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Sentimental Analysis of Environmental Discourse on Twitter: A Computational Corpus Based Study

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Abstract
This paper examines the level of sentimental orientation and subjectivity integrated within environmental discourse on Twitter (X). Based on a self-assembled collection of 100 purposely sampled tweets on environmental topics specifically those about Pakistan climate crisis. TextBlob, a Python natural language processing library, is used to derive polarity and subjectivity rating of each tweet. Theoretical background relies on the Appraisal Theory (Martin and White, 2005), the rate of textual evaluation and Sentiment Polarity Theory which categorizes textual impact on a scale between positive and negative. The results show that positive sentiment is in 40 percent of the tweets, negative 38 percent and neutral 22 percent, which provide on average a positivity of +0.0011, which is a slight positive, but still positive, balance of the environmental conversation. The negative sentiment is primarily related to climate disasters, pollution, and failure in governance whereas positive sentiment is observed in the conversation around renewable energy, community resilience, and climate activism. The results also demonstrate that evaluative adjectives, intensifiers and emotionally colored words are significant to influence sentiment polarity. On the whole, this paper has proven that the discourse on environmental issues on social media is extremely critical and contains the elements of the crisis-related discourses and those of the solution-oriented ones.

Keywords: *Sentiment Analysis, Appraisal Theory, Sentiment Polarity, Environmental Discourse, Twitter, TextBlob, Corpus Linguistics, Climate Communication*

Introduction

Public communication has been greatly altered by the development of social media such as Twitter, Facebook and Instagram. Environmental issues are no longer subject to being relegated to scientific reports, policy publications or other conventional media outlets; they are instead discussed, negotiated and repackaged in digital spaces. Social media makes instant and massive communication possible whereby, individuals, activists, and government agencies, as well as environmental agencies, add to the flow of ideas. This has resulted in the generation of a data-rich environment that is especially useful in the fields of linguistic and computational research.

The growing accessibility of mass digital information has promoted the use of computational processes in language studies. Sentiment analysis, which is a subdivision of natural language processing, provides mechanisms for the detection and classification of emotional orientation in textual information. Text can also be

classified based on the sentimental polarity that is positive, negative, or neutral through automated classification systems. But, although computational sentiment analysis can offer measured and scalable scores, they tend not to be theoretically rich when they are not tied to linguistic models. Because of this reason, a quantitative computational approach is necessary to be used along with discourse-based theories to give meaningful interpretations.

The proposed study is quantitative and based on the computational corpus to study the patterns of sentiment in environmental discourse on social media. Corpus linguistics provides methodical processes of gathering, organizing and examining big volumes of authentic language data. This study is empirically reliable and has a transparent methodology because it will gather a collection of social media posts devoted to the environmental issue to create a specialized corpus. Frequency patterns, keyword distributions, collocations, and sentiment scores are analyzed using computer tools. With the help of such approach, it is possible to identify macro-level trends and retain an analytical accuracy.

The theoretical foundation of this paper is based on Appraisal Theory, which was created in the framework of systems functional linguistics by James R. Martin and Peter R. R. White. Appraisal Theory is a theoretical framework that offers a detailed analysis of evaluative language based on three interrelated subsystems, namely, Attitude, Engagement, and Graduation. Attitude consists of affect (emotions), judgement (ethical evaluation of actions) and appreciation (aesthetic evaluation of phenomena). The concept of engagement looks into the positioning of the speakers relative to the other voices, whereas graduation looks at the amplification or dampening of the evaluative meanings. The framework allows developing a subtle perception of the ways in which environmental concerns are transfigured in digital discourse, both emotionally and ideologically.

Besides the Appraisal Theory, this work is based on the Sentiment Polarity Theory that is concentrated on determining the evaluative orientation of text. Language is categorized into positive, negative, or neutral by using lexicon-based or machine learning models, based on the polarity of language. Although these models can offer measurable trends of sentiment, they are capable of simplifying complicated patterns of discourse. Environmental discourse often has irony, ambiguity, and mixed assessments, which cannot be entirely described using polarity scores only. This study combines the polarity analysis with the types of appraisal, creating a gap between the computational efficiency and theory.

The methodological and interpretative aspects of the study are reinforced by the integration of corpus linguistics, computational analysis, and discourse theory based on appraisal. Quantitative data indicate the sentiments on a large scale, whereas theoretical analysis demonstrates the way in which such sentiments are created linguistically. This cross-disciplinary methodology will make sure that statistical results are not based on numerical results but rather interpreted in functional linguistics.

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Research Questions

1. What are the polarity and subjectivity scores of the sampled tweets, and what linguistic patterns do they reflect?
2. How do positive, negative, and neutral sentiments vary across different environmental topics (e.g., climate change, pollution, deforestation) on social media?
3. How do Appraisal Theory's subsystems (Attitude, Engagement, Graduation) manifest in the quantitative sentiment scores?

Research Objectives

1. To determine the overall sentiment distribution in environmental discourse on social media using computational techniques.
2. To analyse polarity and subjectivity scores using TextBlob and interpret them through the lens of Appraisal Theory.
3. To find how do positive, negative, and neutral sentiments vary across different environmental topics (e.g., climate change, pollution, deforestation) on social media?

Significance of the Study

This study is important not only in the field of linguistics. The implication of the understanding of the way environmental discourse is emotionally framed on social media is applicable to policymakers, environmental activists, and communication strategists. Patterns of sentiments determine the level of involvement, online activism and dissemination of environmental awareness campaigns. This research adds to the knowledge on the construction of environmental realities socially in digital public space by detecting dominant trends of evaluation and emotional orientation. Eventually, this study proves that the computational corpus-based analysis under the control of a strong linguistic theory is a holistic and empirically supported framework to study the discourse of the environment in the modern online communication.

Statement of problem

The social media talk about the environment is occurring every second, and it is informed by fear, hope, anger, and urgency. but these strong voices are great assets that are so easily diminished to mere positive or negative, and the substance of these labels is lost. Meanwhile, the number of posts that can be read and interpreted by any team of people is millions. This puts decision-makers in a dilemma of knowing what people actually feel and how they can address the environmental issues in the current digitalized world.

Literature review

Opinion mining or sentiment analysis is an area of study in the intersection of natural language processing (NLP), computational linguistics and data science. It means recognition, extraction and classification of subjective information in a text that is automatically done (Pang and Lee, 2008). Initial techniques of sentiment analysis were based on lexicon techniques, in which the sentiment score of a text was

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determined by the presence of pre-constructed dictionaries of positive and negative terms. Modern methods combine machine learning algorithms and transformer based models including BERT and GPT that are more effective on more complex tasks of affective classification.

Bhadane, Dalal, and Doshi (2015) presented a background description of sentiment analysis as an NLP task that aims to estimate subjective thoughts in text. Part of the paper reviews and contrasts lexicon-based and machine learning-based approaches to sentiment polarity (positive/negative) classification, showing how each approach transforms text characteristics into attitude or mood. They also describe a two step classification process that includes classification of aspect and determination of polarity, explaining the experimental design and pointing out such obstacles as feature selection and lexical scoring. This paper provides a useful introduction to sentiment analysis processes applicable in the context of opinion mining through the synthesis of major methodologies (Bhadane et al., 2015).

Similar but not the same Like It or Not: A Survey of Twitter Sentiment Analysis Approaches by Anastasia Giachanou and Fabio Crestani (2016) gives an in-depth overview of the practice of sentiment analysis applied to Twitter-based data, with a focus on the peculiarities of the issue and the evolution of the methods. The article classifies the current methods, which are machine learning, lexicon-based, hybrid, and graph-based methods, by clarifying how each one of them tackles the brief, informal, and dynamic aspect of tweets, including the use of hashtags, emoticons, and slang. The survey under consideration is based on the most popular materials and data sets, the strengths and limitations of the methods are considered, the open problems and future research directions of the sentiment analysis on microblogs are identified.

Reyes Menendez, Saura & Alvarez Alonso (2018) examined the attitude of the population towards the environmental problems based on the Twitter information gathered on the occasion of the World Environment Day. Using sentiment analysis and textual analysis in Python and NVivo, the authors divided the tweets into positive, neutral, and negative messages of the concern regarding climate change, pollution, water scarcity, deforestation, and sustainable development goals. They discovered that most of the negative feelings dominated which indicated that there was a general concern on both environmental risks and people health. The research is important as it provided the correlation between the sentiment in social media and the real-world Sustainable Development Goals (SDGs), which provides a preliminary indication that the Twitter discussion could be used to identify the environmental priorities and concerns of the population through such computational tools as sentiment classification and keyword analysis.

In their work, Dahal, Kumar and Li (2019) performed the analysis of the large-scale corpus of geotagged climate change tweets and identified both the thematic and emotional patterns with the help of topic modeling (LDA) and sentiment analysis (VADER). Their results emphasized not only general issues that are widespread in the environment such as causal factors and effects of global warming but also the ability of Twitter (X) as a computational corpus to gauge the popular opinion at both space and time. They used the statistical methods of analyzing Twitter (X) data to show that

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the polarity of sentiment is associated with climate awareness and geographic patterns and mentioned that social media should be implemented as a trustworthy source of population sentiment data about an environmental problem. This article was the foundation of future corpus-based studies of environmental feelings.

Kirelli and Arslankaya (2020) tested the sentiment of the Turkish-language tweets on global warming through the use of supervised machine-learning methods, including Naive Bayes and SVM. They collected 30,000 sentiment polarity-labeled tweets, and benchmarks of classification performance identified potential limitations and opportunities of non-English environmental sentiment analysis. The paper is remarkable because it focuses on language-specific preprocessing and model comparison and states that linguistic variation affects the performance of classifiers. It also demonstrated that the computational sentiment methods can be localized to suit the local languages to obtain subtle public attitudes on environmental problems - this is a valuable consideration on the research of global environmental discourse.

Nur et al. (2021) suggested the use of real-time sentiment analysis as a structure applicable to monitoring climate change public opinion and offers several stages of data collection and machine learning classification. They claimed that retrospective sentiment analysis could not support dynamic event-based environmental discussion. Their results using scalable computing techniques applied to millions of posts of climate-related content provided them with timely sentiment analysis that can be utilized by communicators and policymakers. Despite its emphasis on framework construction, this article highlights the fact that the real-time corpus mining of social media could offer practical sentiment data in times of environmental disasters or policy releases, which is better than the more stagnant ones.

Sham and Mohamed (2022) contrasted between lexicon and machine learning and hybrid approaches to climate change tweet sentiment. They compared seven lexicon-based tools (e.g., VADER, TextBlob) and machine learning classifiers (SVM, Naive Bayes, Logistic Regression) against environment-related tweets. It was found that hybrids (e.g., TextBlob + Logistic Regression) achieved higher results than standalone models and it is important to note that hybrid sentiment analysis strategies can be more accurate in the environmental discourse. The significance of this study lies in its systematic approach to methodological performance of a corpus of climate content that has a guide to further computational sentiment studies in the environment.

Mubaraq & Maharani (2022) used domain-adapted language models to study sentiment on climate change on Twitter in Indonesia by using a transformer-based Indo-BERT model. This paper assembled a huge volume of tweets in the Bahasa Indonesia language and trained Indo-BERT on sentiment polarity. The scores on F1 were high, indicating that the transformer architectures are better at capturing the subtle sentiments in short texts on social media as compared to conventional machine learning methods. The study reaffirms the significance of localized language resources in corpus-based studies of environmental sentiment and notes the explanatory value of deep contextual NLP models in demonstrating the attitudes of the population to climate risks and awareness in the local setting, which can be

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valuable methodological information in the study of sentiment analysis outside the English-centric corpus.

Upadhyaya, Fisichella and Nejdl (2022/2023) proposed a multi-task model, which learns both stance identification and sentiment analysis of climate change tweets. The authors pointed out that sentiment on its own might be missing the ideological nuances of environmental debate e.g. tweets that are negative but not rejecting of climate science. With the inclusion of sentiment as auxiliary task and stance classification, the model enhanced the climate change denial and support detection. Their computation corpus included labeled tweets, and the attention-based features made it possible to generalize better. This paper demonstrates that a mixture of sentiment and stance can facilitate the insight into the discourse of the environment in social media by the public, which is a more advanced analytical tool in the context of corpus research.

Sentiments and Emotions Attention, Sentiments & Emotions toward Emerging Climate Technologies (2023) studied Twitter usage in geoengineering and climate technologies, using computational sentiment analysis to measure and capture positive and negative attitudes of the masses toward particular technological interventions such as carbon removal. This study demonstrates the role of sentiment analysis to distinguish between subtle attitudes to environmental technology issues in large corpora of social media, and demonstrates that discourse sentiment can be different when the topic of discussion is knowledge of the domain, risk perception, and context of technologies.

One of the broadest corpus-based sentiment analyses of climate change on Twitter is that by Guzman Rivera & Jemielniak (2024), who analyzed a total of more than 11 million tweets of a period of eleven years. They identified the changes in the sentiments of the people at different regions and in different periods, using VADER sentiment scoring, showing a rise in positive discourse in the post Sustainable Development Goals advocacy and a fall in discourse during the COVID-19 pandemic.

A new environmental topic classification, sentiment analysis and stance detection dataset of annotated twitter data was presented in the article EcoVerse Dataset (Grasso et al., 2024). The database covers a wide range of environmental issues, allowing multi-task corpus research not only on the aspect of climate change but also on such issues as pollution, biodiversity, and sustainability. The authors presented the classification baseline models with the help of Climate BERT and proved the usefulness of the dataset in environmental NLP tasks. EcoVerse is an important contribution to the research of the environmental discourse, as it expands the corpus landscape and allows to analyze the sentiment and stance of various ecological issues more thoroughly.

Feeling the Heat? The article Climate Change Sentiment in Spain (2024) employed natural language processing of geo-tagged Twitter to examine sentiment patterns in Spain between the years 2017 and 2022. Their corpus analysis found that negative sentiment is found to increase with external temperature peaks and heat events. The study revealed how the social media sentiment can be used to understand the lived experience of climate changes by mapping the patterns of sentiment change and their

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association with the real environmental drivers. The usefulness of corpus-based NLP in this work is to monitor the dynamics of the environmental sentiment and the sensitivity of the social discussion to the climate stressors in particular geographic areas.

The article Social Media Engagement in Waste Sorting (2025) evaluated the influence of sentiment on the development of public awareness of waste management practices through the social media analytics. The study connected sentiment valence to the user engagement measures which shows how positive and negative sentiment trajectories impact the environmental behavior and information sharing. It is not specifically dealing with climate change, but it highlights the importance of sentiment analysis of environmental issues outside climate (e.g., waste, recycling) in informing awareness campaigns and policy communication, which is an important addition to corpus-based environmental sentiment analysis studies (Huang et al., 2025).

In the past ten years, the ways to computational corpus-based environment sentiment analysis on social media evolved such that the techniques originally based on lexicon-based methods have evolved into sophisticated deep learning and transformer models. There has been ongoing geographic, linguistic, and topical expansions of studies and it has been shown that the mass sentiment analysis of social media corpora reflects the dynamic attitudes of the population toward climate change, environmental policies and ecological technologies.

Methodology

Research Design: Descriptive Corpus-Based Design

This research uses the descriptive corpus-based research design to explore the sentiment patterns in the discourse of environmental issues in social media. The corpus-based aspect of the design guarantees empirical rigor and replicability. The idea of corpus linguistics as it was developed by John Sinclair is focused on analyzing actual pieces of language in a systematic and quantitative way. Following this tradition, a professional corpus of environmental discourse was generated based on the publicly available Twitter posts. The platform was chosen because it had the status in the environmental discussions, movements, and live discussions on the subject. Search parameters were thematic by the use of hashtags and keywords that are environmental in nature, including climate change, global warming, sustainability, pollution, and biodiversity.

The descriptive corpus design provides the possibility to analyze both on a macro- and micro-level. Within the macro level, general sentiment distributions and frequency distributions are analyzed. On the micro level, the range of lexical and collocations, as well as evaluative markers, are discussed with references to the categories of the Appraisal Theory. Such a design will make the study data-driven and theoretically informed at the same time. The research is based on natural digital discourse, as the analysis is made using the actual discourse of communication instead of artificial examples.

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Research Method: Quantitative Computational Analysis

The research design that will be used in the research is that of quantitative computational analysis. It is a computational method that combines natural language processing (NLP) and quantitative statistical methods in order to examine massive textual data. The kind of computational analysis that is best applied in sentiment research is quantitative computational analysis because it may be systematically measured, categorized, and patterns identified on large corpora.

This was followed by frequency analysis and key word extraction to come up with dominant lexical and evaluative expressions that are related to environmental discourse. The co-occurrence of words with sentiment and keywords of the environment was analyzed using collocation to detect the patterns of co-occurrence between the two terms. Such quantitative tools allowed discovering statistically significant trends and repetitive patterns of evaluation.

On the whole, the quantitative computational approach corresponds to the descriptive corpus-based design since it allows carrying out a systematic analysis of the data related to the large-scale environmental discourse. It offers a strong methodological basis on which the identification of how sentiment polarity and evaluative meanings are linguistically constructed and distributed in the social media communication can be made.

Theoretical framework

The research is supported by two theoretical frameworks, which are complementary in the sense that you have Appraisal Theory and Sentiment Polarity Theory; both offer a systematic basis of analyzing the evaluative language in the discourse on the environment in the social media.

The Appraisal Theory is a theory of the encoding of evaluation, stance and positioning in discourse by speakers and writers that developed in the context of Systemic Functional Linguistics by J. R. Martin and Peter R. R. White. The model divides the evaluative meaning into three key systems namely Attitude (affect, judgment, appreciation), Engagement (dialogic positioning), and Graduation (intensity and force). With the use of computational corpus analysis, the resources of appraisal can be quantitatively determined and measured and patterns of evaluative language can be systematically studied using large-scale datasets of social media.

Sentiment Polarity Theory is a concept based on computational linguistics and opinion mining studies that aims at classifying text information into positive, negative or neutral sentences. Other scholars like Bo Pang and Lillian Lee have made major contributions to the formalization of the sentiment analysis methods in computational settings. Sentiment Polarity Theory in this research forms the quantitative premise in the identification and classification of emotional orientation in environmental discourse. Combining the concept of polarity with the concept of appraisal, the framework will connect the linguistic theory to the computational modeling, allowing the study of how environmental concerns are framed emotionally, ideologically placed, and socially negotiated within the digital communication platforms in a multidimensional approach

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Data Collection and corpus construction

The data for this study is gathered from Twitter(X) using a systematic and replicable quantitative procedure. Since the research is about the environmental discourse, a first step is identifying a comprehensive list of environmental keywords and hashtags representing the biggest themes in the environmental discourse. These keywords include words such as climate change, global warming, pollution, air quality, deforestation, sustainability, carbon emissions and renewable energy. The choice of keywords is guided by the literature of the environment, global policy debates (e.g. climate summits), and popular hashtags used on social media. This keyword-based filtering helps to ensure that the corpus that is collected remains topically relevant and also aligned with the research objectives.

The corpus consists of 100 English language tweets on environmental and climate-related issues given that there are some specific issues regarding the environmental crisis in Pakistan such as the discourse on the issue of renewable energy, climate activism and environmental governance in an international context. Sampling of the tweets was done intentionally in order to cover all three major types of discourse: Crisis and Grievance Discourse: Tweets responding with alarm, outrage or distress over individual environmental disasters and governmental failures. Neutral and Informal Discourse: Tweets reporting scientific findings, policy announcements and factual updates on environmental matters with rather low emotional loading. Positive/Solution-Oriented Discourse: Tweets celebrating environmental action, resiliency, renewable energy initiatives, and community engagement.

Analytical Tool

TextBlob is a python library used to process textual information, which is based on top of the NLTK (Natural Language Toolkit) and Pattern NLP library. In the case of sentiment analysis TextBlob uses a lexicon-based method whereby each word is polarity weighted and subjectivity weighted using sentiment dictionaries that have been pre-compiled. The library uses modifier rule to deal with negation (e.g. not good - negative) and intensification (e.g. very good - higher positive score).

Procedure

All the 100 tweets were subjected to the sentiment analyzer of TextBlob. The scores of polarity and subjectivity that came, were tabulated and noted. Descriptive statistics such as mean polarity, mean subjectivity, and percentages distributions were calculated and cross tabulated by sentiment category. The acquired quantitative data were further construed in terms of the Appraisal Theory.

Data Analysis and Results

This chapter presents a quantitative computational analysis of environmental discourse on social media, using sentiment scores generated through TextBlob, a Python-based Natural Language Processing library. The sentiment output is interpreted within the theoretical lens of Appraisal Theory and Sentiment Polarity Theory. The dataset consists of 100 tweets focusing on climate disasters, environmental governance, resilience, and sustainability within the Pakistani context.

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The analysis proceeds in three stages: (1) polarity distribution, (2) subjectivity analysis, and (3) interpretative integration through Appraisal Theory.

Descriptive Overview

Out of 100 tweets:

- Negative polarity tweets: 38
- Positive polarity tweets: 40
- Neutral polarity tweets : 22

Table 1 presents the overall sentiment distribution of the 100 analysed tweets. The findings reveal a tri-modal distribution, with positive tweets at 40% and neutral tweets represented at 22% each, and negative tweets constituting 38% of the corpus. The overall mean polarity score of +0.0011 reflects a corpus that is, in aggregate, remarkably balanced though marginally tilted toward a constructive orientation.

Table 1

Orientation	Frequency	Percentage
Negative	38	38%
Neutral	22	22%
Positive	40	40%
Total	**50**	**100%**

Polarity Distribution

Polarity scores in TextBlob range from -1 (most negative) to +1 (most positive). The corpus demonstrates a clearly evaluative orientation with strong emotional loading

Table 1

Polarity Category	Polarity Range	Frequency(n)	Percentage(%)
Strong Positive	0.50 to 1.0	5	5%
Moderate Positive	0.25 to 4.9	15	15%
Mild Positive	0.01 to 2.49	20	20%
Neutral	0.00	22	22%
Strong Negative	-0.5 to -1.	8	8%

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Moderate Negative	-0.25 to -4.99	12	12%
Mild negative	-0.01 to –2.49	18	18%
Total	-1 to +1	100	100%

The minimum polarity score recorded is -1.0

The maximum polarity score recorded is +0.75

High Positive Cluster (+0.5 to +0.75)

The High Positive Cluster +0.5 to +0.75 has tweets that are highly and distinctly evaluative positive. They tend to emphasize the possibilities of the renewable energy, the power of the youth-led climate movements, the rise in the community solidarity, and clean energy reform progress. The terms and expressions of these tweets are inclined to admiration and optimism with a significant number of such words as inspiring, remarkable, revolutionary, visionary, and transformative. Combined, these factors put climate action and sustainability efforts in perspective as promising, progressive ones, which can help bring significant change to the environment and society.

```
[4]: from textblob import TextBlob

[15]: my_sentence=TextBlob("Community volunteers delivering flood relief have demonstrated truly remarkable solidarity and compassion.")

[16]: my_sentence.sentiment

[16]: Sentiment(polarity=0.75, subjectivity=0.75)
```

```
[4]: from textblob import TextBlob

[17]: my_sentence=TextBlob(" Community-based adaptation strategies are proving remarkably successful in reducing climate vulnerability.")

[18]: my_sentence.sentiment

[18]: Sentiment(polarity=0.75, subjectivity=0.95)
```

The positive affect, judgment, and appreciation are highly expressed using these tweets, as emotions, like hope and inspiration, are expressed and such expressions are made praising courage, solidarity, inventiveness, and sustainability. The greatest occurrence of positivity is in those tweets that are more polarity-based where the highest score of +0.75 is witnessed in phrases containing strong intensifiers or Graduation markers such as incredibly promising and powerful and inspiring. This trend shows that there is a definite correlation between the concentration of strengthening language and an increased score on computational policing indicating

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that stronger evaluative wording is likely to generate a greater quantity of positive sentiment measures.

Moderate positive

The tweets in this range are very optimistic but cautious with the expression of overall positive attitude but in a restrained manner. They tend to pay attention to such issues as sustainable farming, climate investment, and urban green projects and emphasize these activities as positive steps to environmental development. In spite of the tone of support, the words are usually of cautious optimism but not high excitement, recognizing the possible usefulness of such projects without suggesting that the work is completed and additional improvement is necessary.

```
[4]: from textblob import TextBlob

[19]: my_sentence=TextBlob("National reforestation drives are significantly restoring degraded ecosystems.")

[20]: my_sentence.sentiment

[20]: Sentiment(polarity=0.375, subjectivity=0.875)
```

```
[4]: from textblob import TextBlob

21]: my_sentence=TextBlob("The collective determination of Pakistani communities during climate disasters is extraordinarily courageous.")

22]: my_sentence.sentiment

22]: Sentiment(polarity=0.3333333333333333, subjectivity=1.0)
```

These tweets incorporate more moderate modifiers which yield moderate levels of polarity and this indicates that the computation system is able to capture positive degrees based on the lexical strength.

Mild Positive (-0.01 to -0.249)

```
[4]: from textblob import TextBlob

10]: my_sentence=TextBlob("Climate anxiety among Pakistani youth is becoming overwhelmingly distressing and psychologically exhausting.")

11]: my_sentence.sentiment

11]: Sentiment(polarity=0.18333333333333332, subjectivity=0.7833333333333333)
```

```
[4]: from textblob import TextBlob

[23]: my_sentence=TextBlob("Urban green initiatives in major cities are producing significantly healthier and more livable environments.")

[24]: my_sentence.sentiment

[24]: Sentiment(polarity=0.14750000000000002, subjectivity=0.43499999999999994)
```

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Neutral Polarity

The total of 22 tweets were rated as 0.0 in polarity, although some of them had implicit evaluative information, e.g., talk about monsoon devastation or displacement caused by climate. This result is indicative of a number of weaknesses of lexicon-based sentiment analysis systems such as TextBlob, such as use of predefined sentiment dictionaries, low context sensitivity, and an inability to identify implicit evaluation involving technical or institutional vocabulary. Consequently, tweets which express either ideological or critical standpoints without any emotive adjectives can be considered neutral. In terms of corpus-based research, this shows that complementing computational polarity analysis by discourse-oriented accounts like the Appraisal Theory is necessary to realize finer evaluative meaning.

```
[3]: from textblob import TextBlob

[9]: my_sentence=TextBlob("Continuous air pollution is damaging public health and worsening environmental living conditions.")

[10]: my_sentence.sentiment

[10]: Sentiment(polarity=0.0, subjectivity=0.06666666666666667)
```

Strong Negative Cluster (-0.5 to –1.0)

Tweets with polarities less than -0.5 have a high negative sentiment with the attributes of condemnation, fear, and moral outrage. Some of the most regular topics of these tweets include floods, government failures, climate unfairness and infrastructure failures. The severity of the feeling is further supported by the strong lexical intensifiers such as catastrophic, terrifying, disgracefully, and mercilessly that enhance the severity of the incidences that are being narrated and the frustration and alarming nature of environmental disasters and the failure of the institutions.

```
from textblob import TextBlob

my_sentence=TextBlob("The government's flood management strategy seems reactive rather than preventive, and vulnerable communities are paying the price.

my_sentence.sentiment

Sentiment(polarity=-0.5, subjectivity=0.5)
```

```
[6]: from textblob import TextBlob

[143]: my_sentence=TextBlob("The unbearable heatwaves in Lahore and Karachi are becoming dangerously life-threatening every single year.")

[144]: my_sentence.sentiment

[144]: Sentiment(polarity=-0.0738095238095238, subjectivity=0.6547619047619048)
```

Appraisal Theory viewpoint suggests that all these tweets evoked a strong reaction of affect, judgment, and appreciation, as they expressed fears, distress, and anxiety

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and negatively evaluated the environmental situation and the authorities. These negativity messages are very strong and this is associated with high scores in Graduation, especially by using force amplification whereby linguistic intensifiers are used to reinforce the evaluation. This trend shows that the more language is intensified the more negative it is computed to be, there is a direct correlation between increased evaluative language and increased measured negativity.

Moderate Negative Cluster (-0.25 to -0.49)

These tweets are more systemic and at the same time are slightly less emotionally intense. They usually concentrate on such problems like structural injustice, policy inadequacy, and economic vulnerability, and draw attention to more upon institutional and socio-economic problems that are associated with environmental or climate issues. Though the tone is still negative, it is more analytical and critical than highly emotive in addressing the underlying systemic problems and the necessity of more productive policies and structural transformation.

```
[6]: from textblob import TextBlob

149]: my_sentence=TextBlob("Post-flood water contamination has created a horrifying public health disaster in already vulnerable rural areas.")

150]: my_sentence.sentiment

150]: Sentiment(polarity=-0.35, subjectivity=0.39166666666666666)
```

```
[6]: from textblob import TextBlob

153]: my_sentence=TextBlob("Floodwaters have mercilessly destroyed crops, pushing struggling farmers into severe economic collapse.")

154]: my_sentence.sentiment

154]: Sentiment(polarity=-0.24999999999999997, subjectivity=0.6)
```

However, very interestingly, objectively negative events (e.g. contamination or heatwaves) were moderately negatively rated, but not extremely. This implies that the presence of lexical polarity is mostly dependent on evaluative adjectives but not topic severity.

Mild Negative Cluster (-0.01 to -0.249)

A small number of tweets received marginally negative scores (e.g., -0.05). These often contain descriptive rather than overtly emotional language.

```
[4]: from textblob import TextBlob

12]: my_sentence=TextBlob("The monsoon devastation brutally exposed the government's dangerously inadequate urban planning systems.")

13]: my_sentence.sentiment

13]: Sentiment(polarity=-0.4916666666666667, subjectivity=0.6333333333333333)
```

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```
[6]: from textblob import TextBlob

[155]: my_sentence=TextBlob("The destruction of crops due to erratic rainfall is severely threatening national food security and stability.")

[156]: my_sentence.sentiment

[156]: Sentiment(polarity=-0.125, subjectivity=0.375)
```

This computational outcome demonstrates that TextBlob is sensitive to explicit affective markers but may under-detect implicit ideological positioning.

Overall Subjectivity

TextBlob subjectivity ranges from 0 (objective) to 1 (highly subjective).

The dataset reveals wide variation:

- Several tweets scored **1.0 subjectivity**, indicating strongly opinionated discourse.
- Some tweets scored **0.0 subjectivity**, indicating descriptive or informational framing.

The findings show that numerous tweets in the dataset reflect moderate to high levels of subjectivity. Tweets that talk about environmental disasters or respond to government actions tend to have very emotional wording and therefore the scores in the subjectivity category are higher than 0.5. These tweets usually contain such evaluative words as devasting, heartbreaking or dangerous, which also show personal attitudes and emotions of people who use them.

```
[4]: from textblob import TextBlob

[25]: my_sentence=TextBlob("The collective determination of Pakistani communities during climate disasters is extraordinarily courageous.")

[26]: my_sentence.sentiment

[26]: Sentiment(polarity=0.3333333333333333, subjectivity=1.0)
```

```
[4]: from textblob import TextBlob

[27]: my_sentence=TextBlob("The repeated cycle of flood destruction and rebuilding is economically devastating and completely unsustainable.")

[28]: my_sentence.sentiment

[28]: Sentiment(polarity=-0.45, subjectivity=0.7)
```

Tweets with high subjectivity tend to be associated with high polarity. As an example, tweets that are either angry at the mismanagement of the environment or in awe of community resilience will most likely have high subjectivity and high polarity values. This trend can be interpreted as an indicator that emotional appeal is a major influencer of environmental discourse on social media.

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```
[4]: from textblob import TextBlob

[29]: my_sentence=TextBlob("The destruction of crops due to erratic rainfall is severely threatening national food security and stability.")

[30]: my_sentence.sentiment

[30]: Sentiment(polarity=-0.125, subjectivity=0.375)
```

```
[4]: from textblob import TextBlob

[31]: my_sentence=TextBlob("Sustainability should be integrated into economic planning rather than treated as an optional public relations strategy.")

[32]: my_sentence.sentiment

[32]: Sentiment(polarity=0.1, subjectivity=0.13333333333333333)
```

On the other hand, tweets in the dataset have low scores on subjectivity, which means that they are rather objective or facts on the ground. In many cases, these tweets can display environmental data in a descriptive form or information. Examples are citing of scientific reports, environmental monitoring or policy guidelines. The informational orientation is the characteristic feature of such tweets with the average polarity scores and the lesser value of subjectivity.

Both subjective and objective tweets exist and this fact proves the varied communicative purpose of the environmental discourse in social media. Whereas most users post personal views and emotional responses to environmental challenges, others use social media communication to post factual information and sensitize the masses.

Interestingly, some negatively framed tweets show low subjectivity (e.g., polarity -0.2, subjectivity 0.0). This suggests that computational tools may detect negativity without classifying the sentence as opinion-based if it lacks explicit first-person or emotional cues.

Integration with Appraisal Theory

While Sentiment Polarity Theory provides measurable orientation (positive vs. negative), Appraisal Theory explains how evaluation is linguistically constructed.

Attitude

Attitude resources are mainly prevalent in the corpus, which demonstrates the high degree of evaluative language in the tweets. Negative tweets mainly focus on feelings and evaluations that pertain to fear, misery and injustice, which is a mixture of expressions of Affect and critical Judgment of situations or authorities. On the other hand, positive tweets refer to the themes of resilience, solidarity, and transformation, relying on the Affect to express hope and inspiration and relying on the Appreciation to positively evaluate actions, initiatives, and social responses to environmental challenges.

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Engagement

The majority of tweets are single utterances, and the evaluations they convey are not dialogically negotiated, but real. This enhances persuasive influence. According to these tweets, there is a disaster preparedness failure. This is a Condemnation move in the Appraisal Theory. This is indicated by the quantitative data, which was low in polarity and moderate in subjectivity.

Graduation

This factor is important in dictating the degree of polarity because linguistic intensifiers enhance the degree of assessment in tweets. Such words like absolutely, deep, massive and extraordinary enhance the size of sentiment by adding weight to the attitude expressed. Consequently, Tweets with increased Graduation have stronger scores on computational Polarity indicating a definite relationship between strengthened language and increased Intensity of measured sentiment..

Environmental Topics and Sentiments

The dataset consists of the tweets that cover a very broad spectrum of environmental issues, such as climate change, floods, air pollution, renewable energy, deforestation, and sustainability programs. The related sentiment patterns are related to each of these topics.

The polarity values of Tweets on environmental disasters are highly negative in nature such as floods and wildfires. Such tweets tend to tell how homes, livelihoods and communities have been destroyed. The adverse mood of these tweets represents the human and economic impact of environmental catastrophes.

By the same note, tweets about smog crises and air pollution have a negative tone often. The social media users tend to focus on the health effects of pollution and ask the authorities to pay more attention to environmental issues. These tweets demonstrate the increased consciousness of the population about the environmental health hazards and the need in the enforcement of stricter environmental policies.

Conversely, tweets that talk about the renewable energy projects, environmental activism and sustainability campaigns show positive scores in polarity. Such tweets focus on the possibility of technological innovation and mass action to resolve environmental issues. The fact that this positive sentiment is present in the given tweets allows concluding that social media can also become a place where environmental optimism can be promoted and sustainable practices encouraged.

Neutral tweets tend to be linked with informational or educative content, e.g. environmental research reports or environmental programs announcements. Such tweets give useful background and information without necessarily stating the bravura emotional responses.

Interpretation through theoretical framework

The theoretical frameworks to be used in this report may be applied to the findings of the sentiment analysis. Appraisal Theory gives a model of the way language conveys attitudes emotions and evaluations in language. The twitter posts that were used in the present study illustrate the different types of attitudinal language such as a concerned expression, criticisms, admiration, and hope. These speech patterns

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demonstrate how the users of social media formulate their attitude to environmental problems.

Equally, Sentiment Polarity Theory is a theory that provides a computational method of labeling textual sentiment in terms of positive, negative and neutral inclination. The scores of polarity produced by the TextBlob can enable the researcher to measure the emotional coloring of the environmental talk and discover more general trends of sentimental distribution.

A combination of these theoretical approaches makes it possible to have a comprehensive insight into social media environmental communication. Whereas computational analysis tends to give some objective measures of sentiment, discourse analysis can tell the linguistic means which are used to represent those sentiments.

Discussion

This research indicate that the environmental discussion of social media is extremely judgmental and emotive, which is associated with a sophisticated interrelation of a crisis narrative and a solution-seeking attitude. Computational sentiment analysis of 100 tweets with TextBlob gave a variety of polarity scores between 0 to strongly negative (-1) and 0 to strongly positive (+1). In general, the dataset shows that the polarity orientation is relatively balanced, with a higher percentage of positive tweets than the negative ones though a lower percentage of tweets were classified as neutral.

The fact that negative polarity scores are high shows how harshly environmental disasters like floods, heatwaves and pollution are positioned in the online discourse. On the other hand, positive scores in polarity are mostly seen in the tweets about climate resilience, renewable energy, and community programs. These findings suggest that the ecological catastrophe social media communicates simultaneously the social anxiety of people about the disasters and the hope and shared responsibility to sustainable development.

On more detailed analysis of the thematic distribution it is evident that various issues in the environment give rise to specific sentiment orientations. Negative sentiment is the most common feature in tweets about climate disasters, governance failures and environmental degradation, as members of society are upset with how institutions cope with such events and how devastating climate change can be.

Much negative polarity is often seen in themes like floods, smog crises, glacier melting and industrial pollution as the perception of an environmental issue as threatening and acute. Conversely, the patterns of sentiment are almost exclusively positive with respect to tweets dedicated to the development of renewable energy sources, climate activism, environmental education, and community resilience. The construction of environmental change in these tweets presents it as an option towards change, innovation, and transformation within the society. The theme sentiment distribution thus shows a two pronged narrative of environmental discourse, which is environmental risk and institutional inadequacy and one of environmental resilience, sustainability and solutions oriented to the future.

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Considered in the light of Appraisal Theory, the results indicate that the category of Appreciation is the strongest one since users judge environmental events and sustainability practices quite often. Judgment is found in the criticism of government policy and institutional reactions, whereas Affect is used to exhibit emotions, which are fear, anxiety, empathy, and hope. Generally, the environmental discourse around social media is a mixture of the assessment of environmental situations and moral emotional reactions.

The other important observation is that of subjectivity in environmental communication. The scores of subjectivity produced by using TextBlob indicates that a significant percentage of the tweets is rather moderate to highly subjective, which means that the environmental discussion on social media is more of opinion than of facts. Nevertheless, a number of tweets got the score of neutral polarity even though they were reporting about overtly adverse environmental occurrences. This result underscores some shortcomings of lexicon-based computational systems, which might not be able to afford an implicit evaluative sense or context-evoking details of the discourse.

This makes the combination of the computational sentiment analysis and discourse based theories like the Appraisal Theory give a more in-depth insight into environmental communication. In general, the results indicate that the social media platforms are spaces in which the discourse about the climate is formed based on emotional expression, moral judgment, and shared accounts of crisis and resilience.

Conclusion

The sentiments of environment in social media is also greatly expressed using certain lexical, grammatical, and discursive characteristics. Such words like catastrophic, devastating, toxic, and emergency, which refer to a crisis, are accompanied by adverbs that cause it to be negatively expressed, i. e. absolutely, severely, and dangerously. Positive sentiment, in its turn, is articulated in terms of solution, i.e. sustainable, inspirational, transformative and promising. The strength of sentiment is also supported by intensifiers, evaluative adjectives, modal structures and framing the narrative to showcase either environmental crisis or collective resilience which show that lexical choice and grammatical intensification are the major predictors of environmental sentiment.

The results indicate that complex types of evaluative strategies were used to construct environmental sentiment during online discussions and not simple statements of opinion. Users can express themselves emotionally, be morally judgemental and descriptively critical. Considering the Appraisal Theory, Affect is a feeling regarding the climate happenings, Judgment observes the responsibility of institutions, whereas Appreciation measures the condition of the environment and policies. When combined with the markers of polarity, these resources form very evaluative discourse, demonstrating how social media is used to form the attitude to climate by expressing emotions and taking a stance.

The disparity in the environmental sentiment indicates evident discourse patterns. Cyclones, pollution, and environmental devastation are some of the topics that create

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a high level of negative feel, mostly one of fear, frustration, and criticism of the institutional response. On the contrary, the topics of renewable energy, community resilience, and climate activism are covered in a positive way and are focused on hope and solutions. The case of neutral sentiment is typically seen in the tweets that describe the events of the environment without using strong evaluative words. In general, the discourse of the environment is more likely to be based on two themes, namely, environmental crisis and vulnerability, and sustainability with collective action.

Corpus analysis reveals that some keywords and collocations are commonly related to certain categories of sentiment. The appearance of negative sentiment is usually accompanied by such phrases like climate disaster, toxic smog, devastating floods, and policy failure, forming semantic prosodies, which focus on the danger and urgency of environmental issues. Positive sentiment on the other hand is associated with words such as renewable energy, sustainable future, community resilience and climate action which advance ideas of optimism and reformation. On the whole, all these repetitive lexical patterns prove that repetitive linguistic associations contribute to the formation of sentimentality and represent the emotional-ideological inclination of environmental discourse on social media.

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