more dominant in predicting words with negative sentiment values related to the topic. On the SVM algorithm, the True Negative value is 59 and False Negative 10 while the True Positive value is 9 and False Negative 3 On the other hand, the Naïve Bayes algorithm has a True Negative value of 58 and False Negative 14 while True Positive is 5 and False Negative 4.

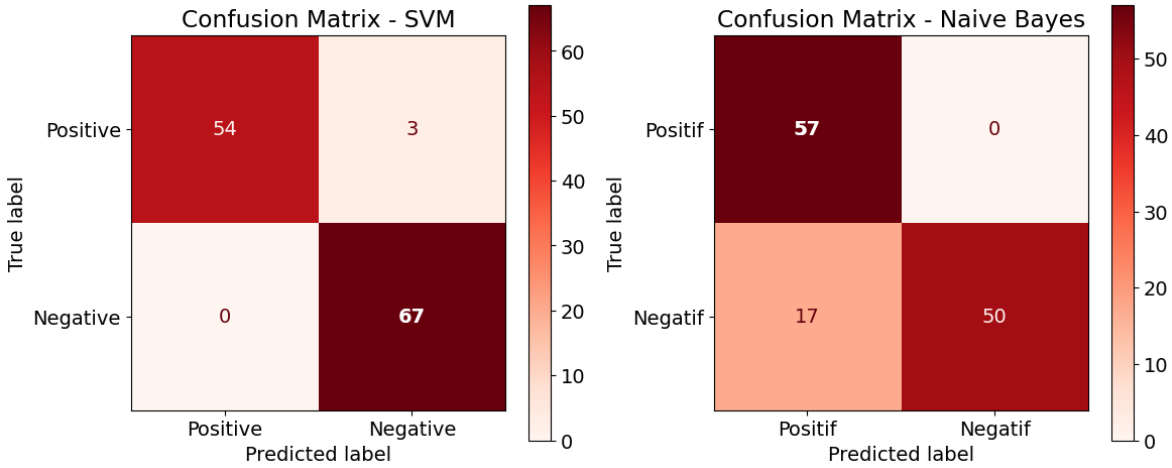


Figure 4. Confusion Matrix After SMOTE

Figure 4 shows that after SMOTE optimization is applied, both algorithms show more optimal performance in predicting positive and negative labels. In the Support Vector Machine (SVM) algorithm, the True Positive value for positive labels is 54, while for negative labels is 67. Meanwhile, in the Naïve Bayes algorithm, the True Positive value for positive labels reaches 57, and for negative labels is 50. These results indicate that after SMOTE optimization, both algorithms are able to improve prediction accuracy, especially in classifying data into the right category.

Wordcloud is a visual representation of the text where the most frequently occurring words in the text are given greater visual emphasis compared to the less frequently occurring words. In wordcloud, the size and colour of the words are adjusted based on the frequency of their occurrence in the text such as the word ‘rafah’. Figure 5 is the result of wordcloud visualization of all sentiments

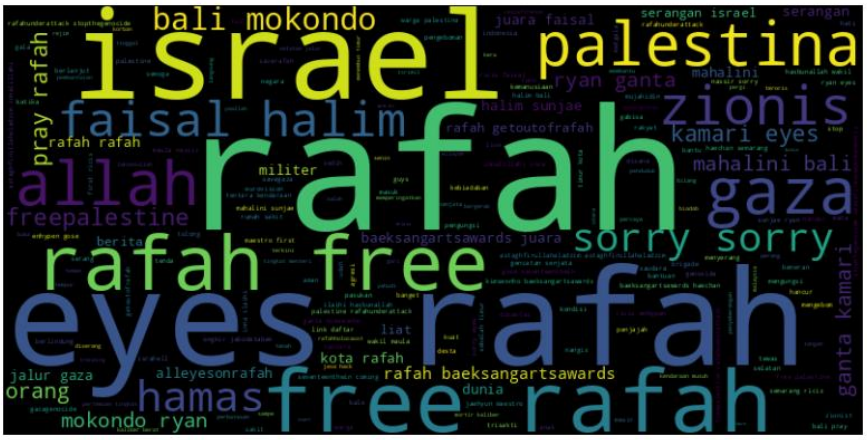


Figure 5. Wordcloud Visualization

DISCUSSION

Based on experimental results in comparing SVM and Naïve Bayes algorithms regarding sentiment analysis of the Capital City of the Archipelago. The data obtained experienced an imbalance in positive and negative sentiment, this resulted in the two algorithms not being able to optimally compare words. Therefore, SMOTE optimization is carried out (Nugroho & Rilvani, n.d.). SMOTE works by creating synthetic samples from the minority class, thereby increasing the number of samples in the class. In this way, SMOTE helps to encourage the model to learn better from the minority class, thereby improving its ability to distinguish infrequently occurring words (Anjani et al., 2023). SMOTE optimizations has a significant impact in helping the algorithms distinguish words. This is evidenced through Figure 4 which shows the confusion matrix comparison, where the SVM and Naïve Bayes algorithms prove to be more optimal in determining words with higher True Positive values.

Experiments comparing SVM and Naïve Bayes algorithms with the application of SMOTE optimizations show that SVM has an advantage. This is due to SVM's tendency to pay more attention to minority groups in the decision-making process, as it focuses on finding a hyperplane that maximizes the margin for each sentiment. Thus, SVM is naturally better able to distinguish infrequently occurring classes. The accuracy of the SVM algorithm after SMOTE optimizations reached 97%, which is the highest. The analysis also shows that both algorithms have advantages in precision and recall for both positive and negative sentiment classes. Therefore, F1-Score is used as an indicator of model performance because F1-Score calculates the value of precision and recall, so the F1-Score value can be used as an indicator to determine the best algorithm where in this study SVM achieved an F1-Score value of 98%, thus showing excellent performance compared to Naïve Bayes which has an F1-Score value of 87%.

In the research discussed, there are several significant differences and improvements compared to previous studies that only used the Naïve Bayes algorithm (Kurniawan & Waluyo, 2022) and the SVM algorithm (Yolanda et al., 2022). Firstly, this

study broadens the scope by comparing two different classification algorithms, namely SVM and Naïve Bayes, in the context of sentiment analysis related to the genocide that occurred in Rafah, Palestine. In addition, the use of SMOTE optimization technique to address data imbalance contributes significantly to improving the performance of both algorithms. The findings show that the SVM algorithm can achieve an accuracy of 97% and Naïve Bayes reaches 86% after the application of SMOTE, which is a considerable improvement compared to previous studies that only used Naïve Bayes. Thus, the application of SMOTE optimization is able to improve the performance of both SVM and Naïve Bayes algorithm models. This experiment gained insight in the form of a wordcloud visualization that displays visuals related to words that are often thrown by users of application X on the topic of Eyes on Rafah such as 'rafah', 'israil', 'free', 'eyes', 'Palestina', and 'Zionis' so that it can be assumed in this study that it reflects public attention to the genocide tragedy in Palestine and can be an input for relevant agencies to raise awareness and global solidarity with the suffering of the Palestinian people due to Israeli actions.

CONCLUSION

Based on the results of sentiment analysis in this study, the genocide that occurred in Rafah, Palestine triggered various reactions from the public. The data used in this study totaled 403 data on the topic. Through sentiment analysis using the Support Vector Machine (SVM) and Naive Bayes classification algorithms, an in-depth understanding of the direction and intensity of positive and negative sentiment towards the incident is obtained. The results of this study show that the comparison of accuracy values in the Support Vector Machine algorithm reaches 83% and the Naïve Bayes algorithm reaches 77%. This classification method is able to identify sentiment with significant accuracy after applying the SMOTE optimizations technique to overcome data imbalance.

The results showed that the SVM algorithm proved to be superior to Naïve Bayes with an accuracy of 97% while Naive Bayes with an accuracy of 86% after the application of SMOTE. In addition, there is a significant increase in precision, recall, and F1-Score in both algorithms after the use of SMOTE. In SVM algorithm, the precision value is 96%, Recall 100% and F1-Score 98%. In addition, this research obtained results in the form of opinions from the public about the genocide that occurred in Rafah, Palestine. wordcloud visualization that can be used by related parties as input regarding the genocide that occurred in Rafah, Palestine. This visualization reflects the Indonesian people's concern for the tragedy and can be used to strengthen support and increase public awareness.

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