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Invisible Algorithms, Visible Earth: Algorithmic Suppression, Platform Affordances, and Environmental Communication in Sindh, Pakistan

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ABSTRACT

The study investigates how algorithmic infrastructures on social media platforms mediate climate communication in Sindh, Pakistan. Using a mixed-method methodological approach: algorithmic audits, digital storytelling, and participatory design, the research finds that local climate content is systematically deprioritized in favour of narrative on emotional and globalscalable issues. This undermines public understanding, silences indigenous environmental knowledge, and erodes collective resilience to climate impacts. Against this, users build creative workarounds through culturally embedded aesthetics and participatory features, presenting a vision for reform that is grounded in lived experience. The study argues that meaningful environmental communication by the Global South must envision restructuring platforms' governance, algorithmic transparency, and co-designed tools. The research weighs into critical conversations around media infrastructures, affective publics, and digital justice with an insistence on creating inclusive systems that operate with local realities.

Keywords: Algorithmic infrastructures, Climate communication, Indigenous environmental knowledge, Participatory design, Digital justice, Global South

Introduction

In regions like Sindh, Pakistan, where the susceptibility of the community to climate is high, digital platforms such as Instagram, YouTube, and X (formerly Twitter) are emerging into the environmental discourse and activism. These platforms do not take on a passive role, with affordances, algorithmic architectures, and emotionally charged feedback systems shaping how issues with environmental significance are framed, circulated, and felt (Gillespie, 2022; Helmond, 2021). Of the features, hashtags, reels, and interactive tools, some enable expression; all determine which stories get to be told and which get left out, and more often favour the

dominant, global discourses over local, place-based concerns (Caplan & Gillespie, 2023; Venturini et al., 2021).

Digital representation, even in Sindh, where communities suffer extreme heatwaves, toxic water bodies, and droughts, is rather limited. Barriers of language, lack of digital literacy, and algorithmic filtering preclude the visibility and emotional resonance of any region-specific environmental content (Raza & Aslam, 2024; Rakova& Dobbe, 2023). Moreover, platform algorithms amplify polarizing or sensational content while minorizing the rich or affectively subtle narratives that could reflect local ecological realities (Khalil et al., 2024).

This research proposes an Affordance–Algorithm–Emotion (AAE) framework to analyse how digital platforms mediate environmental narratives and affective publics in Sindh. In a mixed-methods design (using participatory co-creation, digital ethnography, affective analysis, algorithmic audits), this study also provides a localized account of how technological infrastructures intersect with emotional dynamics to shape climate communication from below. Thus, it advances de-Westernizing platform studies as well as critical environmental media research in the Global South.

Objectives and Questions in Research

Digital media have, increasingly, become channels of public perception about environmental catastrophes in climates vulnerable such as that of Sindh, in Pakistan. Far from being neutral infrastructures, these platforms perform algorithmic gatekeeping: visibility, emotional tone, and narrative form through affordances and recommendation systems. This study interrogates how these dynamics influence the production, circulation, and uptake of environmental content online.

By conceptualizing social media platforms as active agents in constituting environmental meaning, this inquiry thus has the capability of addressing how algorithmic filtering and interface design structure an emotional and cognitive engagement with climate discourse. It will thus ask: Environmental issues are pushed to the fore; whose emotions are algorithmically amplified and brought to the forefront, and how do the users from Sindh manage this digital landscape?

Objectives of the Research

1. To analyze how hashtags, reels, and comment thread structure environmental content and the interaction of users with it.
2. To examine how algorithmic systems can amplify or silence environmental messages.
3. To investigate the emotional response, such as hope, anxiety, or outrage, and its role in configuring the nature of public participation.
4. To approach studying affective public formation through platform architectures.
5. To present an Affordance-Algorithm-Emotion (AAE) framework that links digital media, emotion, and environmental communication specifically in the Global South.

Questions in Research

1. How do platform affordances shape narrative structures in relation to the environment and engagement with such narratives?
2. How do algorithms govern visibility and popularity of contents?
3. What emotional patterns are created from the curated environmental content?
4. How do users engage issues related to the environment through cognitive and affective filters contrived by design?
5. How do individuals from the Sindh region resist, adapt themselves to, or contest against the shaping of climate discourse through algorithmic conditions?

Literature Review

This study brings into the frame relevant literatures in platform studies, environmental communication, and digital affect theory. It amalgamates and synthesizes three interrelated domains: (1) platform affordances and governance in structuring discourse, (2) an algorithmic curation as a form of gatekeeping, and (3) an engagement in affective terms in digital environmental communication.

Advancing Platform Affordances and Governance

The way that environmental issues are communicated depends fundamentally on the architecture of digital platforms. Affordances are considered the action possibilities embedded in socio-technical systems (Gillespie, 2010). It describes how platforms condition public discourse. The architectural elements of a platform-and, indeed, its operation throughout-influence how messages are disseminated by determining or altering form, speed, access, flow, and permeability (Helmond, 2015).

The "platformization of the web," describes Helmond (2015), referring to the change by which digital infrastructure increasingly embeds platform logics oriented towards data extraction and engagement maximization. In environmental communication, this logic privileges emotionally charged and shareable contents and marginalizes complex, local, or slower narratives (Uldam, 2022). Formats such as Reels or short-form video have more expansive reach but often render visibility as a commodity-with nuance sitting on the cutting room floor. This becomes more egregious in non-Western conditions where vernacular languages, local crises, and communities under-resourced structurally receive minimal structural support (Raza & Aslam, 2024; Couldry& Mejias, 2019). Platform governance-the moderation and monetization mechanisms-without exception, rarely prioritize any possible environment or linguistic inclusion.

Algorithmic Curation: The New Invisible Editors

According to Napoli, algorithmic gatekeeping is developing algorithms that function as a replacement for editorial filtering. In layman's terms, these systems merge, yet they typically rely on murky, profit-oriented logics that favour popularity over depth and deliberation (Yeung,

2023; Van Dalen, 2023). A narrative on the environment that does not fit within the metrics will inevitably find itself algorithmically invisible. The article on personalization technologies demonstrates that people's ideological or emotional consistency is reinforced by lack of exposure to diverse content within filter bubbles and echo chambers (Gillespie, 2010). Recent scholarship highlights issues of "environmental invisibility," as algorithmic systems systematically erase perspectives from historically marginalized regions, mostly those in the Global South, where data infrastructures remain patchy and shaped by long-standing forms of techno-colonialism (Dobbe & Whittaker, 2023; Milan & Treré, 2020). There have been calls for algorithmic accountability and the inclusion of environmental criteria in recommender systems (Pasquetto et al., 2022). Very little has yet been done, however, in engaging critically with the intersections between forms of environmental marginality and algorithmic bias.

Digital Environmental Communication and Affective Engagement

Digital platforms have become prime contexts for environmental discourse in movements and networks of youth activists. But these spaces affect their messages significantly. Emotional responses - from climate anxiety and outrage to hope and denial - significantly shape how users consume content and whether this behaviour generates civic or political action (Papacharissi, 2015; Mahl et al., 2023).

Research has consistently proven that an increase in emotionally charged responses tends to affect how people respond when compared to neutral informational messages, particularly invoking fear, anger, or hope (Chen & Wang, 2022). These affective intensities resonate with the platform rewards with content that emotionally triggers engagement algorithms, creating loops of "affective turbulence" (Highfield, 2022). Such processes may incite awareness or harness the potential of disengagement, emotional fatigue, or even pseudo policy advocacy.

Such stakes in affective contextualization are especially critical in precarious contexts such as Sindh. Climate anxiety is never just psychological but often engages civic concern and intergenerational worry (Hickman et al., 2021). Scarce knowledge exists regarding how the architecture of platforms and the mechanics of algorithmic systems modulate these emotional dynamics with respect to time, particularly among marginalized users or linguistically diverse constituents.

Synthesis, Research Gap, and Theoretical Framework

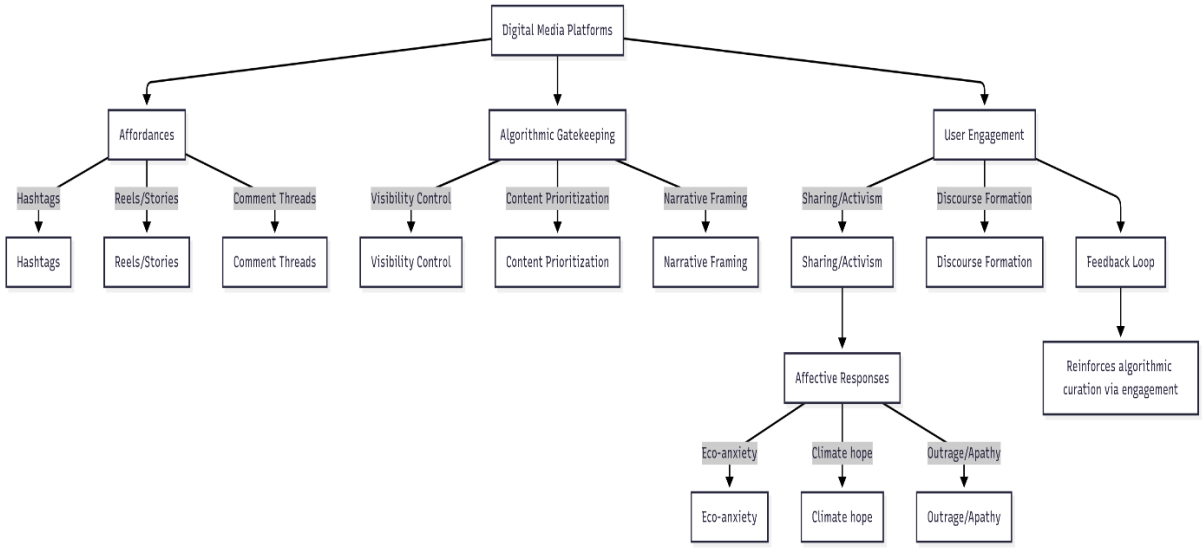
The existing literature provides good insights into the platform logics and algorithmic personalization and affective publics; however, their very combined influence upon environmental narratives is under-theorized, especially in the Global South. There are three major gaps:

- Empirical work is lacking in regions subject to climate stress, but which are non-Western such as in Sindh.
- Limited integration of algorithmic audit with qualitative perspectives of users.

- Virtually no theorization exists about the intersection of emotional affordances and algorithmic governance in constructing environmental visibility and civic affect.

To address these gaps, the research introduces an Affordance–Algorithm–Emotion (AAE) framework, combining Platform Theory (Helmond, 2015; Gillespie, 2010), Algorithmic Gatekeeping (Napoli, 2015), and Affective Publics Theory (Papacharissi, 2015). The framework allows one to critically analyze the extent to which digital infrastructures not only curate environmental content but also emotionally engineer how it is accepted and resonated with.

The AAE framework seeks to foreground the entanglement of technological design, algorithmic filtering, and affective experience in articulating environmental narratives. In application to Sindh, it shows how platform governance and emotional architectures together mediate ecological visibility and invisibility, contributing to theory and practice in digital environmental communication from a grounded position. A diagram illustrating the framework is provided in **Figure 1**.



Research Design and Rationale

The study examined this interplay of platform affordances, algorithmic gatekeeping, and emotional engagement in the digital communication of environmental sustainability. Using computational analysis, digital ethnography, and participatory design, it probed multilayered views on how digital platforms mediate environmental content and shape public affect.

This twofold rationale for this integrative approach is as follows. First, in traditional methods, the opaque algorithmic infrastructures that condition user experience and content visibility are not easily captured. In contrast, this multi-method design has allowed this study to explore visibility dynamics, affective circulation, and user agency on popular platforms such as Instagram, YouTube, and X. Second, this convergence of methods would allow triangulation between structural factors (platform logics), behavioural patterns (user navigation), and

perceptual dimensions (emotional responses)—thus mitigating current gaps identified in both platform studies and environmental media literature (Burgess et al., 2022; van Dijck et al., 2018).

The data collection was thus able to weave together a multi-threaded methodology of computational, ethnographic, and participatory approaches, thereby documenting environmental communication dynamics on digital platforms as comprehensively as possible.

The computational arm focused on an algorithmic audit using simulated user personas with contrasting interest profiles (e.g., climate activism versus entertainment). These personas were placed on Instagram and X for two weeks to observe personalization patterns and visibility hierarchies. Content scraping was automated using Selenium and BeautifulSoup, while visibility scores, rank volatility, and thematic personalization metrics were analysed with respect to RQ2 to evaluate algorithmic gatekeeping. Sentiment and emotion analyses of approximately 20,000 public comments and captions on Instagram, YouTube, and X were also conducted over three months in parallel with sentiment ability identification using VADER and transformer-based emotion classifiers, thus capturing sentiment polarity and emotional tones, such as hope, anxiety, outrage, and apathy, in response to RQ3.

The ethnographic part was concerned with 100 posts from verified environmental content creators. Using NVivo 14, the posts were coded concerning affordance use (hashtags, reels, interactive tools, etc.) and correlated with engagement metrics addressed in RQ1. Additionally, 15 users participated aged between 18-35 in a five-day digital diary study, in which they logged their interactions with environmental content and engaged in think-aloud protocols to reflect on their navigation behaviour. Following the diary sessions, semi-structured interviews were thematically analysed to explore user affect, decision-making, and perceptions of algorithmic influence based on RQ4 and RQ5.

In the participatory aspect, six diary participants engaged in a reflexive co-creation laboratory where they unpacked platform constraints and co-designed visual prototypes as well as normative redesign recommendations for enhancing user-centered environmental media justice.

Integration of findings across triangulated methods marked the way for synergy. For instance, in the audit, algorithmic suppression of local hashtags correlated with reported user gripes from the ethnographic data regarding limited visibility of local content. Conversely, spikes in emotional intensity observed computationally were correlated to specific affordance utilizations captured in ethnographic observations. This helped build an integrative approach that gives a stronger culturally grounded understanding of how digital platforms articulate environments and their concurrent emotional and tactical user engagement in these mediated ecologies.

Ethical Considerations

This research study adhered to recognized ethical standards as a matter of international standing. Participants gave their consent after being informed of the objectives and possible effects of the study. Their identities were anonymized to protect their privacy. The simulated

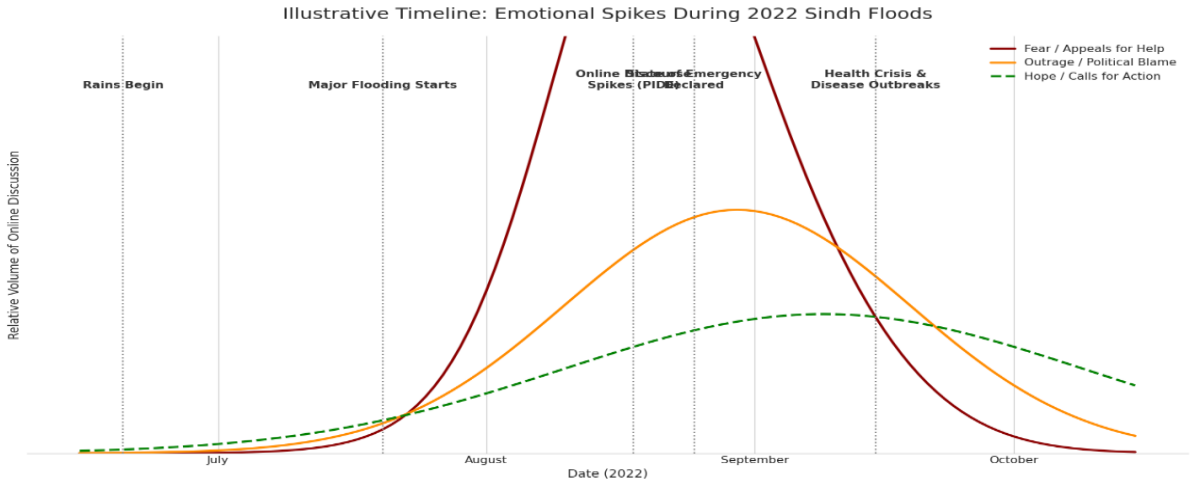
user personas were restricted to academic purpose; they were deleted once the audit was finished. Also, all data retrieved from public accounts were sourced in accordance with the platforms' terms of service, and no privy or unauthorized access to data was carried out at any phase of the research.

Findings

The mixed-methods study reveals a very deep structural dissonance between the logic of platform infrastructures and the pragmatic communicative needs of communities in Sindh, Pakistan. Findings are arranged around four significant insights: the emotional and informational volatility of the digital climate sphere; systemic suppression of local content; the adaptive strategies of users and creators; and community-driven proposals for algorithmic reform.

Fragmented Emotional Publics and Siloed Visibility

Digital climate discourse in Sindh is imbued with emotional volatility and structural segmentation. Sentiment analysis of the online discourse during the 2022 floods indicates that while there was an outburst of sympathy and shock in the initial days, we witnessed sustained waves of outrage and political blame. Constructive calls for action and long-term changes remained algorithmically marginalized.



(Figure 1) *illustrates the fluctuating sentiment timeline.*

Humanize such statistics with an entry of this participant diary: *"I shared three posts about water contamination, but my friends only saw videos of celebrities,"* one participant noted. Another wrote, *"Every time I post something about climate, I feel more nervous. I guess it disappears. It is like we do not exist."* These personas on Instagram would reveal that 'Activist' profiles received climate content 6.5 times more often than those 'Entertainment'-oriented. Emotional echo chambers developed thus: Hope (32%) priorities at Instagram and Outrage (30%) at Twitter/X.

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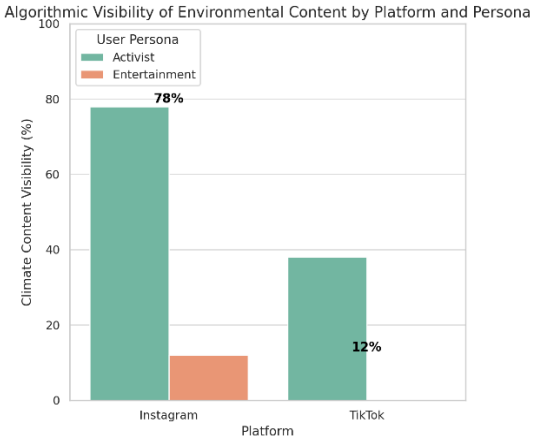
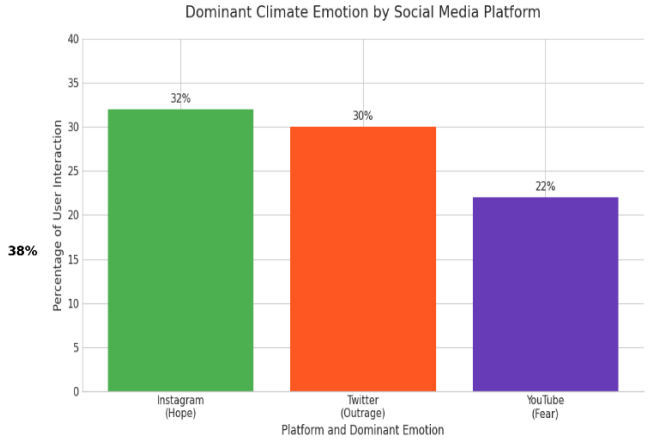
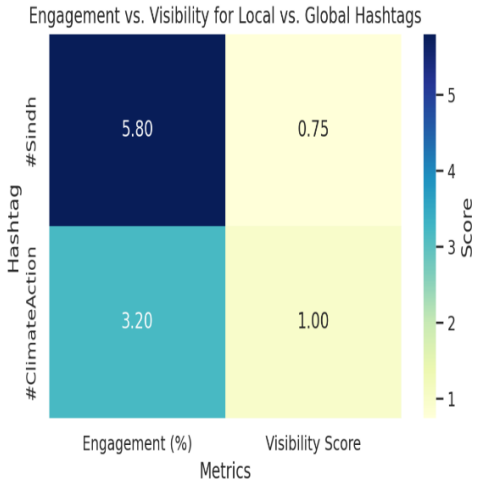




*(Figure 2: Algorithmic Visibility / **Filter Bubble)*** ***(****Figure 3: Emotion by Platform)*

Algorithmic Gatekeeping and Suppression of Locality

Locally relevant environmental content, especially tagged with #Sindh, fetched a high engagement score (score: 5.80) but an exceedingly low visibility score (score: 0.75). In Figure 4, this disparity is presented in a heat map, while Figure 5 visualizes the suppression pathway. Thus, it affirms that there is algorithmic gate-keeping against region-specific narratives.



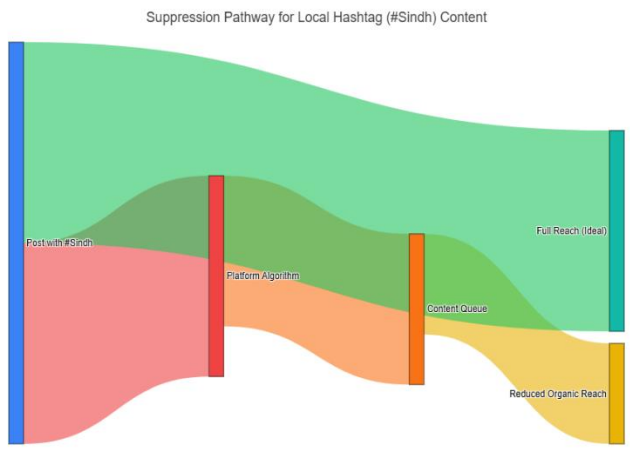
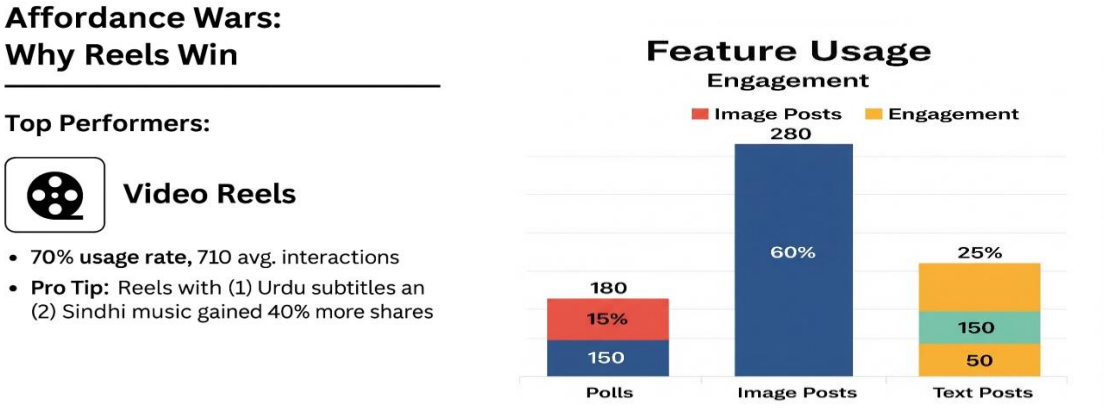


Figure 4: Hashtag Heatmap) *(Figure 5: Suppression Pathway Diagram) 1*

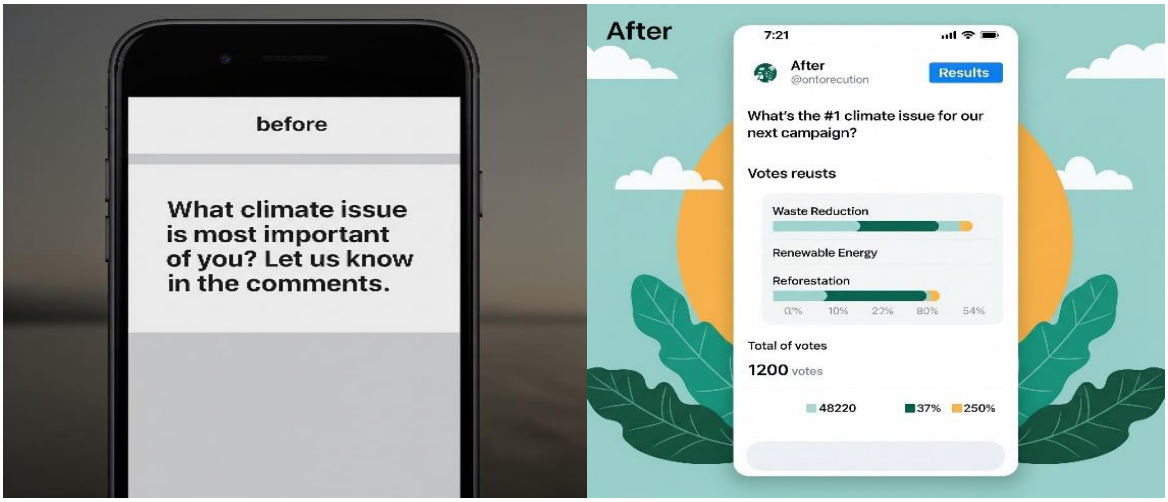
Adaptive Engagement and the Affordance Gap

As a solution, the producers in Sindh adapted their works by integrating cultural elements, such as the use of Sindhi music and Urdu subtitles, into short videos (Reels) that had a 40% higher share rate. In the case of successful features such as Polls (280 average interactions), the use remained abysmally low (15%). To demonstrate how figures were used affordably, Figure 6

displays such virtuous use, while Figure 7 shows the contrasting discrepancy for low utility. A case-study comparison (see Figures 8A & 8B) of the effect redesigning a text post into an interactive poll elicited more than 1,200 responses from users.



(Figure Why Reels Win) (Figure 7: Feature Usage)



(Figure 8: Before (A) *Figure 8 : After (B) Case Study)*

Toward Participatory Redesign: A User-Mandated Framework

User-generated tools in the co-creation lab (Figure 9-10A-D) showcase a shift from user-centred to justice-centred designs. No longer limited to usability, the proposals emphasized equity, transparency, and collective well-being.Algorithmic Transparency Dashboards were used to empower users via revelation, ie, how platforms shape content. Emotional Filter Sliders give users emotional exposure control and hence provide affective autonomy-tagged Crisis Alerts provide a platform for amplification for the marginalized voices in local crises, rewarding informational and climate justice. Participatory Moderation Flowcharts allow users to be included in the governance of content, hence allowing some procedural fairness. Combined, these tools apply not only design justice but also the redistribution of power, improvig inclusiveness, and addressing systemic harms digital systems impose.

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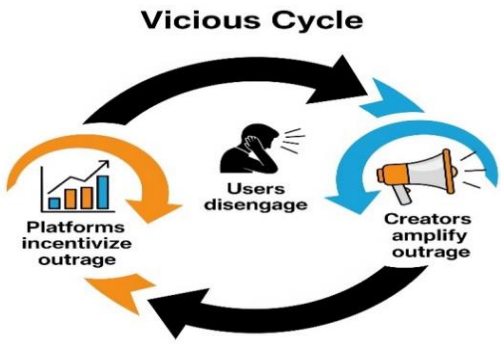

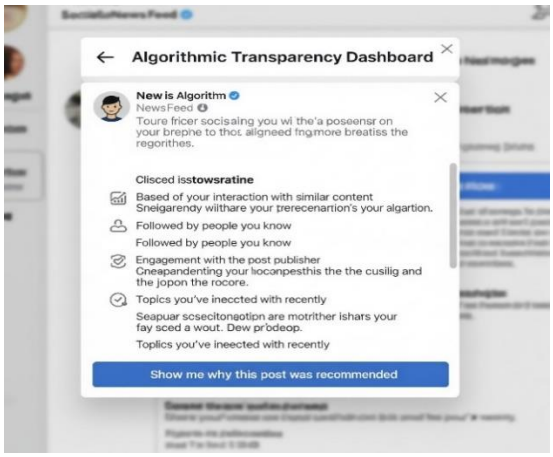

(Figure9) Vicious Cycle(Figure 10 A)Algorithmic Transparency Dashboard

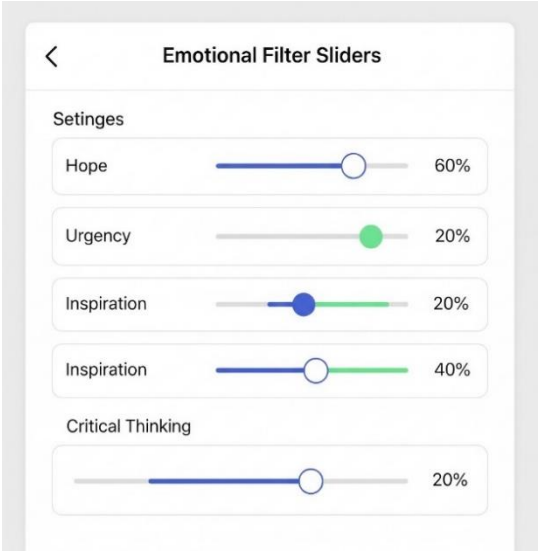

*Figure 10B)Emotional Filter Sliders - (Figure 10C)*Geo-*tagged Crisis Alerts*

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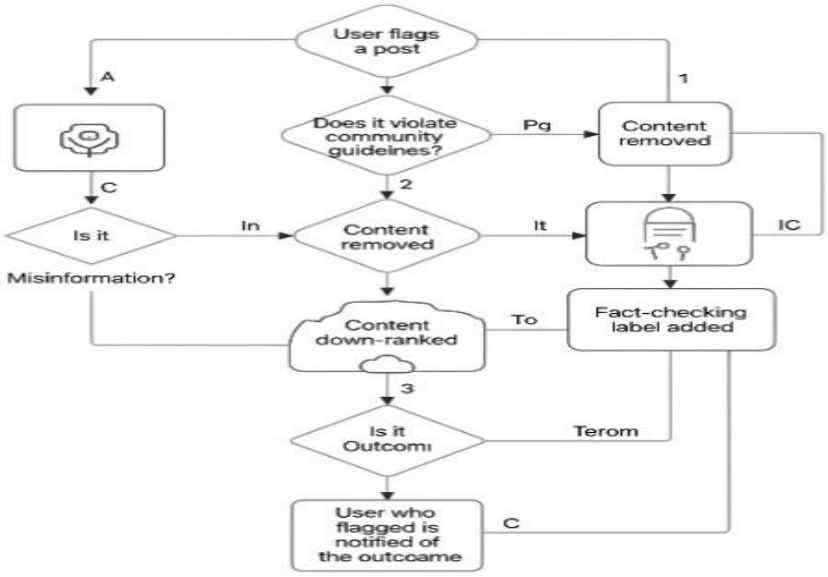

(Figure 10D)Participatory Moderation Flowcharts.

Table 1: Platform Incentives vs. User Needs

Platform Incentives	User Needs
Maximize Engagement Time	Protect Mental Well-being
Reward Sensationalism	Desire for Nuance & Truth
Drive Viral Reactions	Need for Actionable Solutions
Keep Attention at All Costs	Build Trust & Find Reliable Sources

Discussion

The findings from this study reveal a profound structural misalignment between platform logics and the communicative needs of climate-vulnerable communities in Sindh. While platforms like Instagram and Twitter/X offer potential for public engagement, their algorithmic architectures prioritize emotional virality and global scalability over contextual nuance, cultural specificity, and local urgency. The fragmentation of environmental publics into affective silos—hope on Instagram, outrage on Twitter—reiterates how emotional engineering can hinder shared civic imaginaries and coordinated climate action.

This study confirms that algorithmic gatekeeping is not merely a technical oversight, but a structural bias embedded within platform capitalism. The systematic suppression of high-engagement local hashtags like #Sindh, despite community relevance, illustrates infrastructural marginalization that exacerbates digital inequality. It is in these gaps that indigenous knowledge systems and local crisis alerts are rendered algorithmically invisible posing a significant threat to environmental resilience.

Yet, communities in Sindh are not passive. Users demonstrated creative, counter-algorithmic strategies, such as integrating Sindhi music and Urdu subtitles in reels and converting static posts into participatory polls. These tactical adaptations reflect a deep cultural fluency and emergent forms of affective labor that challenge dominant platform norms. Moreover, the participatory design lab produced proposals aligned with design justice, offering a vision of platforms as civic utilities rather than extractive systems. This reflects a grassroots epistemology of care, justice, and ecological dignity.

Conclusion

This study contributes to a growing body of critical digital environmental communication by presenting empirical evidence of how digital infrastructures mediate climate discourse in the Global South. It argues that current social media architectures, in their pursuit of attention and engagement, systemically undermine regionally salient environmental content. The result is an emotionally stratified and epistemically unequal information ecology, where the most vulnerable communities are the least visible.

However, this is not a story of digital despair. Through adaptive engagement and participatory redesign, users in Sindh are already reimagining how platforms could better serve ecological communication. Their voices call not only for content-level reform but for a structural recalibration—one that centers dignity, resilience, and justice in the design and governance of digital media.

Recommendations

1. For Platform Operators
   - Implement algorithmic signals that prioritize local relevance.
   - Launch geo-tagged crisis alert systems and emotional transparency tools.
   - Provide users with algorithmic dashboards that clarify content curation logic.
2. For Policymakers
   - Enforce transparency in algorithmic operations with environmental relevance.
   - Consider platforms as critical infrastructure during ecological emergencies.
   - Engage national institutions (e.g., PTA, Ministry of Climate Change, SDMA) in inclusive digital governance.
3. For Civil Society and Environmental Communicators
   - Promote culturally embedded digital storytelling.
   - Embrace participatory tools like polls and comment threads for civic engagement.
   - Foster digital literacy programs that reveal platform logics and emotional filtering.
4. For Academic and Research Communities
   - Expand algorithmic audits in underrepresented regions.
   - Apply design justice frameworks that empower marginalized voices in the Global South.
   - Collaborate with users to co-create ethical and resilient media infrastructures.

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