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Operationalizing Equity in Urban Redevelopment: A Justice-Centered Metrics Framework

Mark Yarish
Capitol Technology University, Laurel, MD, USA
https://orcid.org/0009-0004-7177-1643
myarish@captechu.edu

ABSTRACT: This article introduces the Justice Metrics Framework (JMF) for incorporating equity into urban sustainability using measurable indicators and a dashboard-based approach for monitoring. Building on research at the intersection of GeoAI, environmental justice, and eco-gentrification, this argument suggests that urban "improvement" should be evaluated through both distributional and procedural justice outcomes, rather than just technical performance. Methodologically, it offers a conceptual and design-oriented framework, illustrated through the Gowanus Canal Superfund redevelopment rather than a complete empirical evaluation. The JMF operationalizes six indicators: an Affordable Units Ratio (AUR) and Local Housing Retention Index (LHR) to monitor affordable housing provision and displacement risk; a Stormwater Burden Mitigation & Storage Ratio (SBMSR) and Combined Sewer Stress & Capacity Index (CSCI) to track how infrastructure changes redistribute hydraulic risk; a Community Participation Score (CPS) to quantify procedural inclusion; and an Environmental Health Burden Index (EHBI) to assess cumulative exposures. These indicators are integrated into an open-data dashboard that combines spatial, socio-demographic, and environmental datasets. The model supports transparency, continuous monitoring, and community oversight, providing a replicable tool for municipal agencies, community organizations, and private developers to assess whether sustainability investments advance or undermine equitable urban renewal.

KEYWORDS: data justice, equity metrics, urban analytics, sustainable urbanism, environmental justice, GeoAI, Gowanus Canal

Introduction

Urban redevelopment in the twenty-first century is often framed as a story of "improvement" and resilience, characterized by cleaner waterways, greener infrastructure, creative districts, and increased housing supply. Yet decades of research in urban political ecology and environmental justice show that such improvements are unevenly distributed and often entangled with displacement, speculative investment, and the rebranding of historically marginalized

neighborhoods (Pearsall, 2013; Gould & Lewis, 2017; Yarish & Richardson, 2025a). The same projects that restore ecological function or cultural amenities can simultaneously drive up land values and sharpen inequalities in who receives the benefits and who bears the costs.

This paper examines how equity can be operationalized in practice within these contested spaces by treating improvement not only as a technical project but also as a symbolic and political one. Building on work on eco-gentrification and "green" branding, it highlights how environmental and cultural redevelopment—ranging from green infrastructure to waterfront parks and arts districts—often functions as a signal of investability. These interventions participate in what Zukin (2010) and Harvey (2005) describe as neoliberal urbanism: governance regimes that deploy sustainability and culture to attract capital, manage risk, and enhance competitive advantage (Yarish, 2025e).

This duality—environmental benefit versus social displacement—defines a core paradox of sustainable urbanism. Environmental cleanups, creative clustering, and adaptive reuse operate as sustainability interventions while also acting as mechanisms for converting symbolic and ecological value into capital. The Gowanus Canal Superfund redevelopment exemplifies this tension: a federal cleanup that delivers environmental benefits and reduced toxic exposures while catalyzing luxury development, rezoning, and deepening spatial inequality (Yarish, 2025b). Similar dynamics are observed in cities such as London, Barcelona, and Seoul, where climate resilience and cultural regeneration projects have been accompanied by rising rents and increased displacement pressures.

Environmental performance is typically assessed through indicators such as reduced pollution loads, increased green space, or improved hydraulic efficiency. By contrast, equity remains under-defined and unevenly measured. Terms like equity, participation, and inclusion are ubiquitous in policy language but are rarely anchored in specific, trackable metrics. As a result, claims that sustainability initiatives will benefit "the community" remain aspirational, while dashboard systems and open-data portals risk reinforcing a narrow, technical understanding of progress. This gap motivates the central question of this article: how might cities bring equity onto the same analytic footing as environmental performance so that justice outcomes can be monitored, debated, and enforced?

This article makes three key contributions. First, it synthesizes research on environmental justice, eco-gentrification, and data justice into a Justice Metrics Framework (JMF) for urban redevelopment. Second, it defines six equity-centered indicators—the Affordable Units Ratio (AUR), Stormwater Burden Mitigation & Storage Ratio (SBMSR), Combined Sewer Stress & Capacity Index (CSCI), Community Participation Score (CPS), Local Housing Retention Index (LHR), and Environmental Health Burden Index (EHBI)—that can be integrated into municipal open-data and performance dashboards and aligned with global frameworks such as SDG 10 (Reduced Inequalities) and SDG 11 (Sustainable

Cities and Communities). Third, the Gowanus CSO Metrics Dashboard demonstrates how these indicators can be integrated into a justice-oriented monitoring system that connects environmental performance to social issues accountability. The central claim is consequential but straightforward: without measurable equity, sustainability remains incomplete.

Literature Review

Eco-Gentrification and the Politics of Improvement

Eco-gentrification refers to the process by which environmental restoration and green infrastructure, while improving ecological quality, simultaneously catalyze real estate speculation and displacement (Checker, 2011; Dooling, 2009; Pearsall, 2013). Under neoliberal urban governance, environmental projects function less as neutral public goods and more as market instruments, embedding ecological progress within growth regimes that prioritize capital accumulation over social equity. Harvey (2005) and Brenner and Theodore (2002) describe this as "actually existing neoliberalism," in which the rhetoric of sustainability legitimizes redevelopment strategies that disproportionately benefit investors at the expense of long-term residents.

In this context, improvement operates as both a technical and symbolic construct. Environmental cleanups, parks, and "green" design projects signal civic virtue while simultaneously restructuring land values and social hierarchies (Gould & Lewis, 2017). As Yarish (2025a) argues in Urban Renewal and Sustainability in Gowanus, this logic produces a paradox of "sustainability without justice," where ecological progress becomes a vehicle for displacement. Therefore, assessing environmental improvement requires frameworks that integrate distributional and procedural justice alongside conventional ecological metrics, a gap that the Justice Metrics Framework (JMF) aims to fill.

Symbolic Infrastructures of Improvement

Building on Bourdieu's concept of symbolic capital and Zukin's (2010) analysis of authenticity, Yarish (2025e) introduces the idea of symbolic infrastructures of improvement. These are narrative and material projects—such as branding campaigns, park redevelopments, and heritage restorations—that convert ecological and cultural change into signals of investability and urban desirability. This framework links environmental cleanup and cultural renewal by highlighting a shared process of value creation.

Whether through the ecological rebranding of the Gowanus Canal or the creative clustering of London's Coal Drops Yard, symbolic infrastructures recast place identity as a competitive asset. These projects do not merely reflect underlying market dynamics; they actively help shape them by framing specific neighborhoods as sustainable, creative, or authentic destinations. This

transformation is not neutral: it often marginalizes vulnerable populations while reshaping urban space into something more "desirable" for new, wealthier residents. Empirical studies support this pattern: in New York, the adaptive reuse of the High Line spurred luxury development and international tourism (Lindner & Rosa, 2017). In London, industrial heritage was repackaged under the banner of design-led sustainability (Breward, 2004). In Tokyo's Harajuku and Shibuya districts, narratives of sustainability and innovation have justified large-scale redevelopment that displaces subcultural communities (Reggiani, 2022; Yarish, 2025). Across these cases, sustainability and creativity function less as community-driven goals and more as branding devices that often legitimize exclusion. For the Justice Metrics Framework (JMF), these symbolic shifts are not only contextual but actionable. By tracking indicators such as affordable housing provision and retention (AUR, LHR), community participation (CPS), environmental health burdens (EHBI), and infrastructure stress and mitigation (SBMSR, CSCI), the JMF provides a means to measure and contest how these symbolic infrastructures contribute to, or challenge, eco-gentrification.

Equity and Accountability in Sustainable Urbanism

Despite decades of scholarship on environmental justice, the implementation of equity in urban sustainability remains uneven. Anguelovski (2016) describes a recurring pattern of "green LULUs," in which new environmental amenities function as locally unwanted land uses for vulnerable communities, benefiting wealthier newcomers while intensifying burdens on existing residents. Similarly, Rigolon and Németh (2020) demonstrate how green infrastructure planning often overlooks affordability and access, resulting in new forms of environmental gentrification. Together, these critiques underscore the need for accountability systems that translate justice principles into measurable outcomes. Traditional sustainability metrics—such as stormwater capture and emissions reductions—track ecological performance but ignore how benefits and burdens are distributed. Without complementary social indicators, equity remains aspirational rather than enforceable.

Emerging work in data governance and civic technology offers tools to address this gap. Real-time dashboards and open-data portals have transformed environmental monitoring and public communication, yet they rarely incorporate social dimensions. Yarish (2025b) demonstrates that integrating geospatial datasets with social indicators can reveal disparities in exposure, benefit, and participation, providing a foundation for more justice-centered assessments.

By addressing this gap, the Justice Metrics Framework (JMF) provides cities with an actionable set of indicators that embed equity within sustainability reporting and urban monitoring. This approach transforms traditional ecological indicators into tools for accountability, democratic participation, and justice.

From Sustainability Reporting to Justice Dashboards

Synthesizing these insights, the shift from environmental performance dashboards to justice dashboards represents a critical step in sustainability governance. By operationalizing equity through measurable indicators of housing access (AUR, LHR), stormwater and sewer burden redistribution (SBMSR, CSCI), community participation (CPS), and environmental health burdens (EHBI), justice dashboards make inequalities visible and actionable. As Yarish (2025d) argues in Toward Net Zero CSO: Designing a Real-Time Metrics Dashboard for Gowanus, integrating social data with environmental monitoring enhances transparency and empowers stakeholders to challenge unequal redevelopment outcomes. Emerging research in data governance supports this shift by linking digital transparency, participation, and accountability to broader social justice frameworks (Hintz, Dencik, & Wahl-Jorgensen, 2018; Dencik, Hintz, Redden, & Treré, 2019; Heeks & Renken, 2018). These perspectives highlight the need for an equity-focused data infrastructure that can democratize sustainability measurement and strengthen community-led oversight.

Framework and Methodology: Equity-Centered Metrics for Urban Redevelopment

Why Measurement Is Needed

Calls for "equitable" or "just" urban redevelopment often remain aspirational. Plans invoke concepts such as resilience, inclusion, and affordability without specifying how they will be measured, monitored, or enforced over time. In legacy industrial watersheds, such as the Gowanus Canal, this vagueness is not just a technical gap; it is a justice problem. Efforts to make urban sustainability more equitable require more than aspirational language; they require measurable indicators. While cities increasingly track environmental performance through metrics such as pollutant removal, stormwater retention, and energy efficiency, the social dimensions of redevelopment are often left unmonitored. Without explicit indicators, it is challenging for residents, advocates, or policymakers to determine whether new investments are reducing environmental burdens, stabilizing housing, or merely displacing long-term communities while rebranding neighborhoods as "green."

This article addresses that gap by proposing an equity-centered metrics framework that links environmental performance, infrastructure stress, housing stability, participation, and health burdens to specific indicators. The goal is not to capture every dimension of justice but to develop a tractable set of measures that can be embedded in dashboards, scenario tools, and oversight processes, allowing redevelopment decisions to be evaluated transparently and contested with evidence. This section outlines the framework and methodology for translating distributive and procedural justice principles into measurable indicators that can be integrated into municipal open-data and dashboard systems.

Indicator Development Process

The Justice Metrics Framework (JMF) emerged from an iterative process that integrated critical urban and environmental justice scholarship, agency and planning documents, quantitative datasets, and community input within the context of Gowanus. Conceptually, the framework draws on environmental justice, data justice, and critical urbanism literature, emphasizing distributive outcomes (who bears the risks and who receives the benefits), procedural justice (who gets to shape the decisions), and recognition (whose histories and vulnerabilities are acknowledged in planning processes).

Empirically, the indicators were grounded in data already produced or easily obtainable within New York City's existing governance infrastructure. These include:

- Municipal open-data portals (e.g., housing, land use, capital projects)
- Hydrologic and hydraulic models used for CSO planning (including EPA SWMM outputs and CSO Long-Term Control Plan scenarios)
- Demographic and housing data from the U.S. Census and American Community Survey
- Environmental health datasets, such as asthma emergency department visits, heat vulnerability indices, and air quality measures

A preliminary inventory of candidate metrics was evaluated using four key criteria:

1. Validity: Does the indicator meaningfully reflect a justice-relevant construct?
2. Interpretability: Can non-technical stakeholders understand what higher or lower values mean?
3. Segmentation: Can results be segmented by neighborhood, sewershed, or environmental justice area?
4. Actionability: Can the indicator inform specific decisions or accountability claims?

These criteria were applied to ensure that the indicators are usable, transparent, and grounded in data that community stakeholders can influence and act upon. The draft indicators and visualizations were informed by ongoing conversations with local community stakeholders. The result is a six-indicator Justice Metrics Framework (JMF) designed to be both analytically rigorous and civically usable in dashboard form.

Data and Analysis

The Justice Metrics Framework (JMF) relies on a range of existing data sources to measure equity in urban redevelopment. Drawing on municipal open-data portals, hydrologic and hydraulic models, and environmental health datasets, it links technical understandings of urban systems to questions of distributional and procedural justice. However, the real innovation of the JMF lies in its incorporation of community-driven data validation and participatory data

stewardship, reflecting key principles of data justice (Taylor, 2017). This process is designed to ensure that data is not just a technocratic tool, but a means of empowering communities and promoting democratic accountability in sustainability governance.

Data Sources

The data sources used in the JMF are both publicly available and readily accessible, allowing them to be integrated into existing municipal infrastructure without requiring significant new data collection efforts. These sources include:

- Municipal open-data portals provide datasets on housing, land use, capital projects, and more, directly from city agencies such as the New York City Department of Environmental Protection (DEP), the Department of Housing Preservation and Development (HPD), and the Department of City Planning (DCP).
- Hydrologic and hydraulic models: These models, including the EPA's Storm Water Management Model (SWMM), provide valuable insights into stormwater runoff and combined sewer overflow (CSO), which are critical for understanding environmental burdens.
- Demographic and housing data: Derived from the U.S. Census and the American Community Survey (ACS), these datasets provide essential information on income, housing tenure, and racial/ethnic demographics that are crucial for understanding displacement risks and housing affordability.
- Environmental health datasets include asthma emergency department visits, heat vulnerability indices, and air quality measures, all of which are crucial for assessing cumulative health burdens in environmentally vulnerable communities.

Community-Driven Data Validation

In line with a data justice approach, these datasets are not simply top-down measures but are enriched through community engagement. Through participatory mapping and local data stewardship, residents and community-based organizations are involved in data collection, validation, and interpretation, helping to ground-truth the datasets used in the JMF.

- Participatory Mapping: Residents contribute their lived experiences and local knowledge, which helps to contextualize and validate quantitative data. This ensures that the JMF indicators reflect on-the-ground realities of environmental and social conditions, rather than relying solely on top-down metrics.
- Local Data Stewardship: The involvement of community organizations in the collection and curation of data enables a more inclusive and transparent data process, ensuring that marginalized voices are represented in the decision-making process.

This co-production of knowledge aligns with data justice principles, which advocate for the fair distribution of data power and the recognition of local expertise. It shifts the balance of authority in data-driven processes, ensuring that communities that are often excluded from planning and decision-making processes are active participants in shaping the data that informs sustainability decisions.

Ensuring Equity in Data Collection and Analysis

Beyond validating existing data, the community's role extends to setting priorities for the data that is collected. For example, residents of the Gowanus neighborhood have highlighted the need for additional indicators that track the survival of small businesses and the preservation of cultural spaces—issues often overlooked in traditional environmental monitoring. By surfacing these priorities, the JMF can be extended over time to respond not only to the technical needs of urban sustainability but also to locally defined concerns about economic and cultural displacement. Incorporating social indicators—such as housing retention and community participation, along with potential extensions like small business survival—requires collaborative efforts to ensure that these indicators are measured consistently and equitably. This community-led approach helps address concerns that social dimensions of sustainability are often sidelined in traditional performance metrics. By incorporating distributive and procedural justice elements into the data collection process, the JMF offers a more comprehensive and equitable assessment of sustainable urban redevelopment.

Justice Metrics Framework (JMF): Six Indicators

Existing work on environmental justice indicators and equity-focused evaluation tools shows that justice can be at least partially operationalized through measurable metrics (Pearsall & Pierce, 2010; Rigolon & Németh, 2020; Taylor, 2017). Building on this scholarship, the Justice Metrics Framework (JMF) translates justice principles into six operational indicators that can be calculated from rezoning commitments, infrastructure models, and open data.

The Affordable Units Ratio (AUR) and Local Housing Retention Index (LHR) track whether new development expands and preserves housing access for lower-income residents. For example, if 40 percent of the units in a new development are formally income-restricted to below 80 percent of the Area Median Income (AMI), the site-level AUR is 0.40. If, over a rezoning period, the share of long-term, lower-income households that remain in a census tract declines from 60 percent to 45 percent, the LHR for that tract would reflect a 15 percentage-point loss in housing retention. The Stormwater Burden Mitigation & Storage Ratio (SBMSR) and Combined Sewer Stress & Capacity Index (CSCI) measure how capital projects, green infrastructure, and new loads redistribute combined sewer overflow (CSO) and flooding risks across neighborhoods. The Community Participation Score (CPS) captures the extent and quality of resident

engagement in planning, oversight, and implementation processes. Finally, the Environmental Health Burden Index (EHBI) aggregates exposures such as air pollution, noise, and proximity to hazardous or noxious uses to assess whether environmental risk is being reduced or simply relocated.

Table 1. Justice Metrics Framework (JMF) Indicators, Definitions, and Data Sources

Indicator	**Justice focus**	**Summary**	**Key data sources**
AUR – Affordable Units Ratio	Housing affordability & displacement	Share of new or preserved units in the redevelopment area that are income-restricted for low- and moderate-income households.	NYC HPD Housing New York; DCP Housing Database; PLUTO; ACS
SBMSR – Stormwater Burden Mitigation & Storage Ratio	Environmental burden & flood risk	Share of modeled CSO/urban runoff volume captured, detained, or infiltrated by gray/green infrastructure in the target sewershed for a design storm.	NYC DEP CSO LTCP models; EPA SWMM; NYC Open Data (capital & green infrastructure)
CSCI – Combined Sewer Stress & Capacity Index	Infrastructure resilience & equity	Composite index of pipe utilization, overflow frequency, and backflow risk at key sewer nodes serving the redevelopment area and nearby EJ neighborhoods.	NYC DEP sewer network; CSO event logs; 311 complaints; EPA SWMM
CPS – Community Participation Score	Procedural justice & voice	The extent to which residents and CBOs shape planning, design, and monitoring through meetings, advisory roles, and co-produced tools and data.	Public meeting records; minutes; planning agency logs; project websites
LHR – Local Housing Retention Index	Anti-displacement & tenure security	The degree to which low-income renters and long-term residents remain in the neighborhood is supported by housing protections, subsidies, and enforcement.	ACS; NYC Rent Guidelines Board; HPD registrations; eviction and right-to-counsel data
EHBI – Environmental Health Burden Index	Cumulative health & exposure burden	Composite measure of asthma ER visits, heat vulnerability, proximity to hazardous/industrial sites, and traffic-related air pollution for local populations.	NYC DOHMH EpiQuery; NYC Heat Vulnerability Index; EPA TRI; traffic counts; land-use/zoning GIS

Note. AMI = Area Median Income; ACS = American Community Survey; CSO = Combined Sewer Overflow; DEP = New York City Department of Environmental Protection; CBO = Community-based organization; TRI = Toxics Release Inventory. EJ = Environmental justice.

Application: Integrating Metrics into the Gowanus CSO Dashboard

The Gowanus Canal redevelopment serves as a testbed for applying the Justice Metrics Framework (JMF). A proposed Combined Sewer Overflow (CSO) Metrics Dashboard, designed to track stormwater management and pollution reduction under New York City's Unified Stormwater Rule, provides the technical foundation for this framework. By integrating the six equity indicators, the system evolves into a Justice Metrics Dashboard (JMD)—a participatory tool that links hydrological and environmental performance to social accountability.

The JMD visualizes relationships among CSO reductions, affordable housing provision and retention (AUR, LHR), environmental health burdens (EHBI), and, where data are available, supplementary indicators such as small business turnover or storefront vacancy. This enables stakeholders to assess whether ecological improvements are benefiting long-term residents and local businesses. Through participatory mapping and local data stewardship, community organizations could help residents validate datasets and contribute their lived experiences. Such co-production of knowledge would embody core principles of data justice (Taylor, 2017), helping ensure that measurements align with community-defined priorities, not just technocratic standards.

Incorporating social and environmental indicators in this way transforms dashboards from passive data repositories into governance tools: platforms for negotiation, transparency, and co-creation that integrate sustainability monitoring with democratic accountability.

Discussion

Integrating equity metrics into sustainability dashboards reshapes how cities conceptualize progress. Traditional performance indicators often emphasize efficiency and resilience, but they can also obscure underlying inequities. The Justice Metrics Framework (JMF) repositions justice as a measurable dimension of sustainability, rather than a rhetorical supplement. By embedding distributive and procedural equity into data systems, cities can move beyond symbolic commitments to more accountable forms of governance.

However, significant challenges remain. Data fragmentation, institutional inertia, and political resistance all hinder the implementation of justice dashboards. Despite these obstacles, the JMF offers practical solutions, providing a framework for equity-focused monitoring and democratic participation.

Challenges

1. **Data Fragmentation:**
   Data fragmentation—where social and environmental data are dispersed across multiple systems and agencies—remains a key barrier to effective monitoring.

The JMF overcomes this challenge by integrating existing municipal data sources (e.g., NYC Open Data, EPA SWMM) and ensuring compatibility with widely used datasets. Additionally, by incorporating community-driven data collection and validation, the JMF helps reduce reliance on fragmented, top-down systems, fostering a more integrated approach to data governance. This community stewardship of data ensures that it reflects on-the-ground realities and is used as a tool for accountability rather than just a technical exercise.

2. **Political Resistance:**
   Political resistance to equity-focused policies is often a significant obstacle in cities where economic interests and development pressures conflict with social justice goals. The JMF addresses this by embedding equity indicators within transparent, open-data dashboards that can be easily accessed and scrutinized by communities, advocacy groups, and policymakers. This transparency transforms data from a technocratic artifact into a platform for democratic deliberation. As a result, data becomes a tool for public accountability, allowing for greater community engagement in shaping urban redevelopment processes. By making equity a core component of sustainability governance, the JMF helps ensure that justice is prioritized alongside traditional environmental metrics, making it harder for equity to be sidelined in policy discussions.
3. **Institutional Inertia:**
   Institutional inertia—the resistance to change within bureaucratic systems—slows the adoption of new models, including those focused on equity and social justice. However, the JMF offers a modular, scalable approach that can be implemented incrementally, starting with pilot projects in smaller districts or neighborhoods. This incremental approach provides a proof of concept that demonstrates the framework's potential to drive real change. The Gowanus Canal serves as a key example where participatory monitoring and equity-centered metrics have already gained traction, highlighting the JMF's potential to catalyze local and institutional change.

Global Relevance

The JMF's global relevance is underscored by the growing use of open-data platforms and participatory governance models in cities such as Barcelona, London, and Seoul, which have increasingly embraced data justice and democratic transparency.

1. **Barcelona:**
   The Barcelona Digital City initiative offers a compelling example of how open-data platforms can be leveraged to engage citizens in monitoring urban sustainability indicators. The JMF could complement this by integrating equity indicators that address social outcomes (e.g., affordable housing retention and

community engagement) alongside traditional environmental metrics. This would create a more comprehensive tool for democratic urban governance, ensuring that sustainability metrics include both environmental performance and social equity.

2. **London:**
   The Greater London Authority (GLA) has implemented participatory governance models that allow local communities to engage in decision-making processes related to urban sustainability. The JMF could enhance these efforts by providing equity indicators that align with existing sustainability goals in areas such as housing retention (AUR, LHR), community participation (CPS), and environmental health burdens (EHBI), while leaving room for locally defined extensions, such as small business viability or cultural preservation. By embedding these social justice metrics into London's sustainability framework, the JMF can help make urban governance more inclusive and actionable for communities advocating for more equitable development.
3. **Seoul:**
   Seoul's Smart City initiative tracks environmental indicators, including air quality, waste management, and traffic flow, using data dashboards. While these dashboards have transformed environmental monitoring, they have yet to incorporate social equity metrics fully. The JMF can be integrated into Seoul's existing framework by adding indicators like affordable housing provision and retention (AUR, LHR), community participation (CPS), and environmental health burdens (EHBI), ensuring that the city's smart technologies benefit all residents—especially those vulnerable to gentrification and displacement.

These examples demonstrate that the JMF is not limited to New York City; it can be adapted for global contexts and integrated into existing urban data infrastructures. By promoting equitable and sustainable urban governance, the JMF can strengthen the global movement toward data justice and democratic participation in cities worldwide.

Conclusion

This paper presents a practical framework for integrating equity into urban redevelopment through measurable, justice-centered indicators. In Gowanus and beyond, the Justice Metrics Framework demonstrates that sustainability can be evaluated through a clear set of metrics: affordable housing provision and retention (AUR, LHR), stormwater burden mitigation and sewer stress (SBMSR, CSCI), community participation in decision-making (CPS), and environmental health burdens (EHBI).

The central argument is simple yet crucial: sustainability without measurable justice is incomplete. At the same time, the JMF does not claim to exhaust the meaning of justice. Any indicator system risks reducing complex lived experiences to numbers, and the framework is intended to complement, not replace, qualitative narratives, organizing, and deliberation. Justice dashboards can help surface patterns and contradictions, but they still require political interpretation and contestation.

By incorporating equity metrics into environmental monitoring systems, dashboards evolve from descriptive tools into participatory governance mechanisms that align technological innovation with social responsibility. The Justice Metrics Framework (JMF) thus contributes to both theory and practice by defining equity as a standard that can be monitored, evaluated, and contested within sustainable urbanism.

However, the JMF is only a partial remedy, and its implementation will require overcoming barriers such as data fragmentation, political resistance, and institutional inertia. While the JMF offers a pathway toward more transparent and accountable governance, it must be part of a broader effort to integrate equity into the heart of sustainability practices. As cities increasingly adopt data-driven management systems, frameworks like the JMF will be essential for ensuring that sustainability is inclusive, just, and democratic.

Future research should focus on collaborative data collection, AI-enabled spatial analytics, and cross-city comparative testing to refine, validate, and extend this framework across diverse urban contexts. By doing so, cities can move toward more transparent, accountable, and justice-centered models of sustainable development. This work provides a critical foundation for ensuring that equitable urban renewal becomes a reality, not just an aspiration.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Data supporting the conceptual framework are derived from publicly accessible datasets available via NYC Open Data (https://opendata.cityofnewyork.us/) and the U.S. Environmental Protection Agency's Storm Water Management Model (EPA SWMM).

Conflicts of Interest

The author declares no conflict of interest.

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