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Nature and Trends in Science & Technology (NTST)

From Technical Repair to Social Repair: A Human-Centred Framework for Post-Impact Assessment of Infrastructure Disruption

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Article Information

https://doi.org/10.69798/98774907

Published by: Koozakar LLC. Atlanta GA 30350, United States.

Edited by: Oluseye Oludoye PhD

Abstract

Large-scale infrastructure disruptions increasingly shape human behaviour, livelihoods, and institutional trust, yet post-impact assessment remains dominated by technocratic and ex ante evaluation frameworks. Here we argue that conventional environmental and engineering assessments systematically under-capture lived experience, behavioural adaptation, and governance accountability, particularly in low- and middle-income countries where infrastructure dependence is high, and margins for error are narrow. Based on a post-impact assessment of a canal blockade affecting the Imiringi and Anyu communities in Nigeria's Niger Delta, we propose a human-centred Post Impact Assessment (PIA) framework organized around three interdependent pillars: lived impacts, behavioural adaptation, and institutional response. We show how integrating these pillars reframes post-impact assessment from a procedural exercise into a mechanism for social learning, ethical accountability, and policy recalibration, offering a scalable approach for governing contested infrastructure disruptions in an era of climate stress, infrastructural aging, and institutional fragility. Policymakers should mandate the integration of this PIA framework into national infrastructure governance policies, requiring participatory data collection on the three pillars and linking findings to recovery funding and reforms, while agencies establish cross-functional units to initiate assessments within 30 days of disruptions for timely social repair.

Keyword: Infrastructure disruption, Post-impact assessment, Lived experience, Institutional accountability, Behavioural adaptation, Trust and governance

INTRODUCTION

Large-scale infrastructure systems, such as canals, dams, pipelines, and transport networks, form the backbone of contemporary societies. They shape livelihoods, settlement patterns, and collective behavior. However, when these systems are interrupted, whether by natural disasters, malfunctioning technology, or human intervention, the impact extends beyond physical damage. It reshapes social relations, alters economic routines, disrupts environmental circumstances, and erodes trust in institutions (Efiok *et al.*, 2015; Odubo & Raimi, 2019; Okoyen *et al.*, 2020; Morufu *et al.*, 2021; Raimi *et al.*, 2021). Such disruptions affect not only the immediate environment but also the underlying social and economic structures. This is evident in regions where infrastructure dependence is high, such as the Niger Delta, where the canal blockade had a profound impact on local communities (Morufu *et al.*, 2022; Tano *et al.*, 2024; Nimisingha *et al.*, 2024).

Historically, assessment frameworks have mainly focused on the prevention or alleviation of construction-related impacts, aiming to avert potential problems by promoting environmentally sound infrastructure and ensuring project approval (Tano *et al.*, 2025; Tomquin *et al.*, 2025; Aziba-anyam & Morufu, 2025). Far less attention has been given to post-impact assessment, the systematic evaluation of human, social, and behavioral consequences after infrastructure disruption occurs. This gap is becoming increasingly consequential in a world shaped by climate stress, aging infrastructure, and contested resource governance (Ojile & Morufu, 2025; Raimi *et al.*, 2018; Raimi *et al.*, 2019; Omidiji & Raimi, 2019; Raimi *et al.*, 2020). When post-impact assessments are conducted, they often remain sectoral and technocratic. They prioritize environmental indicators, technical remediation, and hydrological restoration, while human impacts are treated as secondary or anecdotal (Adedoyin *et al.*, 2020; Olalekan *et al.*, 2020a; Olalekan *et al.*, 2020b).

These traditional methods, therefore, fail to address the ways in which infrastructure disruption affects daily behavior, livelihoods, social cohesion, and perspectives on accountability and legitimacy. Post-impact reactions often lack coordination, are fragmented, reactive, and poorly institutionalized, ultimately limiting their capacity to promote learning, mitigate harm, or prevent recurrence (Morufu *et al.*, 2021b; Christopher *et al.*, 2025; Raimi, 2025e). This is particularly problematic when disruptions stem from poor governance or intentional interference, such as canal blockades, which turn infrastructure into a battleground for power struggles. The absence of a coherent, human-centered post-impact framework risks normalizing social suffering, cementing injustices, and undermining public confidence in the actors, both state and non-state, entrusted with infrastructure governance (Raimi *et al.*, 2019; Raimi, 2025e; Olalekan *et al.*, 2020a). Such challenges are particularly acute in low- and middle-income countries (LMICs), where communities are often heavily reliant on shared infrastructure for water access, agriculture, and economic survival. In these settings, institutional responses to disruptions may be slow, opaque, or contested (Omidiji & Raimi, 2019; Raimi *et al.*, 2020; Olalekan *et al.*, 2020b; Morufu *et al.*, 2021b).

For example, the canal blockade affecting the Imiringi and Anyu communities highlights how infrastructure disruption can cascade into environmental degradation, livelihood loss, social tension, and changes in behavioral adaptation strategies (Morufu *et al.*, 2021; Raimi & Raimi, 2025; Aziba-anyam *et al.*, 2025a). This case exemplifies that such events cannot be fully understood or effectively governed through conventional environmental or engineering assessments alone. To address these gaps, we propose a human-centered Post Impact Assessment (PIA) framework that redefines infrastructure disruption as a socio-behavioral and governance challenge. This framework integrates environmental change, community experience, and institutional accountability to guide post-impact learning, recovery, and policy reform (Efiok *et al.*, 2015; Raimi *et al.*, 2021; Odubo & Raimi, 2019; Tano *et al.*, 2024). The novelty of the human-centered PIA framework lies in its deliberate integration of three interdependent pillars: lived impacts, behavioral adaptation, and institutional response. These pillars form a cohesive, post-hoc governance mechanism that transcends traditional approaches. While established frameworks like Social Impact Assessment (SIA) are primarily ex ante, and post-disaster needs assessments focus on

rapid physical and economic recovery, they consistently fail to capture the longitudinal socio-behavioral dynamics and accountability issues that arise after a disruption (Raimi *et al.*, 2019; Raimi *et al.*, 2020; Adedoyin *et al.*, 2020; Olalekan *et al.*, 2020b). By reframing infrastructure disruption as an ongoing social process, this framework shifts the assessment goal from mere documentation to active social learning and ethical accountability (Morufu *et al.*, 2022; Raimi & Raimi, 2025; Michael-Olomu *et al.*, 2025). For regulators and practitioners, the PIA framework offers a structured decision-making nexus that translates community experience and adaptive behavior into actionable insights for redress, policy reform, and preventative governance. This ensures that technical repair efforts are accompanied by measurable social repair, providing a more comprehensive approach to post-impact assessment and recovery (Raimi *et al.*, 2021; Tano *et al.*, 2025; Aziba-anyam *et al.*, 2025b).

Foundation and Positioning of a Human-Centred Post Impact Assessment Framework: The Imiringi-Anyu Canal Blockade

This framework is informed by a post-impact assessment of a canal blockade affecting the Imiringi and Anyu communities in Nigeria's Niger Delta (2021-2022). A non-state actor intentionally obstructed a critical freshwater canal for over 14 months. The immediate impact was the cessation of water flow for domestic use, irrigation, and fishing. This triggered a cascading sequence: salinization of farmland, collapse of dry-season agriculture, distress migration of youth, and protracted inter-community tension over dwindling alternative water sources. Institutional responses were delayed, inconsistent, and involved multiple agencies with unclear accountability, prolonging the crisis and deepening community distrust long before a partial technical clearance was attempted (Raimi *et al.*, 2021; Morufu *et al.*, 2022; Tinimoye *et al.*, 2026). When post-impact assessments are conducted, they are frequently technical. The understanding that infrastructure disruption is a social event that alters behavior, livelihoods, and institutional relationships rather than just an environmental or architectural failure gives rise to the framework presented in this perspective (Raimi *et al.*, 2021; Tano *et al.*, 2024; Nimisingha *et al.*, 2024). A single act of infrastructure obstruction can have a cascading effect on several domains, including environmental degradation, decreased agricultural productivity, altered water-use practices, economic precarity, and increased social tension, as demonstrated by the post-impact assessment of the canal blockade affecting the Imiringi and Anyu communities. These effects developed as interdependent processes mediated by human decision-making, adaptive behavior, and governance responses rather than as discrete outputs (Raimi *et al.*, 2020; Christopher *et al.*, 2025; Seiyaboh & Raimi, 2025).

By combining knowledge from community-based risk studies, social impact assessments, and environmental governance, we determine the necessity for an organized method of interpreting such events after they occur, one that treats affected populations not as passive recipients of harm, but as active agents navigating constrained choices within uneven institutional landscapes (Raimi *et al.*, 2020; Olalekan *et al.*, 2020b; Morufu *et al.*, 2021). Conventional assessment tools are poorly suited to this task. Environmental Impact Assessments (EIAs) and Environmental and Social Impact Assessments (ESIAs) are primarily ex ante instruments, designed to predict and mitigate impacts before project approval. Disaster response and damage assessment frameworks, by contrast, focus on emergency relief and physical restoration, often emphasizing speed over reflection. Neither approach is designed to systematically capture how communities interpret disruption, reorganize livelihoods, or recalibrate trust in institutions over time (Omidiji & Raimi, 2019; Raimi *et al.*, 2020; Olalekan *et al.*, 2020a).

In cases such as canal blockades, where disruption is entangled with governance failures, contestation, or deliberate human action, these tools leave a conceptual vacuum. The result is a pattern of post-impact responses that restore physical infrastructure while leaving social harm unacknowledged, behavioral adaptations undocumented, and accountability unresolved (Morufu *et al.*, 2021a). Therefore, the framework put out here is positioned as a normative, post-hoc, human-centered decision framework rather than an extension of current effect assessment tools. It is intended to highlight ethical, behavioral, and governance issues that need to be resolved before

recovery is considered finished or further interventions are planned, in contrast to descriptive post-event reports (Raimi *et al.*, 2021; Morufu *et al.*, 2022; Tano *et al.*, 2025). By posing a different set of queries, it enhances rather than replaces technical repair and environmental monitoring: How did the interruption change coping mechanisms and daily behavior? Which people's livelihoods were most impacted, and why? What effects did institutional reactions have on how people saw justice and legitimacy? The approach reframes post-impact assessment as a method for learning, accountability, and policy recalibration by emphasizing these topics, especially in LMIC situations where infrastructure dependence is high and institutional trust is fragile (Aziba-anyam & Morufu, 2025; Raimi & Raimi, 2025; Ojile & Raimi, 2019). In this sense, the framework functions as a bridge between environmental events and human behavior, translating post-impact realities into actionable governance insight.

The Three Pillars of a Human-Centred Post Impact Assessment Framework

This research puts forth a Human-Centred Post Impact Assessment (PIA) model built upon three connected foundations: Lived Impacts, Behavioural Adaptation, and Institutional Response and Accountability (see Figure 1 below). Taken together, these foundations offer a clear way to view infrastructure breakdown as an ongoing social process instead of a fixed situation after something happens. The framework focuses specifically on times after effects, once damage is done, and the main problem is not guessing, but grasping, learning, and fixing. Though different when studied, the three foundations support each other: lived impacts affect behavioural responses, behavioural adaptations show institutional good points and flaws, and institutional responses, again, change how effects feel and are handled as time passes.

Pillar 1: Lived Impacts - Experiencing Infrastructure Disruption

The first pillar centres on lived impacts, defined as the direct and indirect ways infrastructure disruption is experienced by individuals, households, and communities in their everyday lives. In contrast to conventional impact assessments that privilege biophysical or economic indicators, this pillar foregrounds how environmental change translates into social stressors, livelihood disruption, and altered well-being. In the context of canal blockades, lived impacts extend beyond reduced water flow to encompass agricultural losses, increased labour burdens, health risks, and shifts in social relations linked to resource scarcity. Importantly, these impacts are not evenly distributed; they are shaped by gender, occupation, age, and socioeconomic position, often amplifying pre-existing vulnerabilities (Benjamin & Appah 1999). A human-centred PIA requires systematic attention to these differentiated experiences. Rather than treating community impact as a homogeneous outcome, this pillar emphasizes heterogeneity and perception, how different groups understand harm, prioritize needs, and assign responsibility.

Guiding questions for this pillar include

- Which social groups experience the most severe or prolonged impacts, and through what mechanisms?
- How do environmental changes translate into economic, health, and social stressors at the household level?
- Which impacts are formally recognized by institutions, and which remain invisible or normalized?

Minimum Indicators/Variables

- Impact severity by livelihood type (e.g., farmer, fisher, trader)
- Change in time/effort for water/fuel collection
- Reported incidence of water-borne diseases or stress-related illness
- Perceived responsibility for harm (community attribution)

Data Sources

- Stratified household surveys
- Health facility records
- Participatory resource mapping
- Focus group discussions (gender/age-segmented)

Example Assessment Questions

- Which group reports the highest livelihood loss?
- How has women's daily workload changed?
- Which impacts are officially acknowledged by institutions, and which remain invisible?

Pillar 2: Behavioural Adaptation - Coping, Adjustment, and Agency

The second pillar focuses on behavioural adaptation, capturing how individuals and communities respond to disruption through coping strategies, adaptive practices, and collective action. Infrastructure disruption rarely results in passive suffering; instead, affected populations actively adjust their behaviour in ways that may mitigate harm, redistribute risk, or generate new vulnerabilities. In canal-dependent communities, such adaptations may include changes in cropping patterns, alternative water sources, increased labour migration, or informal negotiation over access.

These behaviours are not merely reactive; they reflect constrained agency shaped by social norms, resource availability, and institutional signals (Seiyaboh & Raimi, 2025). By foregrounding behavioural adaptation, the framework shifts attention from what infrastructure fails to deliver to how people reorganize life in its absence. This pillar is critical for understanding long-term consequences, as adaptive behaviours can entrench inequality, create path dependencies, or undermine future recovery efforts if left unexamined.

Guiding questions for this pillar include:

- What coping and adaptive behaviours emerge in response to the disruption, and who adopts them?
- Which adaptations reduce vulnerability, and which transfer risk to other groups or future periods?
- How do power relations and social norms shape which adaptations are possible or sanctioned?

Minimum Indicators/Variables:

- Adoption rate of primary coping strategies (e.g., migration, asset sale, altered cropping)
- Proportion of households using high-risk alternatives (e.g., unprotected wells)
- Emergence of new collective action groups or conflict over resources

Data Sources:

- Longitudinal household surveys
- Key informant interviews with community leaders
- Ethnographic observation

Example Assessment Questions:

- What is the most common coping strategy? Is it sustainable?
- Are adaptations transferring risk to other groups, such as the elderly or children?
- How have power dynamics shaped access to adaptation options?

Pillar 3: Institutional Response and Accountability - Governance After Impact

The third pillar addresses institutional response and accountability, examining how authorities, organizations, and governance structures respond to disruption and how these responses are perceived by affected communities. Infrastructure disruption is as much a test of institutional legitimacy as it is a technical challenge. Delays in response, lack of transparency, or exclusion of community voices can deepen harm and erode trust, even when physical repairs are eventually made. Conversely, inclusive and responsive governance can mitigate social damage and support recovery beyond material restoration. This pillar interrogates not only what institutions do, but how responsibility is assigned, contested, or avoided in the aftermath of disruption. In cases involving deliberate actions such as canal blockades, questions of accountability become especially salient, revealing power asymmetries and governance gaps that conventional assessments often sidestep.

Guiding questions for this pillar include:

- How timely, transparent, and inclusive were institutional responses to the disruption?
- How do affected communities perceive responsibility, blame, and redress?
- What governance failures or strengths does the post-impact response reveal, and how can these inform future policy?

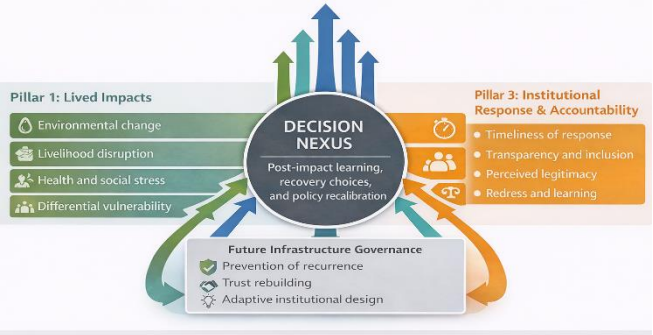

Figure 1: A Human-centred Post Impact Assessment (PIA) Framework for Infrastructure Disruption
Source: Author Design (2026)

Minimum Indicators/Variables:

- Time lag from disruption to first official communication/action
- Number and accessibility of formal community engagement forums held
- Existence and functionality of a publicly known grievance mechanism
- Community trust score in responding institutions (pre- vs. post-response)

Data Sources:

- Institutional activity logs & press releases
- Meeting minutes & attendance records
- Grievance log audit
- Perception surveys

Example Assessment Questions:

- Was the first response within an acceptable timeframe (e.g., 7 days)?
- Were community priorities reflected in action plans?
- Is there a clear, accessible path for seeking redress?

Good vs. Poor Institutional Response:

- Good: Timely response (within 7 days), transparent communication with the community, inclusive participation in decision-making, functional grievance mechanisms.
- Poor: Delayed response (beyond 7 days), lack of transparency, exclusion of community input, absence or failure of grievance mechanisms.

Thus, the framework conceptualizes infrastructure disruption as a socio-behavioural event rather than a purely technical failure. Lived impacts capture how environmental change is experienced across households and social groups; behavioural adaptation reflects coping strategies, agency, and collective responses; and institutional response examines accountability, legitimacy, and governance performance. The convergence of these pillars informs post-impact decision-making, emphasizing learning and social repair before institutional closure. By embedding behavioural and governance insights into recovery pathways, the framework reframes post-impact assessment as a critical mechanism for preventing recurrent harm in contested infrastructure contexts.

Operational Indicators for Human-Centred Post-Impact Assessment

As part of the framework's operationalization, this study presents the "Operational Indicators for Human-Centred Post-Impact Assessment" as shown in Table 1 below. Table 1 outlines the pillars, indicators, data sources, sample assessment questions, and output metrics for each of the three pillars. Table 1 serves as a practical guide for conducting post-impact assessments and offers clear benchmarks for assessing social impacts, adaptive responses, and institutional effectiveness.

From Assessment to Action: Translating Human-Centred PIA into Policy and Recovery Pathways

A major issue with quite a few impact reviews is that they do not lead to action outside of quick fixes. Documents get written, points are made; however, organizational ways stay the same, and those hurt do not see real change. The human-centred PIA framework fills this need as it works to link what happened to people with how choices are made by those in charge. Instead of seeing review as the finish, the framework sees it as a point where choices must be made before getting better is seen as done or more work is given the go-ahead. In this way, PIA turns into a tool for groups to learn, understand actions, and change policy. The move from review to action starts when the three main parts are put into a clear order that helps to explain things. Lived impacts establish who was harmed and how; behavioural adaptations reveal how communities coped and at what cost; and institutional responses expose where governance succeeded or failed. When analysed together, these dimensions generate actionable insight that cannot be derived from any single pillar in isolation (see Figure 2).

For example, adaptive behaviours that temporarily sustain livelihoods may mask long-term environmental degradation or social fragmentation, while technically adequate institutional responses may still undermine legitimacy if they fail to acknowledge community experience. The framework, therefore, requires decision-makers to confront trade-offs explicitly, rather than defaulting to technocratic closure (Figure 2).

Table 1: Operational Indicators for a Human-Centred Post-Impact Assessment

S/N	Pillar	Key Indicators / Variables	Example Data Sources	Sample Assessment Questions	Potential Output Metric
1.	Lived Impacts	- Impact severity score by livelihood type (e.g., farmer, fisher, trader) - Change in time/effort for water/fuel collection - Reported incidence of water-borne diseases or stress-related illness - Perceived responsibility for harm (community attribution)	- Stratified household surveys - Health facility records - Participatory resource mapping - Focus group discussions (gender/age-segmented)	- Which group reports the highest livelihood loss? - How has women's daily workload changed? - Which impacts are officially acknowledged?	-Disaggregated impact severity index - Map of "unseen" impacts vs. officially recorded ones
2.	Behavioural Adaptation	- Adoption rate of primary coping strategies (e.g., migration, asset sale, altered cropping) - Proportion of households using high-risk alternatives (e.g., unprotected wells) - Emergence of new collective action groups or conflict over resources	- Longitudinal household surveys - Key informant interviews with community leaders - Ethnographic observation	- What is the most common coping strategy? Is it sustainable? - Are adaptations transferring risk to the elderly or children? - How have power dynamics shaped access to adaptation options?	- Typology of adaptive behaviours and their risk profile - Network map of collective action/conflict
3.	Institutional Response & Accountability	- Time lag (days) from disruption to first official communication/action - Number and accessibility of formal community engagement forums held - Existence and functionality of a publicly known grievance mechanism - Community trust score in responding institutions (pre- vs. post-response)	- Institutional activity logs & press releases - Meeting minutes & attendance records - Grievance log audit - Perception surveys	- Was the first response within an acceptable timeframe (e.g., 7 days)? - Were community priorities reflected in action plans? - Is there a clear, accessible path for seeking redress?	- Institutional Response Timeline with accountability checkpoints - Transparency and Inclusivity Index - Grievance Resolution Rate

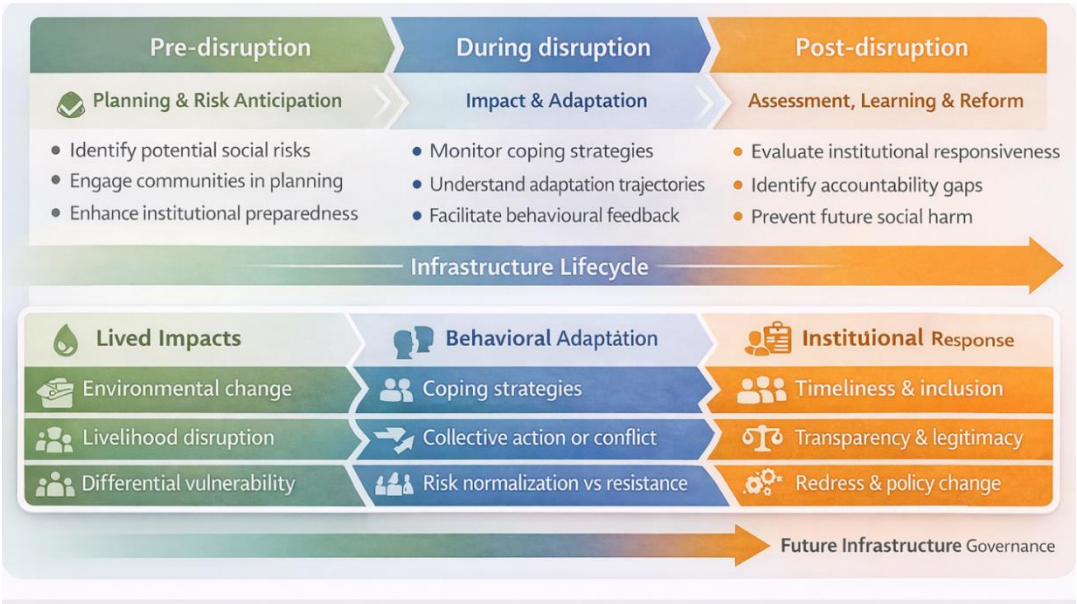

Figure 2: The Operational Pathway of the Human-centred PIA Framework, Linking Assessment Pillars to Actionable Governance Insights for Recovery, Policy, and Prevention
Source: Authors' conceptualization (2026)

Crucially, this synthesis informs three domains of action. First, it guides recovery and redress, ensuring that post-impact interventions address social and behavioural harm alongside physical repair. Second, it supports policy reform by identifying governance gaps, accountability failures, and institutional blind spots revealed through the disruption. Third, it shapes prevention and preparedness, as insights from post-impact analysis feed back into infrastructure governance, risk management, and community engagement strategies (Elemuwa *et al.*, 2024; Teddy *et al.*, 2025). In LMIC contexts, where infrastructure dependence is high and margins for error are narrow, this feedback loop is essential for avoiding recurrent harm and maladaptive cycles of disruption and response (see Figure 2). Conceptually, this pathway can be represented as a single, integrated figure in which the three PIA pillars converge into a decision nexus that informs recovery actions, policy adjustments, and future safeguards. The figure emphasizes sequence and dependence: human-centred assessment precedes institutional closure, not the reverse. By embedding behavioural and governance insights into post-impact decision-making, the framework redefines success not as the mere restoration of infrastructure, but as the restoration and strengthening of social and institutional relationships. This reframing is particularly important in cases of contested infrastructure, such as canal blockades, where unresolved social dynamics can render technical fixes temporary or ineffective.

DISCUSSION: IMPLICATIONS, TENSIONS, AND LIMITS

The human-centred Post Impact Assessment (PIA) framework unveils critical issues often hidden within governance processes following a disruption. One of the most pressing concerns is the balance between the urgent rebuilding of infrastructure and the slower, more nuanced work of repairing societal damage and ensuring institutional accountability. In the aftermath of events like canal blockades, organizations face immense pressure to restore normalcy quickly. However, this urgency frequently clashes with what affected communities desire: acknowledgement of their suffering, appropriate remedies, and meaningful involvement in decision-making processes. The PIA framework does not offer easy solutions to these tensions but instead brings them into sharp focus, compelling organizations to explicitly address whose needs are being prioritized and what the long-term consequences of these decisions might be. By focusing on the real-life experiences of individuals and the behavioral changes they undergo, the framework questions the reliance on purely technical solutions, urging decision-makers to consider the broader social and ethical implications of recovery efforts. The assumption that recovery strategies are neutral and unbiased is often challenged by the framework, revealing how such choices can exacerbate inequality, marginalize at-risk groups, or deepen societal distrust. This is particularly crucial in low- and middle-income countries (LMICs), where histories of injustice, unequal power dynamics, and weak institutional accountability systems make decisions after a disruption even more critical (Raimi *et al.*, 2020; Adedoyin *et al.*, 2020; Olalekan *et al.*, 2020a, b; Raimi, 2025e). Here, the human-centered approach serves as a tool for transparency and social justice, encouraging organizations to rethink the balance between swift recovery and social repair. However, while the framework's potential is undeniable, it is not without its limitations. As a conceptual and normative tool, the human-centred PIA does not prescribe specific methods or standardized metrics, nor does it guarantee institutional uptake, particularly in politically constrained environments. Its success hinges on the willingness of authorities and organizations to confront uncomfortable truths, including acknowledging governance failures or contested responsibility. The risk remains that, without genuine commitment, the human-centred PIA could be reduced to a procedural formality, rather than serving as a meaningful mechanism for social learning, accountability, and reform. This underscores the need for a shift in the application of the framework from mere rhetoric to tangible, transformative practice.

Looking ahead, future work is needed to test and refine the framework across diverse infrastructure disruptions, contexts, and regions. This includes adapting the framework's indicators to specific local conditions, ensuring they are context-sensitive, and evaluating whether the framework's

application leads to more equitable recovery outcomes, enhanced community resilience, and improved institutional trust. Such work is vital if we are to fully understand the impact of post-impact assessments on governance and social justice, and whether these insights can shape future infrastructure governance. Recognizing these limitations is key to ensuring that post-impact assessment transitions from a theoretical concept to a practical, meaningful tool for recovery and reform. Importantly, the human-centred PIA framework is most applicable in situations where infrastructure disruption has significant, differentiated social consequences and where governance accountability is a critical issue. This includes contested resource settings, communities with high dependency on single infrastructure systems, or cases where there is suspected institutional negligence. In these settings, the PIA framework can be transformative, providing a comprehensive tool for understanding the social dimensions of infrastructure disruption and guiding recovery processes that are not only technically sound but socially responsible. However, there are instances where the framework may be less suitable. For example, in rapid-onset, catastrophic disasters such as earthquakes or tsunamis, where immediate life-saving measures and stabilization take precedence, the framework may not be immediately applicable. Yet, the core pillars of the framework, lived impacts, behavioural adaptation, and institutional response, remain highly relevant during subsequent recovery phases. This underscores the adaptability of the PIA framework, which can be integrated into different stages of disaster recovery, ensuring that social and behavioural factors are adequately considered as part of the longer-term rebuilding process. For the framework to be credibly applied, it requires meaningful access to affected communities for participatory data collection. Additionally, institutional actors must be engaged to provide necessary response timelines, decision logs, and transparency regarding their actions. The PIA framework is designed to be adaptive, with its core pillars providing the necessary structure for evaluation, while the specific indicators and methods must be tailored to the unique socio-political and infrastructural context of each case. This ensures that the framework remains flexible, responsive to local needs, and capable of addressing the specific challenges that arise in each post-impact scenario.

Implications for Policy, Governance, and Research

A human-centred Post Impact Assessment (PIA) system has major effects on infrastructure policy when it sees disruption not as just a technical problem, but as a social issue causing lasting effects on behaviour and trust. Policy tools for infrastructure growth, environmental cleanup, and payment plans must include post-impact reviews that show real lived experience, behavioural adaptation, and how groups act, instead of just using technical or environmental data. Adding these needs to rules would let leaders spot different risks, expect bad coping methods, and fix social damage before it seems normal (Morufu *et al.*, 2021a; Seiyaboh & Raimi, 2025). In terms of control, the system shows how important groups to be responsive, open, and learning to build public trust. Post-impact steps that are slow, unclear, or shut people out may worsen social issues and hurt legitimacy, while quick and inclusive reactions can turn disruption into a chance to fix and improve groups (Perekibina *et al.*, 2025; Awogbami *et al.*, 2024). Importantly, this perspective suggests that closure of an infrastructure incident should be defined not by physical restoration alone, but by demonstrable social learning and accountability.

For research, the proposed framework underscores the need to move beyond outcome-focused evaluations toward longitudinal, mixed-methods approaches capable of tracing how individuals and communities adapt over time and how institutions respond or fail to respond to these adaptations. Behavioural indicators such as coping strategies, collective action, risk normalization, and resistance remain under-theorized and under-measured in infrastructure and environmental governance research, despite their central role in shaping recovery trajectories (Oweibia *et al.*, 2024; Opaminola & Raimi, 2025). Future studies should therefore integrate ethnographic insights, behavioural data, and institutional analysis to capture feedback loops between lived impacts and governance responses across the infrastructure lifecycle. Comparative research across sectors and regions would further identify conditions under which post-impact assessment functions as a

mechanism for prevention rather than documentation. By positioning human behaviour and institutional accountability at the core of post-impact inquiry, this perspective invites a reorientation of both policy and scholarship toward infrastructures that are not only technically resilient but socially adaptive and ethically governed.

CONCLUSION AND CALL TO ACTION

When things like canal blockages mess up our infrastructure, it shows more than just technical problems. It also shows how people act, how much we trust our institutions, and how governments handle the effects of environmental issues. This article says that when we check things after they happen, we need to look at more than just the technical stuff. We need to focus on people and how they live. We need to think about how people change their behavior and how institutions are responsible for what happens. If we don't do this, we might fix the infrastructure, but people will still suffer. We also won't learn anything, and the same problems could happen again. The people-focused way of checking things that we suggest here gives us a way to deal with these issues. It makes checking after something happens a key time to think about what's right, understand behavior, and change policies. We ask that leaders make people-focused ways of checking things a basic rule after infrastructure messes up. This would make sure that choices about fixing things are based on what people in the community have gone through and that the process is open and honest. For those who do this work, we suggest using the questions in our plan to talk to the people who are affected and not stopping too soon. We need to focus on fixing problems for people, not just fixing things. For researchers, the immediate priority is to operationalize and test this framework across diverse post-impact contexts, examining how its application influences recovery trajectories, governance reform, and institutional trust over time. Taken together, these actions can transform post-impact assessment from an administrative afterthought into a catalyst for more just, resilient, and human-centred infrastructure governance.

RECOMMENDATIONS: Implementation Roadmap for a Human-Centred PIA

To effectively translate the proposed human-centred Post Impact Assessment (PIA) framework into practice, the following actionable steps are recommended for key stakeholders. These recommendations are designed to ensure the framework is integrated into existing governance structures, operationalized in response to infrastructure disruptions, and continuously improved through research and practice.

For Policymakers and Infrastructure Regulators

Mandate Integration

Policymakers and infrastructure regulators should formally integrate the human-centred PIA framework into national and sub-national infrastructure governance policies. This would ensure that post-disruption assessments become a compulsory procedure, alongside environmental and technical audits. By embedding the PIA framework within legal and regulatory structures, governments can ensure that the social, behavioural, and governance dimensions of infrastructure disruption are systematically assessed and addressed (Raimi *et al.*, 2020; Olalekan *et al.*, 2020a). This integration will guarantee that all infrastructure projects and disruptions are evaluated holistically, considering both technical restoration and social repair.

Set Minimum Standards

Policymakers should also establish and enforce minimum standards for PIA reporting. These standards would require:

- Data Collection: Utilization of participatory methods such as structured household surveys, focus group discussions, and community timelines to capture lived impacts and behavioural adaptations. This data will offer a more accurate understanding of the social consequences of disruption (Tano *et al.*, 2025; Raimi & Raimi, 2025).
- Core Indicators: Develop clear metrics on differential vulnerability, coping strategy prevalence, institutional response timelines, transparency in communication, and the accessibility of grievance mechanisms. These indicators will provide a comprehensive picture of the socio-behavioural impacts and

governance effectiveness (Raimi *et al.*, 2021; Christopher *et al.*, 2025).
- Tangible Deliverables: Ensure that the PIA reporting is accessible to the public, with deliverables such as a live dashboard of key recovery indicators, a formal grievance and redress log, and an actionable, publicly available PIA report (Morufu *et al.*, 2022).

Create Accountability Linkages

A critical step is to create legal linkages between the PIA findings and consequential actions. This can include:
- Conditioning Recovery Funds: Releasing recovery funds or approving future infrastructure projects only when documented social harms from previous disruptions have been resolved. This ensures that financial resources are used to rectify past injustices (Adedoyin *et al.*, 2020).
- Mandating Policy Adjustments: Requiring policymakers to implement specific policy adjustments or institutional reforms based on the gaps identified in the governance structure. These adjustments are necessary to ensure that past failures are not repeated, and that future infrastructure disruptions are managed more effectively (Raimi *et al.*, 2020; Olalekan *et al.*, 2020b).

For Implementing Agencies and Infrastructure Operators

Build Dedicated Capacity

To operationalize the human-centred PIA framework, implementing agencies and infrastructure operators must establish dedicated, cross-functional post-impact units. These units should combine technical, social science, and community engagement expertise. The establishment of these units will ensure that all aspects of the PIA framework, technical, social, and behavioural, are effectively integrated into the post-impact response process (Ojile & Raimi, 2019; Raimi *et al.*, 2020).

Institutionalize Transparent Processes

Transparency and inclusivity are essential for building public trust. To institutionalize these values, agencies should implement standard operating procedures for:
- Timeliness: Ensure that a PIA is initiated within 30 days of a major disruption. This swift response is crucial for addressing the immediate social impacts of the disruption while recovery efforts are still in their early stages (Raimi & Raimi, 2025; Morufu *et al.*, 2022).
- Transparency: Agencies must commit to publishing interim findings and response plans on a public platform, keeping the affected communities informed and involved in the recovery process. This transparency will ensure that the recovery process is seen as legitimate and accountable (Tano *et al.*, 2025; Raimi *et al.*, 2021).
- Inclusivity: Establish independent community liaison officers and participatory decision-making forums. These structures will ensure that local voices, especially from marginalized groups, are heard and included in the recovery planning process (Aziba-anyam & Morufu, 2025; Christopher *et al.*, 2025).

Embed Learning Loops

A vital aspect of the PIA framework is its capacity for learning and adaptation. Agencies should conduct mandatory after-action reviews based on the findings of the PIA. These reviews should document both failures and successes, which will help update risk management plans and community engagement strategies. By embedding learning loops, agencies can continuously refine their practices and improve future responses (Raimi *et al.*, 2020).

For Researchers and Practitioners

Develop Toolkits

Researchers and practitioners should collaborate to create and validate context-sensitive, standardized indicator sets for each pillar of the PIA framework. This will enable comparative analysis across sectors and regions, ensuring that the framework can be applied universally while also being adaptable to local conditions. The development of these toolkits will provide a valuable resource for practitioners in the field (Raimi & Raimi, 2025; Tano *et al.*, 2024).

Pilot and Evaluate

To test the efficacy of the framework, researchers must operationalize and pilot the PIA in diverse

post-impact settings, such as floods, pipeline vandalism, or dam failures. These pilots will help refine the methodology and demonstrate how the framework impacts recovery equity, institutional trust, and long-term resilience in different contexts (Raimi *et al.*, 2021; Adedoyin *et al.*, 2020).

Build Evidence

Researchers should also focus on generating longitudinal, mixed-methods studies to trace the causal pathways between institutional responses, adaptive behaviours, and long-term community resilience. These studies will provide valuable insights into how institutional actions affect community recovery trajectories and the rebuilding of social trust (Ojile & Raimi, 2019; Christopher *et al.*, 2025). By collecting and analyzing data over time, researchers will help strengthen the evidence base for the PIA framework and its applicability across various infrastructure disruptions.

Health Significance

A human-centred PIA is critical for public health as it reveals and addresses the indirect pathways through which infrastructure disruption affects population well-being:

i. Makes Hidden Risks Visible: Documents how behavioural adaptations (e.g., using contaminated water, distress migration) and prolonged livelihood stress create cumulative health risks, beyond immediate physical injuries.
ii. Guides Targeted Interventions: By identifying differentially vulnerable groups (by gender, occupation, socioeconomic status), it enables earlier and more precise public health responses.
iii. Strengthens Health-Promoting Governance: Demonstrates how institutional response qualities, timeliness, transparency, inclusivity, directly influence psychosocial stress, community cohesion, and long-term trust, which are fundamental social determinants of health. Embedding this framework thus protects health by ensuring recovery processes actively strengthen the socio-institutional foundations of community resilience.

Thus, the human-centred PIA framework ultimately contributes to health system strengthening by ensuring that recovery processes do more than just restore infrastructure; they also promote and protect public health. By addressing the psychosocial and behavioural impacts of disruption, the framework helps to ensure that the recovery process actively supports the rebuilding of trust and community cohesion, both of which are fundamental social determinants of health. This comprehensive approach is graphically represented in Figure 3 below, which illustrates the pathways through which infrastructure disruptions impact health outcomes. The figure highlights the complex interplay between environmental, social, and governance factors and their cumulative effect on community health.

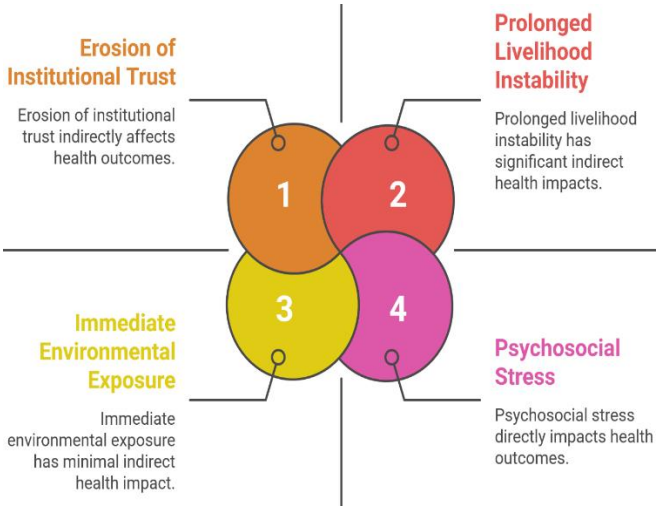

Figure 3: Pathways linking infrastructure disruptions to health outcomes, highlighting the mediating role of lived experiences, behavioural adaptations, and institutional responses.
Source: Authors' conceptualization (2026).

Funding

The authors affirm that no funding, whether financial or non-financial, was received for the execution of this study. This research was conducted independently of any external financial or material support. We uphold transparency in disclosing the absence of funding, underscoring the authors' commitment to conducting unbiased research driven solely by scientific inquiry.

Author Contributions

Both authors contributed equally to this work and take full responsibility for its content. All authors read and approved the final version for submission.

Competing interests

The authors affirm that they have no competing interests to declare. There are no conflicts of interest that could influence the objectivity or impartiality of the research findings presented in this study.

Acknowledgements

The authors would like to acknowledge Niger Delta University and the Niger Delta Institute for Emerging and Re-emerging Infectious Diseases, Federal University Otuoke, Bayelsa State, Nigeria.

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