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### Environmental Justice and the Equitable Distribution of Climate Burdens in Yenagoa, Bayelsa State, Nigeria: A Review and Spatial-Distributive Analysis of Flood and Oil-Pollution Burdens in a Niger Delta Urban Capital

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#### Abstract

Yenagoa, the riverine capital of Bayelsa State in Nigeria's Niger Delta, sits at the intersection of two compounding environmental stressors: climate-induced flooding and five decades of oil- and gas-related pollution. This paper applies the environmental justice (EJ) framework comprising distributive, procedural, and recognitional dimensions to examine how the burdens of these overlapping hazards are distributed across the city's population. Drawing on a structured review of peer-reviewed flood-risk studies, remote-sensing assessments, the 2023 Bayelsa State Oil and Environmental Commission (BSOEC) report, and national poverty statistics, the paper shows that flood-affected land area in Yenagoa Local Government Area nearly doubled between 2018 and 2022 (from 54.92 km<sup>2</sup> to 90.15 km<sup>2</sup>), that vulnerability is concentrated among residents of low-lying,

informally built waterside settlements with few alternative livelihoods, and that Bayelsa's multidimensional poverty incidence (88.5%) is markedly above the national average (63%). The evidence indicates a systematic pattern in which low-income, waterside, and oil-bearing communities absorb a disproportionate share of both climatic and industrial environmental burdens, while institutional response, compensation, and land-use planning remain concentrated in upland, better-serviced districts. The paper concludes that equitable climate adaptation in Yenagoa requires integrating distributive equity, procedural inclusion of riverine and informal communities, and formal recognition of oil-impacted host communities into flood-risk management and urban planning policy.

**Keywords:** Environmental Justice, Climate Justice, Flood Vulnerability, Oil Pollution, Niger Delta, Yenagoa, Distributive Equity, Bayelsa State

#### 1. Introduction

Environmental justice (EJ) scholarship begins from the observation that environmental risks and benefits are rarely distributed evenly across society, and that low-income and marginalised communities tend to bear a disproportionate share of environmental harm while enjoying a disproportionately small share of environmental benefit (Bullard, 1990) [5]. As the climate crisis intensifies flooding, storm surge, and other hazards, this distributive concern has extended into climate justice: the recognition that the populations who have contributed least to greenhouse gas emissions and industrial pollution are frequently those most exposed to their consequences (Anderson *et al.*, 2024) [2]. Nowhere is this tension more visible than in the Niger Delta of Nigeria, a region that has simultaneously supplied the bulk of Nigeria's oil wealth and absorbed the bulk of its ecological cost.

Yenagoa, the capital of Bayelsa State, exemplifies this dual burden. Built on the low-lying floodplain of the Epie Creek and the Nun River, the city is naturally exposed to seasonal flooding; but its vulnerability has been sharply intensified by rapid, poorly regulated urban growth, drainage-blocking waste disposal, and the loss of natural floodplain buffers (Echendu, 2020, 2022) [6, 7]. At the same time, Bayelsa State has hosted commercial oil production since 1956 beginning with Nigeria's first oil well at Oloibiri and has accumulated, by the estimate of an independent state-commissioned inquiry, spill volumes equivalent to an Exxon Valdez-scale disaster every year for fifty years (Bayelsa State Oil and Environmental Commission [BSOEC], 2023) [4]. These two burdens, climatic and industrial, do not fall evenly on Yenagoa's residents. This paper asks: how are the climate and

pollution burdens associated with flooding and oil extraction distributed across Yenagoa's socio-spatial landscape, and what does this distribution reveal about environmental (in)justice in the city?

The paper pursues three specific objectives. First, it reviews the theoretical foundations of environmental and climate justice and adapts them into an analytical framework suited to a Niger Delta urban context. Second, it synthesises the empirical evidence on flood exposure, oil pollution, and socioeconomic vulnerability in Yenagoa to identify who bears the greatest share of these burdens and why. Third, it draws out the procedural and recognitional dimensions of injustice — who is consulted, compensated, and represented in flood and pollution governance — and proposes policy directions for a more equitable distribution of climate burdens. The paper is structured as follows: Section 2 sets out the theoretical framework; Section 3 describes the study area; Section 4 outlines the methodology; Section 5 presents the results and discussion, organised around distributive, spatial, and procedural dimensions of injustice; Section 6 proposes policy directions; Section 7 notes the study's limitations; and Section 8 concludes.

## 2. Theoretical and Conceptual Framework

### 2.1 Environmental Justice: Origins and Core Dimensions

The environmental justice movement emerged in the United States in the 1980s from grassroots opposition to the disproportionate siting of hazardous waste facilities in African American and low-income communities. Bullard's (1990) [5] seminal study, *Dumping in Dixie*, documented how noxious land uses consistently followed a “path of least resistance” into communities with the least political capital to resist them, establishing distributive inequity the unequal spatial allocation of environmental harms and goods as the founding concern of EJ scholarship. Subsequent theoretical work broadened this distributive core. Schlosberg (2007) [12] argued that a full account of environmental justice must move beyond distribution alone to incorporate recognition (whether the identities, knowledge systems, and claims of affected communities are acknowledged by decision-makers) and participation or procedural justice (whether affected communities have a meaningful voice in the processes that produce environmental risk and its governance). These three dimensions distribution, recognition, and procedure are treated in this paper as interdependent: a community that is materially exposed to a disproportionate hazard burden but also excluded from decision-making and unrecognised in policy design experiences a deeper and more durable form of injustice than distributive inequity alone would suggest.

### 2.2 Climate Justice and the Distribution of Climate Burdens

Climate justice extends the EJ framework to the specific harms generated by anthropogenic climate change: intensified flooding, sea-level rise, heat stress, and the erosion of livelihoods dependent on stable ecological conditions. A growing body of work shows that climate risk assessments which measure only direct physical exposure (e.g., property in a flood zone) understate the true burden on vulnerable populations, because indirect impacts loss of access to healthcare, markets, and schools, and the erosion of social and economic resilience compound and are unevenly distributed across income and location (Anderson

*et al.*, 2024) [2]. In the Niger Delta, this distributive climate burden is compounded by an additional, historically prior burden: decades of oil-industry pollution that has degraded the very ecosystems (wetlands, mangroves, and floodplain vegetation) that would otherwise buffer communities against flooding, while also depleting the fisheries and farmland that constitute local adaptive capacity (BSOEC, 2023) [4]. Climate vulnerability in Yenagoa therefore cannot be understood in isolation from the region's pre-existing pattern of industrial environmental injustice.

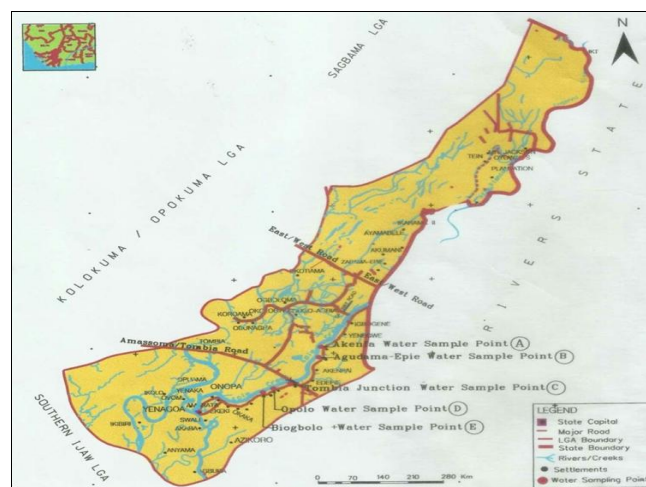
### 2.3 Analytical Framework Applied in This Study

This paper operationalises the EJ framework along three analytical dimensions summarised in Table 1: (i) distributive justice the spatial and socioeconomic pattern of exposure to flooding and oil pollution; (ii) procedural justice the extent to which affected communities participate in flood-risk governance, land-use planning, and pollution remediation decisions; and (iii) recognitional justice whether the specific vulnerabilities of waterside, informal, and oil-host communities (including gendered vulnerabilities) are acknowledged in policy and planning documents. This framework structures the presentation of results in Section 5.

**Table 1:** Analytical Framework: Dimensions of Environmental Justice Applied to Yenagoa

| EJ Dimension          | Guiding Question for Yenagoa                                                                                     | Key Sources                                                       |
|-----------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Distributive justice  | Who is most exposed to flood and pollution hazard, and who bears the resulting economic and health costs?        | Bullard (1990) [5]; Echendu (2020, 2022) [6, 7]; BSOEC (2023) [4] |
| Procedural justice    | Are waterside, informal, and oil-host communities included in flood-risk and land-use decision-making?           | Schlosberg (2007) [12]; Anwana & Owojori (2023) [3]               |
| Recognitional justice | Are the specific claims, knowledge, and gendered vulnerabilities of affected communities acknowledged in policy? | Schlosberg (2007) [12]; BSOEC (2023) [4]                          |

## 3. Study Area: Yenagoa



**Fig 1:** Study area map

### 3.1 Geographic and Hydrological Setting

Yenagoa is the capital of Bayelsa State and the administrative centre of Yenagoa Local Government Area (LGA), located in the core of the Niger Delta in southern

Nigeria, between approximately Latitude 4°15' and 5°23' North and Longitude 5°22' and 6°45' East. The city is bisected by the Epie Creek, a tributary system connected to the Nun River, and sits on low-lying, poorly drained alluvial terrain that is naturally part of the Niger Delta floodplain (Oborie & Ezeze, 2024) [10]. This hydrological setting means that flooding is not an anomalous event but a recurring seasonal feature of the city's environment; historical accounts suggest major “mega-floods” recur roughly every seven to ten years, layered atop smaller annual and rainy-season floods (Oborie & Ezeze, 2024) [10].

### 3.2 Demographic, Socioeconomic, and Industrial Profile

Rapid, largely unplanned urbanisation since Bayelsa State's creation in 1996 has drawn migrants from across Nigeria into Yenagoa, increasing population density and expanding built-up areas into floodplains and wetlands that previously buffered the city against flooding (Anwana & Owojori, 2023) [3]. This growth has occurred without commensurate investment in drainage, solid-waste management, or flood-resilient housing, compounding physical exposure with infrastructural neglect. Economically, Bayelsa State's fortunes are dominated by oil and gas: it accounts for an estimated 18–20% of Nigeria's oil production, yet paradoxically ranks among the poorest states in the country (BSOEC, 2023; National Bureau of Statistics [NBS], 2022) [4, 9]. Table 2 summarises key contextual indicators for the study area.

**Table 2:** Contextual Profile of Yenagoa and Bayelsa State

| Indicator                                   | Value / Description                                              | Source                                 |
|---------------------------------------------|------------------------------------------------------------------|----------------------------------------|
| Hydrological setting                        | Low-lying floodplain bisected by Epie Creek/Nun River system     | Oborie & Ezeze (2024) [10]             |
| Flood-affected area, Yenagoa LGA (2018)     | 54.92 km <sup>2</sup>                                            | Sentinel-1/2 flood mapping (2018–2022) |
| Flood-affected area, Yenagoa LGA (2022)     | 90.15 km <sup>2</sup> (≈ 64% increase)                           | Sentinel-1/2 flood mapping (2018–2022) |
| Share of Bayelsa oil production nationally  | ≈ 18–20% of Nigeria's oil output                                 | BSOEC (2023) [4]                       |
| Multidimensional poverty incidence, Bayelsa | 88.5% of population                                              | NBS (2022) [9]                         |
| National multidimensional poverty incidence | 63.0% of population                                              | NBS (2022) [9]                         |
| Estimated cumulative oil-spill volume       | Equivalent to one Exxon Valdez-scale spill per year for 50 years | BSOEC (2023) [4]                       |

### 4. Methodology

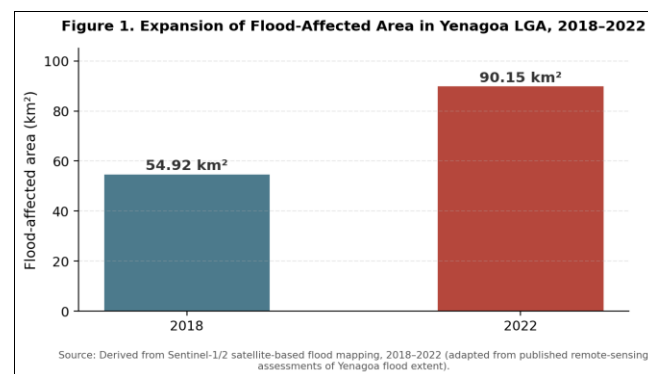
This paper adopts a qualitative, desk-based synthetic review design appropriate to a distributive environmental justice analysis in a context where primary household-level microdata are not publicly available at the ward level. Evidence was drawn from three categories of source: (i) peer-reviewed empirical studies of flooding, flood vulnerability, and remote-sensing-based flood mapping in Yenagoa and Bayelsa State published between 2020 and 2025; (ii) the 2023 report of the Bayelsa State Oil and Environmental Commission, an independent, internationally supported inquiry into the scale of oil pollution in the state;

and (iii) national statistical sources, principally the National Bureau of Statistics' 2022 Multidimensional Poverty Index survey. Quantitative findings reported in these sources (flood-extent figures, poverty incidence, self-reported vulnerability drivers) were extracted and are presented descriptively in Section 5, without re-analysis of primary microdata. The spatial distribution of burdens across Yenagoa's residential zones (Fig 5) is presented as an illustrative schematic synthesis of the qualitative and remote-sensing evidence reviewed, rather than as an original GIS-derived map; it is intended to communicate the general pattern of burden concentration reported in the literature, not precise ward boundaries. This limitation is discussed further in Section 7.

## 5. Results and Discussion

### 5.1 Distributive Injustice I: The Escalating and Concentrated Burden of Flooding

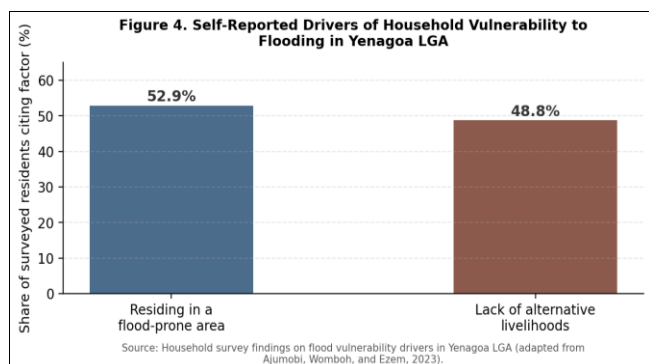
Remote-sensing analysis using Sentinel-1 and Sentinel-2 satellite imagery shows that the flood-affected area within Yenagoa LGA expanded from 54.92 km<sup>2</sup> in 2018 to 90.15 km<sup>2</sup> in 2022 an increase of roughly 64% in four years (Fig 2). This expansion coincided with a sequence of major flood events, including the catastrophic nationwide floods of 2022, during which the Bayelsa State Emergency Management Agency reported that approximately 1.5 million people were affected statewide, with roughly 1.2 million displaced into camps and 96 deaths recorded (as reported in Guardian Nigeria coverage of the disaster). Land-use analysis further indicates that flooding is not distributed evenly across land types: a majority of the flooded area in recent events fell within built-up residential land, meaning the burden fell directly on housing and household assets rather than on unoccupied land.



**Fig 2:** Expansion of flood-affected area in Yenagoa LGA, 2018–2022, based on Sentinel-1/2 satellite flood mapping

Household-level survey evidence corroborates that this burden is not randomly distributed but is concentrated among residents with the least capacity to relocate or absorb loss. In a survey of 600 respondents across 18 flood-prone areas of Yenagoa, the two most frequently cited drivers of household vulnerability to flooding were simply residing in a flood-prone area (52.9% of respondents) and having no alternative livelihood options (48.8%) (Fig 3), pointing to a vulnerability trap in which the same economic constraints that confine households to low-lying, low-cost waterside land also prevent them from adapting once flooding occurs (Ajumobi *et al.*, 2023) [1]. Despite this awareness, many residents reported remaining in flood-prone neighbourhoods

such as Swali, Opolo, Tombia, Akenfa, and Agudama because of the economic opportunities, cultural ties, and affordability these waterside locations offer relative to upland, planned districts illustrating how distributive injustice can be locked in by the very economic logic that makes low-lying land the only affordable option for poorer households.



**Fig 3:** Self-reported drivers of household flood vulnerability in Yenagoa LGA (survey of 600 respondents across 18 flood-prone communities)

This pattern is consistent with the broader Nigerian literature on flooding and informal settlements. Echendu's (2020, 2022) [6, 7] systems-thinking analyses of flooding and Nigeria's Sustainable Development Goals identify flooding as a primary obstacle to poverty reduction, food security, health, and educational attainment, precisely because its impacts compound existing deprivation rather than being randomly distributed across the population. Similarly, a systematic mapping of the flood-vulnerability literature on informal settlements found that unplanned, densely built waterside neighbourhoods — the very areas produced by unaffordable formal housing markets are consistently the most exposed to both flood hazard and the compounding effects of inadequate drainage and waste-management infrastructure (Anwana & Owojori, 2023) [3].

## 5.2 Distributive Injustice II: Oil Pollution as a Compounding and Historically Prior Burden

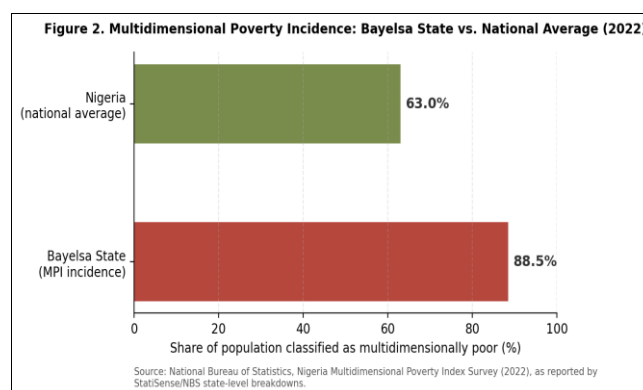
Climate burden in Yenagoa cannot be assessed in isolation from the region's pre-existing burden of oil-industry pollution, which both compounds flood vulnerability and constitutes an independent, longstanding distributive injustice in its own right. The 2023 report of the Bayelsa State Oil and Environmental Commission (BSOEC) an independent inquiry chaired by the former Archbishop of York and supported by international scientific and legal experts concluded that Bayelsa State has suffered contamination equivalent to an Exxon Valdez-scale oil spill every year for fifty years, and that biological samples from some affected communities showed lead and cadmium concentrations up to six times recognised safe thresholds (BSOEC, 2023) [4]. The Commission's report, titled *An Environmental Genocide*, found that while every local government area in Bayelsa has experienced oil contamination, the burden is heavily concentrated in a small number of oil-producing communities, and estimated the cost of an adequate clean-up at approximately US\$12 billion over twelve years (BSOEC, 2023) [4].

This pollution burden interacts with flood risk in at least two ways relevant to distributive justice. First, oil spills, effluent

discharge, and drilling-waste dumping degrade the wetlands and mangrove ecosystems that would otherwise absorb floodwater and buffer settlements, meaning that oil-impacted communities face compounded rather than merely additive risk. Second, flood events themselves can redistribute and re-mobilise legacy contamination sediment, heavy metals, and residual hydrocarbons into residential areas and water supplies, converting a historical industrial burden into an acute climate-linked health hazard. Consistent with this, a study of toxic heavy metals in the breast milk of postpartum mothers in Yenagoa noted the city's decades-long history of crude-oil spills as a plausible pathway of exposure, reflecting how industrial contamination can penetrate even the most intimate scales of household and maternal health (Philip-Slaboh *et al.*, 2023) [11]. More broadly, health advocates working with former BSOEC commissioners have continued to raise concern over the long-term public-health consequences of this pollution burden in Bayelsa, particularly for communities lacking access to clean water and adequate healthcare infrastructure.

## 5.3 Socioeconomic Differentiation: Poverty as Both Cause and Consequence of Exposure

Bayelsa State's extreme poverty profile is central to understanding why its population is disproportionately exposed to, and disproportionately harmed by, both flooding and pollution. According to the National Bureau of Statistics' 2022 Multidimensional Poverty Index (MPI) survey, 88.5% of Bayelsa's population is classified as multidimensionally poor, compared with a national average of 63.0% — making Bayelsa the second-poorest state in Nigeria on this measure (NBS, 2022) [9]. Fig 4 illustrates this gap. This concentration of poverty is not incidental to the environmental burdens described above: it is both a cause of continued residence in hazard-prone waterside settlements (because such land is cheapest and most accessible to informal livelihoods such as fishing and small-scale trading) and a consequence of decades of environmental degradation that has undermined the fisheries, farmland, and clean water on which local livelihoods depend.



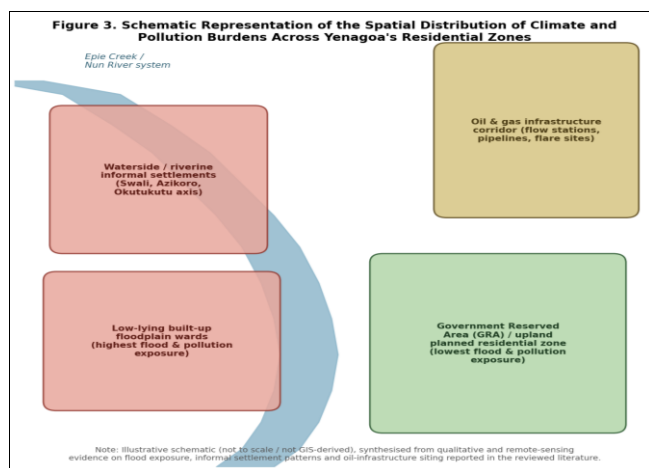
**Fig 4:** Multidimensional poverty incidence: Bayelsa State compared with the national average (2022)

This reciprocal relationship between poverty and environmental burden constitutes what the EJ literature would characterise as a structural rather than incidental injustice: it is not simply that poor households happen to live in hazardous locations, but that the political economy of oil extraction and urban land markets in Yenagoa has

systematically pushed the poorest residents into the most exposed spaces, while directing the economic benefits of oil production largely away from those same communities. Gender adds a further layer of differentiation: qualitative research with women traders in Bayelsa's riverine areas documents how climate-induced flooding disrupts trading, fishing, and farming activities that women disproportionately depend upon, while also exposing them to gender-specific risks around safety, mobility, and access to information during and after flood events.

#### 5.4 The Spatial Pattern of Burden Concentration

Synthesising the evidence reviewed above, a consistent spatial pattern emerges in Yenagoa: climate and pollution burdens are concentrated in low-lying, waterside, and informally developed settlements and in the immediate vicinity of oil and gas infrastructure, while upland, formally planned districts such as the Government Reserved Area (GRA) experience comparatively limited exposure to either hazard. Fig 5 presents this pattern schematically, drawing on the qualitative and remote-sensing evidence discussed in Sections 5.1 and 5.2 rather than on original geospatial data (see Section 7 for this limitation). The pattern is consistent with Bullard's (1990) [5] original distributive-justice thesis: environmentally hazardous conditions follow a path of least political and economic resistance, settling most heavily on communities with the fewest resources to resist, relocate, or seek remediation.



**Fig 5:** Schematic representation of the spatial distribution of climate and pollution burdens across Yenagoa's residential zones (illustrative synthesis, not a GIS-derived map)

#### 5.5 Procedural and Recognition Injustice

Beyond the distributive pattern documented above, the evidence points to significant procedural and recognition gaps in how Yenagoa's flood and pollution risks are governed. Commentary from local environmental advocates has repeatedly attributed the severity of flooding in Yenagoa to the absence of a genuinely participatory, technically grounded urban planning process: houses and roads have been permitted on floodplains and natural drainage channels, reflecting a planning process that has not meaningfully incorporated the knowledge or priorities of the communities most exposed to resulting risk. State disaster-response mechanisms have similarly been criticised as reactive rather than anticipatory, with no dedicated flood-insurance scheme, no reliable resettlement provision, and inconsistent, poorly documented distribution of post-flood

relief gaps that fall hardest on households with the least capacity to self-insure against loss.

On the pollution side, the BSOEC (2023) [4] inquiry itself represents a significant, if belated, act of recognitional justice: convened by the Bayelsa State Government with independent international scientific and legal support, it explicitly framed the state's oil pollution as amounting to "environmental genocide" and called for international oil companies to accept financial and moral responsibility, alongside the creation of a \$12 billion remediation fund. That the companies named in the report have publicly rejected the Commission's findings and calls for compensation illustrates a further procedural asymmetry: the entities with the greatest capacity to remediate harm face limited binding accountability, while affected communities who were neither meaningfully consulted in the original siting of oil infrastructure nor compensated proportionate to documented harm continue to bear the resulting health and ecological costs. This dynamic mirrors the broader environmental justice literature's finding that recognition and participation gaps tend to reinforce, rather than merely accompany, distributive inequity (Schlosberg, 2007) [12].

#### 6. Towards Equitable Distribution of Climate Burdens: Policy Directions

Addressing environmental injustice in Yenagoa requires interventions across all three dimensions of the analytical framework set out in Section 2.3, rather than technical flood-control measures alone. Table 3 summarises key policy directions organised by EJ dimension.

**Table 3:** Policy Directions for Equitable Distribution of Climate Burdens in Yenagoa, by EJ Dimension

| EJ Dimension | Policy Direction                                                                                                                                                                                                                                                                                        |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Distributive | Prioritise drainage, embankment, and floodplain-restoration investment in the identified high-exposure waterside wards rather than distributing infrastructure spend uniformly across the LGA; integrate a dedicated flood-insurance and resettlement-support scheme targeted at low-income households. |
| Distributive | Link oil-pollution remediation funding (following the BSOEC recommendations) explicitly to the communities documented as most contaminated, with independent verification of clean-up and health-monitoring outcomes.                                                                                   |
| Procedural   | Establish statutory, ward-level participatory planning forums for flood-risk and land-use decisions, ensuring waterside and informal-settlement residents have a formal, funded voice in the ongoing implementation of the Yenagoa master plan.                                                         |
| Procedural   | Create an independent, adequately resourced monitoring body — building on the BSOEC precedent — with authority to track both flood-adaptation and oil-remediation commitments and to report publicly on compliance.                                                                                     |
| Recognition  | Formally recognise oil-host and waterside communities' customary knowledge of hydrology and land use in flood-risk mapping and planning documents, rather than relying solely on top-down technical assessment.                                                                                         |
| Recognition  | Mainstream gender-differentiated vulnerability (e.g., of women traders and fisherfolk) into disaster-risk-reduction planning, consistent with Sendai Framework principles on inclusive, gender-responsive disaster governance.                                                                          |

## 7. Limitations of the Study

This paper is a synthetic, desk-based review rather than a primary empirical study, and several limitations follow from this design. First, the spatial “map” of burden distribution presented in Fig 5 is an illustrative schematic synthesised from qualitative and remote-sensing findings reported in the reviewed literature; it is not derived from original GIS analysis or ward-level census microdata, and should be read as indicative of a general pattern rather than as a precise cartographic claim. Second, poverty and flood-exposure statistics are drawn from state- and LGA-level sources; finer-grained, ward-level data which would allow a more rigorous quantitative distributive-justice analysis were not available for this review. Third, several of the flood-vulnerability and community-resilience studies synthesised here rely on household surveys of varying sample sizes and sampling frames, which may not be fully representative of the entire Yenagoa population. Future research should prioritise primary, geo-referenced household survey data linked to verified flood-extent and pollution-exposure maps, to allow a formal quantitative environmental justice index to be constructed for Yenagoa and comparable Niger Delta cities.

## 8. Conclusion

This paper has applied an environmental justice framework to examine the distribution of climate and pollution burdens in Yenagoa, Bayelsa State. The evidence reviewed shows a consistent and compounding pattern of injustice: flood exposure has nearly doubled in extent over a four-year period and is concentrated among residents of low-lying, informally built waterside settlements who lack the economic means to relocate; this climate burden is layered atop five decades of oil-industry pollution that has degraded the very ecosystems that would otherwise buffer communities against flooding; and both burdens fall most heavily on a population that is already, by national standards, extremely poor. These distributive inequities are compounded by procedural and recognitional gaps in planning processes, disaster response, and corporate accountability that leave the most exposed communities with the least voice in decisions that shape their risk. Equitable climate adaptation in Yenagoa therefore cannot be achieved through flood-control engineering alone; it requires deliberately redistributing adaptation investment toward the most exposed communities, embedding those communities' participation in planning and monitoring processes, and formally recognising the compounded historical and climatic burdens borne by the Niger Delta's oil-producing communities. As climate change intensifies rainfall variability across West Africa, the cost of failing to do so will continue to be paid disproportionately by those least responsible for, and least equipped to withstand, both the industrial and climatic transformation of their environment.

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