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Representation of Climate Change in Pakistani Social Media: A Content Analysis

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***Abstract*:** Pakistan, with agriculture contributing 18.9% to its economy, is significantly impacted by climate change. According to German Watch, Pakistan is the 7th most vulnerable country to climate change. This study examines how media shapes the discourse on environmental issues and the extent of coverage provided to these topics. A qualitative content analysis of three leading English newspapers was conducted, focusing on op-ed pages over a four-year period from 2021 to 2024. Despite media's role as a societal mirror, the content on these platforms is often dominated by media elites and powerful establishments. The findings reveal that while there is substantial coverage of climate change and related issues, different newspapers employ various frames such as global warming, pollution, melting glaciers, and rising sea levels. However, the overall low coverage of environmental issues results in a public that is less sensitive to these critical topics. This insufficient coverage has significant implications for both individuals and society at large.

Keywords: Press, Climate change, Pakistan, content analysis, agenda.

1. Introduction

Climate change, characterized by long-term shifts in average weather patterns that shape local, regional, and global climates, has far-reaching impacts that often surpass what the term alone conveys (Shivanna, 2022). While Earth's climate has fluctuated naturally over millennia, the past two centuries have witnessed an unprecedented surge in greenhouse gas emissions, profoundly altering climate patterns (Jogdand, 2020). During the 20th century, global temperatures rose by 0.76°C, with an additional 0.6°C increase in the first decade of the 21st century (Kononova & Lupo, 2020). These climate shifts, driven by atmospheric carbon dioxide levels, temperature changes, and precipitation patterns, have cascading effects on sea levels, salinity, arable land, crop yields, soil quality, nitrogen deposition, and biodiversity (Kabir et al., 2023). These effects are not uniform, varying spatially and temporally, and they impact nature, human health, and economies differently across regions (Kononova & Lupo, 2020).

The impacts of climate change on water, agriculture, health, biodiversity, forests, and socio-economic sectors are visible worldwide, with developing and least developed countries bearing the brunt (Abbass et al., 2022; Hussain et al., 2020; Nhemachena et al., 2020; Patel et al., 2021). At the community level, the poor are particularly vulnerable due to limited resources and access to information (Abbass et al., 2022; Hussain et al., 2020). Human activities, particularly since the industrial revolution, have driven climate-related disasters that disproportionately affect marginalized populations (Foster et al., 2024).

Climate change gained considerable public attention in the 1980s and has since become a major focus of academic research, reflecting its growing significance for societies worldwide (Moser, 2024). This attention highlights the gravity of climate change for individuals and communities (Reser & Bradley, 2020). A review of prior studies reveals that the intersection of political elites' interests and media ownership strongly influences climate change coverage (Adam, Reber, Häussler, & Schmid-Petri, 2020). Moreover, climate change receives heightened media coverage during major global events but less attention otherwise (Hase, Mahl, Schäfer, & Keller, 2021). Media portrayals often amplify climate change imagery, which can distort public perception (Petrescu-Mag, Burny, Banatean-Dunea, & Petrescu, 2022). Additionally, media coverage plays a critical role in shaping public understanding and the political discourse surrounding climate change (Hase, Mahl, Schäfer, & Keller, 2021).

Climate change is a pressing concern for many nations, and Pakistan, a developing country with approximately 220 million people, ranks as the 7th most vulnerable nation to climate change (Eckstein et al., 2020; Ejaz, Ittefaq, & Arif, 2024). Pakistan faces multiple climate-related challenges, including increased monsoon variability, the impact of receding Himalayan glaciers on the Indus River system, reduced water reservoir capacity, diminished hydropower during droughts, extreme weather events like floods and droughts, and food security threats (Ahmed, Zounemat-Kermani, & Scholz, 2020). The country's diverse climate, spanning from the Arabian Sea to the Himalayan Mountains, exhibits significant spatial and temporal variability in climatic conditions (Rahman et al., 2022). Monsoon rains, which provide 59% of Pakistan's annual rainfall, are the primary hydrometeorological resource (Ahmed, Zounemat-Kermani, & Scholz, 2020). The Greater Himalayan region receives winter precipitation as snow and ice, sustaining river flows year-round (Rahman et al., 2022). Coastal areas experience a distinct climate from the mountainous north, while the central region has a tropical continental climate (Ahmed, Zounemat-Kermani, & Scholz, 2020).

Pakistan's vulnerability to climate change is compounded by its warm climate, its location in a region experiencing above-average temperature increases, its predominantly arid and semi-arid terrain, and its reliance on the receding Hindu Kush-Karakoram-Himalayan glaciers for river flow (Habib, 2021). The country's agrarian economy is highly sensitive to climate, facing risks from monsoon variability, large floods, and prolonged droughts (Ahmed, Zounemat-Kermani, & Scholz, 2020). Water, food, and energy security are under threat, further exacerbated by sea-level rise, coastal erosion, saline intrusion, and increased cyclonic activity in the Arabian Sea (Habib, 2021). The Indus Delta, already situated in an intense heat zone, faces additional risks from upstream climate activities. Despite these challenges, opportunities exist for resilience and adaptation, such as wind power generation and investment in climate-resilient infrastructure.

1.1 Social Media and Climate Change

Social media, a transformative digital technology, has revolutionized communication and public discourse (Olaniyan & Akpojivi, 2021). It has collapsed traditional social barriers, fostering new channels for public debate on critical issues like climate change (Meikle, 2024). Social media's societal impact includes the reshaping of public issue communication (Vasylchyshyn et al., 2024). Media play a pivotal role in shaping public opinion, informing both the public and policymakers (Meikle, 2024). The influence of mass media is extensive, making it an essential tool for accessing current affairs and global news (Vasylchyshyn et al., 2024). Climate change is one such issue that receives substantial media coverage, with the media mediating political and scientific debates on the topic (Adam, Reber, Häussler, & Schmid-Petri, 2020). In many countries, media serve as the primary source of climate change information (Vasylchyshyn et al., 2024). However, despite being a critical issue, climate change often receives incomplete and biased coverage (Gunderson, Stuart, & Houser, 2020). Some studies suggest that the media pay less attention to climate change compared to other scientific issues, resulting in a limited public understanding of the problem's nature and implications (Schäfer & Painter, 2021). Therefore, the transformative power of social media and the influential role of traditional media underscore the need for comprehensive and nuanced climate change coverage (Maddison, 2024).

The communication of climate change through media is a well-explored area of research (Schäfer & Schlichting, 2018), encompassing various approaches such as historical analyses (Moser, 2024), examinations of political ramifications, evaluations of stakeholders' roles in social discourse, and analyses of representation across diverse media platforms (Schäfer & Schlichting, 2018).

In recent years, social media platforms have emerged as crucial channels for climate change communication, enabling the dissemination of information and providing a space for public engagement in debates and actions related to climate change (Olaniyan & Akpojivi, 2021). Social media can psychologically bring climate change

closer to the public, raising awareness and encouraging proactive measures (Mah et al., 2020). Despite its potential, research on the impact of social media images on climate change communication is still in its early stages (Schäfer & Schlichting, 2018).

Unlike traditional media, which are non-interactive by nature, social media thrives on interaction and user influence (Vasylchyshyn et al., 2024). This dynamic allows individuals to share knowledge, express opinions, and connect with others who share similar concerns (Schäfer & Schlichting, 2018). Consequently, the impact of climate change imagery can vary significantly between social and traditional media, highlighting the need for further research into how visual content on social platforms can effectively communicate climate change issues.

Tetzlaff et al. (2024) examine the visual communication of extreme heat risks in Canadian media during the 2021 Heat Dome. Analyzing thousands of online news articles from five subscription databases, they coded 845 images for denotative, connotative, and ideological content. Their analysis revealed that only 16% of images suggested heat danger, with merely 40% depicting people and 46% indicating human suffering. The study concludes that most images in Canadian news coverage contradicted evidence-based heat protection measures.

León, Negredo, and Erviti (2022) explore the principles of effective visual communication of climate change on social media through the lens of news values theory and availability heuristics. Their study aims to identify characteristics of images that enhance user interaction on Twitter, providing insights for cross-national visual communication strategies. The authors conducted a content analysis of 380 randomly selected images (including photographs, illustrations, and graphics) featured in 'top tweets' about climate change. The analysis revealed that the types of images used on social media closely resemble those used in traditional media, with the notable exception of fewer images depicting identifiable people on social media platforms.

Supran and Oreskes (2021) analyze ExxonMobil's climate change communications, revealing the company's strategic use of rhetoric and framing to influence public discourse. Through algorithmic corpus comparison and machine-learning topic modeling of 180 communications, including peer-reviewed publications, internal documents, and New York Times advertorials, they find that ExxonMobil overemphasizes terms like climate "risk" and consumer energy "demand." This creates a "Fossil Fuel Savior" (FFS) frame that minimizes the seriousness of climate change, normalizes fossil fuel dependency, and shifts responsibility onto consumers. The study parallels these tactics with the tobacco industry's strategy of deflecting corporate blame onto consumers, suggesting that the fossil fuel industry uses similar arguments to oppose climate litigation, regulation, and activism. This research underscores the need to critically examine corporate communications to understand their impact on public perception and climate policy.

Chinn, Hart, and Soroka (2020) investigate the long-term trends in the politicization and polarization of climate change news content in major U.S. newspapers from 1985 to 2017. Through computer-assisted content analysis, the authors reveal significant shifts in the media representation of climate change. Their findings indicate an increasing politicization of climate change news, with a growing emphasis on political actors and a corresponding decline in the prominence of scientific actors. This shift reflects a broader trend where political figures and agendas dominate climate change discourse in the media. Additionally, the study identifies a marked increase in polarization, highlighting distinct differences in how Democratic and Republican discourses frame climate change.

The majority of published research on climate change, however, is Eurocentric, with the UK contributing the largest share (Schäfer & Schlichting, 2018). Asian countries, in contrast, receive limited scholarly attention (Schäfer & Schlichting, 2018). This trend is evident in Pakistan, where media provide marginal coverage to human development issues compared to other topics (Ejaz, Ittefaq & Arif, 2024). Poor communication between the media and the general population contributes to this issue, resulting in misunderstanding, skepticism, and low levels of knowledge about climate change in Pakistan (Medvecky et al., 2018). So far, only a few studies have been conducted about the role of media in portraying climate change in Pakistan. Ejaz, Ittefaq, and Arif (2024) investigates the influences shaping climate change journalism in Pakistan, focusing on how misinformation and fact-checking are addressed. Using the hierarchy of influences model, their study examines various levels of impact on climate content creation. Through interviews with 21 self-identified climate journalists, the authors uncover that individual factors such as lack of expertise and education significantly affect environmental reporting. Additionally, adherence to Western journalistic models influences the reporters' routines and coverage. In another study, Sharif and Medvecky (2018) investigated the factors limiting climate change coverage in Pakistani news media, which contribute to public confusion, uncertainty, denial, and low awareness. Through qualitative semi-structured interviews with media professionals, the study identifies political, economic, social, cultural, technological, and scientific influences as key determinants affecting the reporting of climate change issues. Saeed, Hussain and Riaz

(2023) critically examines how two leading Pakistani newspapers, the English-language Dawn and the Urdu-language Jang, represented the COP21 climate conference. Focusing on frames of criticism and attribution of responsibility in national and international contexts, the research analyzed 35 purposively sampled news articles using a quantitative approach. The analysis revealed that only 16 articles adopted a critical and responsible tone. The coverage was largely descriptive rather than interpretative, with Dawn emphasizing criticism of international industrialized nations and Jang focusing on the Pakistani government and opposition. The study highlights the need for more expert opinions and suggests using social media to enhance the interactivity of climate-related news.
This study aims to bridge the gaps in existing literature and provide a deeper understanding of how media shape public discourse and perception of climate change. The aim of this study is to analyze how social media, specifically, Facebook, X (formerly Twitter) and Instagram portray climate change in Pakistan. The specific objectives were to

3. Methods and Materials

This study was conducted with a mixed methods approach using both quantitative and qualitative content analysis.

3.1 Data Collection

Primary data for this research was collected from three social media platforms including Facebook, X and Instagram. Separate accounts were created for all these social media sources and relevant posts were searched using terms such as climate change, global warming, climatic extremities etc. (See Table 2). The posts retrieved were saved and analyzed separately using both quantitative and qualitative content analysis.

3.2 Data Analysis

For the data analysis in this study, we examined the Pakistani social media's coverage of climate change, focusing on the representation across three online platforms i.e. Facebook, X and Instagram. The analysis involved a comprehensive assessment of the extent and nature of climate change reporting on these online news sources. In this research, we employed a content analysis approach, using specific inclusion and exclusion criteria to ensure the selection of the most relevant and supportive data to effectively achieve the research objectives. The inclusion criteria focused on two key aspects: the content had to be related to climate change and its relevant topics, and the posts analyzed were limited to those published between 2021 and 2024. Data collection was restricted to three selected social media platforms: X, Facebook, and Instagram. Quantitative content analysis was employed to measure the frequency and prominence of climate change topics, while qualitative insights were gathered to understand the underlying reasons for the observed reporting patterns. This approach enabled us to identify the gaps in climate change coverage within the Pakistani media landscape and to evaluate the factors contributing to the limited focus on this critical issue.

3.3 Frames Used in this Study

For this study, the researchers employed seven specific frames to conduct the content analysis: global warming, hazards, desertification, flooding, climate change, drought, and other. Content related to global warming and rising temperatures was categorized under the global warming frame, while discussions of rising sea levels, unpredictable rainfall, and floods were classified within the flooding frame. Write-ups that addressed melting glaciers and snow were placed in the melting glacier frame, and content discussing various forms of pollution was assigned to the pollution frame. Extreme weather conditions, such as unusual heat waves or cold spells, were grouped under the extreme weather frame. The measures frame included all content related to mitigation or adaptation efforts. Any content that did not fit into these specific categories was placed in the ‘other’ frame.

4. Results

Table 1 shows the frequency of coverage regarding climate changes in the selected social media platforms.

Table 1: Number of Posts on Climate Change from 2021-2024

years	Instagram	Facebook	X
2021	10	27	13

2022	38	42	34
2023	45	56	39
2024	54	86	42
Total	147	201	128

The Table 1 presents the number of posts related to climate change on Instagram, Facebook, and X from 2021 to 2024. In 2021, Instagram had 10 posts, Facebook had 27, and X had 13. The following year, 2022, saw an increase in activity, with Instagram posts rising to 38, Facebook to 42, and X to 34. This upward trend continued in 2023, with Instagram reaching 45 posts, Facebook 56, and X 39. By 2024, the number of posts further increased, with Instagram at 54, Facebook at 86, and X at 42. Overall, over the four-year period, Facebook had the highest total number of posts (201), followed by Instagram (147) and X (128).

Table 2: Frames used for climate change coverage in social media

Frames	Frequency
Global warming	80
Climate change	167
Drought	59
desertification	36
Flooding	65
Hazards	54
Other	15
Total	476

The Table 2 outlines the frequency of various frames used in climate change coverage on social media. The "Climate Change" frame was the most frequently used, appearing 167 times. This was followed by the "Global Warming" frame with 80 occurrences, and the "Flooding" frame with 65 mentions. The "Drought" frame appeared 59 times, while the "Hazards" frame was used 54 times. "Desertification" was mentioned 36 times, and the "Other" category, which includes frames that did not fit into the predefined categories, had 15 occurrences.

Table 3: Frequency of frames used in Facebook, X and Instagram for climate change in Pakistan

Framing	Instagram	Facebook	X
Damages	49	69	46
Responsibility Issues	35	48	55
Causes	42	46	43
Increasing temperature	50	58	67
Climatic extremities	53	35	42
Impacts	64	76	58
Solutions	30	32	21

The Table 3 provides an overview of the frequency of different frames used in climate change discussions across Instagram, Facebook, and X in Pakistan. The "Impacts" frame was the most frequently employed across all platforms, with 64 mentions on Instagram, 76 on Facebook, and 58 on X. The "Increasing Temperature" frame was also prominent, appearing 50 times on Instagram, 58 times on Facebook, and 67 times on X.

The "Damages" frame was used 49 times on Instagram, 69 times on Facebook, and 46 times on X, while the "Responsibility Issues" frame was more frequently used on X (55 times) compared to Facebook (48 times) and Instagram (35 times). The "Causes" frame had a relatively balanced presence across the platforms, with 42 mentions on Instagram, 46 on Facebook, and 43 on X.

The "Climatic Extremities" frame appeared 53 times on Instagram, 35 times on Facebook, and 42 times on X.

Lastly, the "Solutions" frame was the least used, with 30 mentions on Instagram, 32 on Facebook, and 21 on X. This distribution indicates varied focus areas across the different social media platforms in the context of climate change discussions in Pakistan.

Results of the qualitative content analysis revealed people in social media talked about climate change, weather extremities, causes, responsibility issues, impacts and solutions related to climate change. In the context of this study, one social media post highlighted the increasing vulnerability of the Chitral Valley in the Khyber Pakhtunkhwa province, which is located in the Hindu Kush mountain range in northwest Pakistan. The post emphasized that Chitral, with its population of half a million, has a long history of flooding, but the intensity and frequency of these events have significantly increased in recent years. The rising temperatures have caused more glacial meltwater to flow into the rivers, resulting in the destruction of major roads, including the Chitral to Shandoor route, as well as damaging the water system, numerous homes, and agricultural land in the Reshun Valley of Upper Chitral. The local villagers expressed their concerns about the potential for further glacial melt due to the high summer temperatures, exacerbating the risk of future flooding. This post says:

> *Chitral valley, the largest district of Khyber Pakhtunkhwa province with a population of half a million, is situated in the heart of the Hindu Kush mountain range in northwest Pakistan. It is one of the most vulnerable areas to climate change in Pakistan and has a long history of flooding. However, the intensity and frequency of such events has risen in recent years. Due to rise in temperature more water flows to the rivers from glaciers and swept away major roads (Chitral to Shandoor), water system, many homes and agricultural land in Reshun valley, Upper Chitral. The local villagers were worried about the possibility of their valley glacier, perched high above on a mountain ridge, melting again because of high temperatures in the summers. (Facebook, Post 05)*

Figure 1: Image from Facebook about climate change

An Instagram post explains the impacts of climate change in Pakistan in these words:

> *Pakistan is currently experiencing the unprecedented effects of climate change. With temperatures hitting 45 degrees (Instagram, 2023).*

Another post of Facebook explains the impacts of climate change in Pakistan in these words:

> *The enraged nature*
>
> *Severe flooding in the northern region of Pakistan, particularly in Chitral, has become an increasingly frequent and devastating phenomenon, primarily attributed to climate change. This picturesque area, known for its mountainous landscapes and vibrant cultural heritage, has been facing the brunt of extreme weather events in recent years.*
>
> *The severe flooding in Chitral underscores the urgent need for comprehensive strategies to address the multifaceted impacts of climate change. While immediate relief efforts are*

> *necessary to support affected communities, long-term measures focused on sustainability and resilience are crucial for reducing the frequency and severity of such events in the future. Through a combination of local action and global cooperation, it is possible to mitigate the effects of climate change and protect vulnerable regions like Chitral from devastating floods (Facebook, 2023).*

Another Facebook post highlighted the significant reduction in rainfall that Pakistan experienced in January 2021, marking it as the 17th driest month in the past 60 years, according to the Met Office. The post noted that nationwide rainfall during January was 59% below the normal levels, suggesting the potential impact of climate change on the country's weather patterns.

> *Pakistan received much less rainfall in January 2021 as compared to previous years, making it the 17th driest month in 60 years, according to the Met Office. The countrywide rain in January was 59pc below the normal, indicating the possible impact of climate change (Facebook, 2021.*

A post on X says:

> *The menace of climate change has already seen the worst of the impacts globally, especially in third-world countries like Pakistan.*

Figure 2: Image from Instagram depicting the impact of climate change in Chitral, Pakistan.

A number of posts also highlighted the cause of climate change. One social media post emphasized the growing threat of global climate change, attributing much of the environmental degradation to human activities driven by greed. The post underscored the urgent need to address the causes, effects, and solutions of climate change in order to safeguard the environment and protect future generations from catastrophic consequences. It highlighted the critical importance of combating environmental pollution as a means to preserve both nature and humanity.

> *Global climate change is emerging a tremendous problem these days.It is the human being who is intending consistently towards degrading the quality of environment in many ways due to its greedy needs. To save the nature from environmental pollution means to save the humanity. Now it is the need of hour to discuss causes, effects and solution of climate change so as to protect our next generation from climatic catastrophic danger (Facebook, 2024).*

Another post on Instagram refers to global warming as a cause of increasing urban flooding in Pakistan:

> *Urban flooding during monsoons is becoming a serious issue. Let's understand what role Global Warming plays and work towards sustainable solutions for our cities (Instagram Post, 2024).*

A Facebook post highlighted Pakistan's ranking as the world's third-largest user of groundwater, underscoring the country's significant dependence on this resource for agriculture, industry, and domestic purposes. The post pointed out that this extensive use of groundwater reflects the pressing challenges Pakistan faces in water management and sustainability, particularly in the context of increasing demand and the impacts of climate change:

> *Pakistan has been ranked as the world's third-largest user of groundwater, reflecting the country's heavy reliance on this resource for agricultural, industrial, and domestic needs. The extensive use of groundwater highlights the challenges Pakistan faces in water management and sustainability amid growing demand and climate change impacts (Facebook, 2022).*

Some people on social media were also talking about solutions for climate change issues. For instance, an Instagram post discussed the federal government's initiative to involve students in environmental conservation efforts:

> *Pakistan faces severe impacts from climate change, GGDC Hayatabad No 1 College's principal, students, and staff have taken part in a tree planting event. This initiative includes tree planting and an awareness campaign, aiming to improve the environment and promote sustainability (Instagram, 2024).*

A Facebook post says:

> *The Federal government plans to incentivize students to plant trees by offering 20 extra marks to students who plant at least 20 saplings, according to Minister of State for Climate Change. A legislation to this effect is being introduced in parliament and is aimed at integrating youth in the 10 Billion Tree Tsunami plantation project (Facebook, 2024).*

A number of posts on social media also reported mitigation measures and awareness campaigns to enhance awareness about climate change and reduce the impacts of climate change. One post on X says:

> *Pakistan has been recognized as a Global Leader for protecting environment and battling climate change and is honored to host the World Environment Day (X, 2024).*

Figure 3: An Instagram image depicting measures to mitigate climate change

Another post on Facebook elaborates the mitigation measures of the Pakistani government in these words:

> *With PM Imran Khan's vision for conserving the nature, Pakistan is planting 10 billion trees, in the largest ever tree plantation drive in the history of Pakistan. Tree plantation has been found effective solution to fight climate change in Asia. After the success of the "Billion tree tsunami" in the Khyber Pukhtunkhwa province, the Pakistani government has advocated a larger, "Ten billion tree tsunami" for all Pakistan (Facebook, 2021).*

An Instagram post talks about measures needed to reduce the impacts of climate change in these words:

> *In Pakistan climate change is a major issue. We, therefore, ought to change the way we are living and play our part in controlling this climate change. In short, it is high time to be a #ClimateChanger for our country, our world, and for the upcoming generation (Instagram, 2024).*

4.1 Discussion

The findings from this study align with and extend the existing body of research on climate change communication in media, particularly in the context of Pakistan. For instance, similar to Tetzlaff et al.'s (2024) exploration of the Canadian media's portrayal of extreme heat risks, our results indicate a discrepancy between the framing of climate change issues on social media and the actual severity of these issues. Just as Tetzlaff et al. (2024) found that only a small percentage of images suggested the dangers of extreme heat, our study revealed that while social media platforms like Facebook, Twitter, and Instagram engage with various frames such as damages, responsibility issues, and climate extremities, the representation is often insufficient in conveying the full impact of climate change.

This parallels the findings of León, Negredo, and Erviti (2022), who noted that the types of images used on social media are similar to those in traditional media, often lacking the critical elements necessary to enhance user interaction and awareness. Our study also reflects the conclusions drawn by Supran and Oreskes (2021), who emphasized the strategic use of rhetoric in shaping public discourse on climate change. In the context of Pakistani social media, this can be observed in how certain frames, such as responsibility issues and solutions, are utilized in a way that may downplay the urgency of climate action, thereby influencing public perception.

Moreover, the politicization and polarization trends in climate change news identified by Chinn, Hart, and Soroka (2020) are echoed in the framing observed in our study. The emphasis on responsibility issues and the varied focus across different social media platforms suggest a similar politicization of the climate change discourse in Pakistan. This is further supported by the limited and often superficial coverage of climate change in Pakistani media, as highlighted by Saeed, Hussain, and Riaz (2023), who found that only a few articles critically engaged with climate change issues during the COP21 conference.

The discussion surrounding climate change solutions on social media, as observed in the results of this study, aligns with and expands upon existing research in the field of climate change communication. The emphasis on grassroots initiatives and government-led tree planting programs in Pakistan, as highlighted in the Instagram and Facebook posts, resonates with the findings of Tetzlaff et al. (2024), who identified a gap between the representation of climate risks and the actual protective measures depicted in media. In this context, our study reveals that social media platforms in Pakistan are being used to promote proactive environmental actions, such as the 10 Billion Tree Tsunami project, which contrasts with the often insufficient portrayal of climate action seen in other regions.

The focus on student involvement in tree planting initiatives, as noted in the Instagram post, can be related to León, Negredo, and Erviti's (2022) exploration of effective visual communication of climate change on social media. While their study emphasizes the importance of imagery in enhancing user interaction, our findings suggest that content promoting tangible actions, such as tree planting, also plays a crucial role in engaging the public and fostering a sense of responsibility towards environmental conservation. This aligns with the broader goal of enhancing climate change awareness and action, as discussed in the literature.

Moreover, the strategic framing of climate change mitigation efforts by the Pakistani government, as seen in the Facebook and X posts, echoes the themes identified by Supran and Oreskes (2021) in their analysis of corporate climate communications. Just as ExxonMobil's rhetoric sought to influence public discourse, the Pakistani government's narrative around the tree plantation drive presents an image of leadership and responsibility in combating climate change. This framing not only highlights the government's efforts but also aims to shift public perception towards a more positive and action-oriented view of climate change solutions.

The emphasis on the need for individual and collective action to mitigate climate change, as seen in the Instagram post calling for people to become "ClimateChangers," is consistent with the trends of politicization and polarization in climate change discourse identified by Chinn, Hart, and Soroka (2020). In Pakistan, where climate change is a pressing issue, the promotion of individual responsibility and community involvement reflects a broader effort to depoliticize the issue and encourage widespread participation in environmental conservation.

Additionally, the discussion of tree planting as a key climate change solution aligns with the findings of Saeed, Hussain, and Riaz (2023), who observed that Pakistani media coverage of climate change often focuses on national efforts and initiatives. The posts in this study similarly emphasize Pakistan's leadership role in environmental conservation, reinforcing a narrative of national pride and responsibility in addressing global climate challenges.

The limited scholarly attention to climate change in Pakistan, as noted by Schäfer and Schlichting (2018), is evident in our study, which underscores the challenges in effectively communicating climate change on social media. The findings align with the research by Ejaz, Ittefaq, and Arif (2024) and Sharif and Medvecky (2018), which emphasize the influence of political, economic, and social factors on the reporting of climate change. Our results further indicate that the lack of expertise and a strong reliance on Western journalistic models, as identified by Ejaz

et al. (2024), continue to shape the climate change narrative in Pakistan, contributing to the public's limited awareness and understanding of the issue. The recent promotion of climate change solutions and awareness campaigns on social media, however, suggests a growing recognition of the need for more comprehensive and participatory approaches to climate change communication in Pakistan. This shift towards greater public engagement is crucial in addressing the challenges of climate change and fostering a more informed and active citizenry.

Overall, this study contributes to the broader discourse on climate change communication by highlighting the unique challenges faced in Pakistan, particularly in the context of social media, where the representation of climate change remains inadequate and often misaligned with the realities of the issue. The findings underscore the need for more nuanced and comprehensive coverage, incorporating expert opinions and interactive elements to enhance public engagement and understanding of climate change.

In conclusion, the discussion of climate change solutions on social media in Pakistan reflects broader trends in climate change communication, emphasizing the importance of both governmental initiatives and individual actions in combating climate change. The results of this study contribute to the understanding of how social media can be leveraged to promote climate action and raise awareness, highlighting the potential for these platforms to play a key role in shaping public discourse and driving meaningful environmental change.

5. Recommendations and Conclusion

Based on the findings of this study, several recommendations can be made to enhance climate change communication and action in Pakistan, particularly through the use of social media platforms.

5.1 Enhancing Public Engagement through Social Media

Social media has proven to be a powerful tool for raising awareness about climate change and mobilizing action. Government agencies, non-governmental organizations (NGOs), and educational institutions should leverage these platforms more effectively to disseminate accurate information and engage with the public. Campaigns should be designed to encourage user interaction and participation, such as the tree-planting initiatives highlighted in this study. By actively involving citizens, particularly the youth, in climate action, these campaigns can foster a sense of ownership and responsibility towards environmental conservation.

5.2 Integrating Climate Education into the Curriculum

The study underscores the importance of involving students in climate change initiatives, as seen in the federal government's incentive program for tree planting. This approach should be expanded by integrating climate change education into school curricula at all levels. Students should be taught not only about the science of climate change but also about practical measures they can take to mitigate its effects. This could include hands-on projects like tree planting, energy conservation, and waste reduction, which would help to instill sustainable habits from a young age.

5.3 Developing Targeted Communication Strategies

The study revealed that different frames, such as damages, responsibility issues, causes, and solutions, are used on various social media platforms. To maximize the impact of climate change communication, targeted strategies should be developed that cater to the specific characteristics and user demographics of each platform. For instance, Instagram, which is popular among younger audiences, could focus on visually compelling content that highlights the immediate impacts of climate change and the actions that individuals can take. On the other hand, platforms like Facebook could be used to foster in-depth discussions and debates about policy measures and collective action.

5.4 Strengthening Policy Support for Grassroots Initiatives

The success of initiatives like the 10 Billion Tree Tsunami demonstrates the potential of grassroots movements to contribute significantly to climate change mitigation. Policymakers should provide more support for such initiatives by allocating resources, providing technical assistance, and creating enabling environments for community-based projects. Additionally, legislation should be enacted to ensure that these initiatives are sustainable and scalable, with clear monitoring and evaluation mechanisms in place.

5.5 Promoting Cross-Sector Collaboration

Addressing climate change requires collaboration across various sectors, including government, private industry,

academia, and civil society. This study highlights the need for a coordinated approach to climate change communication and action. Government agencies should work closely with media organizations, educational institutions, and NGOs to develop and implement comprehensive strategies that address the multifaceted challenges of climate change. Public-private partnerships could also be explored to mobilize resources and expertise for large-scale climate projects.

This study provides valuable insights into how climate change is framed and communicated on social media platforms in Pakistan. The analysis of social media posts from 2021 to 2024 reveals a growing awareness and engagement with climate change issues, particularly through initiatives like tree planting and awareness campaigns. The results underscore the importance of using social media as a tool for climate change communication and highlight the potential of these platforms to mobilize public action and influence policy.

The study also reveals the need for more targeted and effective communication strategies that cater to the specific characteristics of different social media platforms. By developing tailored messages that resonate with various audiences, climate change communication can be made more impactful and relevant. Furthermore, the study highlights the critical role of education in fostering a culture of sustainability and environmental stewardship among the younger generation.

While this study provides important insights, it also opens up several avenues for future research. Future research could explore how climate change is communicated on social media in different regions of Pakistan and compare these findings with other countries. Such comparative studies could provide a deeper understanding of regional variations in climate change perceptions and the effectiveness of different communication strategies. Given the dynamic nature of social media, longitudinal studies could track changes in the framing and communication of climate change over time. This would help identify emerging trends, shifts in public perception, and the impact of major events (e.g., natural disasters, policy changes) on social media discourse. Further research could assess the impact of specific social media campaigns on public behavior and policy outcomes. This could involve analyzing user engagement metrics, conducting surveys to gauge changes in attitudes and behaviors, and evaluating the effectiveness of different campaign strategies. Social media influencers play a significant role in shaping public opinion. Future studies could examine how influencers contribute to climate change communication and whether their involvement enhances the reach and effectiveness of climate campaigns. Finally, research could investigate the extent to which social media communication influences policy decisions related to climate change. Understanding the relationship between online discourse and policy outcomes would provide valuable insights into how social media can be leveraged to advocate for stronger climate action at the governmental level.

In conclusion, this study highlights the critical role of social media in climate change communication in Pakistan and offers practical recommendations for enhancing public engagement and policy support. By building on these findings, future research can continue to advance our understanding of how to effectively communicate and address the urgent challenges posed by climate change.

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