

The Kafue River Pollution Disaster: Examining Unequal Environmental Burdens and Environmental Justice Among Rural Communities

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Abstract: The 2025 Kafue River pollution disaster exposed significant environmental and socio-economic inequalities among rural communities dependent on the river for their livelihoods. This study examined how the disaster disproportionately distributed environmental burdens and analysed the environmental justice dimensions of distributive, procedural, and recognition inequalities experienced by affected communities. A mixed-methods convergent parallel design guided by the pragmatism paradigm was employed. Data were collected from 65 participants comprising 50 small-scale fish farmers and 15 key informants using structured questionnaires and semi-structured interviews. Quantitative data were analysed using descriptive statistics and regression analysis, while qualitative data were analysed using thematic analysis. The findings revealed substantial livelihood losses following the pollution incident, with fish production declining by 45.1%, household income by 45.3%, food security scores falling from 7.8 to 4.0, and livelihood resilience decreasing from 7.5 to 4.1. Women experienced disproportionate impacts through disrupted fish processing and marketing activities and increased household food security responsibilities. The study further established that environmental injustice was reflected in the unequal distribution of environmental burdens, weak environmental governance, limited community participation, inadequate regulatory enforcement, and insufficient recognition of vulnerable communities during response and recovery efforts. The study concludes that the Kafue River pollution disaster disproportionately affected rural livelihoods while exposing significant distributive, procedural, and recognition injustices. It recommends strengthening environmental regulation and monitoring, enhancing community participation in environmental governance, establishing transparent compensation mechanisms, and implementing livelihood restoration programmes to promote environmental justice and improve resilience among vulnerable rural communities.

Keywords: Kafue River Pollution, Environmental Justice, Distributive Justice, Rural Livelihoods, Environmental Governance.

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I. INTRODUCTION

In February 2025 Zambia was hit by what come to be appreciated as the worst environmental disaster in the country's history. The collapse of the tellings dam operated by Sino Leach Metal Ltd released approximately 50 million tonnes of acidic, heavy metal effluent into the Mwambashi Stream contaminated more than 150 kilometres of the Kafue River system (AP, 2025). This industrial leak led to near-total fish mortality, disrupted water supply for over 700,000 residents in Kitwe, and placed at risk the health and livelihoods of an estimated 12 million people who depend on the Kafue River basin (Zimba, 2025).

The Kafue River pollution disaster exposed clear dissimilarities in the share of environmental risks that come with this level of environmental damage and the socio-economic costs suffered by rural communities relying on the sanctity of the waterways. The contamination was caused by

a multinational Chinese firm, yet the catastrophic consequences were borne by small scale rural fish farmers in the Kalulushi-Kitwe corridor, whose livelihoods depend directly on clean and accessible water resources (Kambole, 2025). While Sino Metal could cover its losses and return to normal operations in double quick time, for the farmers it was different who lost entire stock in their ponds because of widespread fish mortality compounded by loss of income, food insecurity, and disruption of local fish markets, demonstrating that environmental harm is not experienced equally across society (MOFL, 2025).

This disaster in everyway illustrates key facets of environmental justice which emphasises a fair share of both environment benefits and its ills, it also advocates for participation in environmental decision-making, and accountability for environmental harm (United Nations, 2019; IERE, 2025). The had hit less privileged aquaculture farmers contributed close to nothing to the historic pollution,

yet experienced the most severe environmental, economic, and social consequences. The disproportionate impact was worsened by slow and weak institutional response, questionable environmental governance and inadequate compensation mechanisms, which increased the vulnerability of already marginalised communities (Maulu & Hasimuna, 2024; Hasimuna, 2023).

Environmental injustice question here goes beyond the immediate damage to the environment as well as the livelihoods. The issue touches on the long-term contamination that could be present for the decades threatens the future of these communities and the ecology and biodiversity of the region beyond Kululushi and Kitwe rural. The aquaculture industry in the area lead to the loss of stock and interest leaving women who trade in fish to loss of income and jobs were lost creating intergenerational challenges for rural youth, thereby reinforcing existing socio-economic disparities (Galappaththi et al., 2020; Maulu & Hasimuna, 2024). These outcomes illustrate how environmental disasters can deepen existing inequalities when vulnerable populations lack the institutional, financial, and adaptive capacity to recover.

This study examined how the Kafue River pollution disaster disproportionately affected rural communities by analysing the unequal distribution of environmental burdens, institutional responses, and the recognition of affected communities' rights and livelihoods through the environmental justice framework, with the aim of informing more equitable environmental governance and policy.

➤ *Statement of the Problem*

The failure of the tailings dam and subsequent spillage of more than 50 million tonnes of acidic and heavy metal-contaminated from Sino Metal into local streams and eventually the Kafue River destroyed fish stocks and poisoned water and severely degraded the ecosystem, severely affecting communities with limited capacity to recover (AP, 2025). The brunt of the consequences as already seen were the underprivileged communities of small-scale fish farmers and other rural households that contributed least to the environmental degradation (Zimba, 2025).

The environmental justice alarms are all to clear with the distribution of environmental risks in this instance stacked at the doors of the poor. This is heightened by risks, weak regulatory enforcement, delayed institutional responses, and inadequate recognition and protection of affected communities.

Despite the consequences of the pollution of Kafue River and its tributaries in the area have been acknowledged by Sino Metals, Government and many international and local NGOs, there has been little to no empirical research done on to examine how these impacts were unequally distributed through the distributive, procedural, and recognition dimensions of environmental justice. This knowledge gap limits the development of equitable environmental governance and effective policy responses capable of protecting vulnerable rural communities from future industrial pollution disasters. This study therefore seeks to examine how the Kafue River pollution disaster created unequal environmental burdens for rural communities and to explore the environmental justice dimensions underpinning these disparities.

➤ *Research Objectives*

- To examine how the pollution disaster has created unequal environmental burdens among rural communities.
- To explore the environmental justice dimensions of the disparities created by the pollution disaster among rural communities.

II. LITSERATURE REVIEW

➤ *Theoretical Framework*

• *Environmental Justice Framework*

The Environmental Justice Framework serves as the primary theoretical framework for this study. The framework explains how environmental risks, benefits, and decision-making processes are distributed across different social groups, with particular emphasis on distributive, procedural, and recognition justice (Schlosberg, 2007; United Nations, 2019).

Table 1 Environmental Justice Framework

Framework Component	Description in the Context of the Study	Indicators/Variables
Distributive Justice	Examines whether environmental burdens and benefits are distributed fairly among communities.	• Fish mortality • Water contamination • Loss of livelihoods • Household income losses
Procedural Justice	Assesses the fairness and inclusiveness of environmental governance and decision-making processes.	• Regulatory enforcement • Institutional response • Community participation • Compensation mechanisms
Recognition Justice	Examines whether affected communities' rights, livelihoods, and vulnerabilities are acknowledged in environmental governance.	• Recognition of rural livelihoods • Protection of vulnerable groups • Corporate accountability • Policy responsiveness

Source: Adapted from Schlosberg (2007) and United Nations (2019).

The Environmental Justice Framework provides the principal lens for examining how the Kafue River pollution disaster disproportionately transferred environmental burdens to rural communities that contributed least to the pollution. It explains how unequal exposure to environmental harm, weaknesses in environmental governance, and inadequate recognition of vulnerable communities collectively produce environmental injustice. The framework directly addresses the study objective by analysing the distributive, procedural, and recognition dimensions of the

pollution disaster and their implications for equitable environmental governance.

• *Analytical Framework: DPSIR Framework*

The DPSIR (Drivers–Pressures–State–Impact–Response) Framework provides the analytical structure for explaining the sequence of events surrounding the Kafue River pollution disaster.

Table 2 Analytical Framework: DPSIR Framework

DPSIR Component	Description	Indicators
Drivers	Industrial mining activities	• Mining operations
Pressures	Toxic effluent discharge	• Acidic and heavy metal pollution
State	Environmental degradation	• Water contamination • Fish mortality
Impacts	Environmental and socio-economic consequences	• Livelihood losses • Environmental injustice • Food insecurity
Responses	Government and institutional interventions	• Regulatory action • Environmental monitoring • Compensation • Policy reforms

Source: Adapted from the European Environment Agency (1999).

The DPSIR Framework complements the study by systematically linking industrial activities to environmental degradation, the unequal burdens experienced by rural communities, and the institutional responses that influence environmental justice outcomes.

➤ *Empirical Review*

• *Examining how the Pollution Disaster Has Created Unequal Environmental Burdens for Rural Communities*

History has shown that there never equality in the dispersal of effects of environmental pollution among members of society. Rural communities more often than not get the bulk of environmental risk. Across the globe, environmental disparity is closely linked to industrial growth, extractive industry, and weak environmental governance, which frequently expose poor and politically marginalised populations to pollution while wealthier groups enjoy the associated economic benefits (Agyeman, 2013). Many academics of environmental justice argue that these discrepancies are as a result of governance systems that fail to adequately protect vulnerable populations from environmental harm (Martínez-Alier, 2016). Consequently, environmental degradation extends beyond ecological damage to become a livelihood and development challenge, particularly in developing countries where communities rely directly on natural resources for survival (United Nations, 2019; UN-Habitat, 2020).

Aquaculture is incredibly dependant on the quality to sustain fish production consistently and rural livelihoods. Historical evidence from the Kafue River Basin demonstrated that heavy metal contamination adversely affects fish reproduction, aquatic biodiversity, and marketability through

bioaccumulation, thereby threatening both food security and household income (Mwase, 1998). Recent articles on the have shown that aquaculture systems are increasingly endangered by increasing levels of environmental degradation and demand practices proficient enough to weather pollution and ecological stressors (Abisha et al., 2022). These findings suggest that environmental pollution has consequences that extend beyond ecological deterioration to undermine the socio-economic wellbeing of communities whose livelihoods depend on healthy aquatic ecosystems.

The Kafue River contamination of February, 2025 embodies broader patterns of environmental disparity. Zulu (2025) shows that more than 200 small fish farmers were robbed of their primary source of income as a result of the contamination from the acid and heavy metal discharge from Sino Leach Metal. Maulu et al. (2024) further charged that small-scale aquaculture producers in Zambia are at the mercy of their diminished adaptivity capacity, dependence on natural water systems, and weak institutional support. Additionally, women down the value chain who process and market fish also experienced disproportionate livelihood losses, while persistent contamination poses long-term risks to future generations through reduced employment opportunities, declining food security, and weakened livelihood resilience (Galappaththi et al., 2020; Maulu et al., 2024). Collectively, the literature demonstrates that industrial pollution creates unequal environmental burdens that reinforce existing socio-economic inequalities within rural communities.

- *Explore the Environmental Justice Dimensions of the Disparities Resulting from Environmental Disasters*

How environmental pressures are felt by different sides of the economic divide and how bureaucratic processes effect of the community is explained by Environmental Justice. Distributive justice, procedural justice and recognition justice are the key to modern environmental justice theory (Schlosberg, 2013). Distributive justice focuses on the fairness of environmental risk allocation, procedural justice examines the inclusiveness and transparency of environmental decision-making, while recognition justice considers whether vulnerable communities and their livelihoods are acknowledged and protected within governance systems (Schlosberg, 2013). These put together these dimensions help to explain why environmental disasters usually produce uneven outcomes within the same ecological settings.

Evidence from around the show that weak environmental governance often worsens environmental injustice. Across Latin America, Asia, and Africa, studies have shown that inadequate regulatory oversight, limited public participation, and strong corporate influence allow the environmental costs of industrial development to be transferred to vulnerable communities, while the economic benefits accrue elsewhere (Martínez-Alier, 2016). The United Nations (2019) similarly argues that environmental degradation undermines fundamental human rights, including the rights to health, food, water, and sustainable development, thereby linking environmental justice directly to broader social justice concerns.

The evidence in Zambia is not too dissimilar of the patterns relevant on the global stage. Kambole (2003) also made not of historically persistent weaknesses in Zambia's environmental regulations which extends to insufficient water quality monitoring and management, poor enforcement apparatus and non-existent community participation environmental management.

The deficiencies were brought to the fore during the Kafue River Pollution disaster which saw the culprit Sino Leach Metals taking charge of the immediate environmental assessment. This raised serious concerns regarding transparency, accountability and a clear conflict of interest. Policy analyses following the disaster have therefore emphasised the need for stronger regulatory independence, improved environmental monitoring systems, and greater community participation in environmental governance to enhance environmental accountability and safeguard rural livelihoods.

➤ *Research Gap*

Despite increasing recognition of the socio-economic consequences of industrial pollution, there remains limited empirical research examining the Kafue River pollution disaster through the integrated lens of distributive, procedural, and recognition justice. Existing studies primarily document ecological damage, fish mortality, or livelihood losses but pay comparatively little attention to how governance processes, institutional responses, and the recognition of vulnerable communities collectively shaped the unequal environmental burdens experienced by rural households. This knowledge gap limits understanding of the broader environmental justice implications of the disaster and constrains the development of equitable environmental governance frameworks. The present study addresses this gap by examining how the Kafue River pollution disaster disproportionately affected rural communities while analysing the distributive, procedural, and recognition dimensions of environmental justice underpinning these disparities.

III. METHODOLOGY

This chapter outlines the methodology used to investigate the environmental justice implications of the 2025 Kafue River pollution disaster on small-scale fish farmers in the Chambishi–Kitwe Corridor. It describes the research design, study area, target population, sampling procedures, data collection instruments, data analysis techniques, and ethical considerations.

➤ *Research Design*

This study employed both qualitative and quantitative research principles in its mixed-methods convergent approach, the paradigm selected was pragmatic research paradigm. The marriage of qualitative and quantitative data helped to gather data on income disruption and qualitative information the live experience of the affected small-scale farmers. This approach enabled the simultaneous collection and integration of quantitative and qualitative data to provide a comprehensive understanding of the effects of pollution and climate variability on rural livelihoods.

➤ *Study Area*

The study was conducted area along the Kafue and Mwembeshi rivers in Kalulushi and Kitwe districts of the Copperbelt. The Chambishi–Kitwe Corridor of Copperbelt Province was idea as it contained some of the worst affected fish farmers along the road as well as presence of key informants working with these communities.

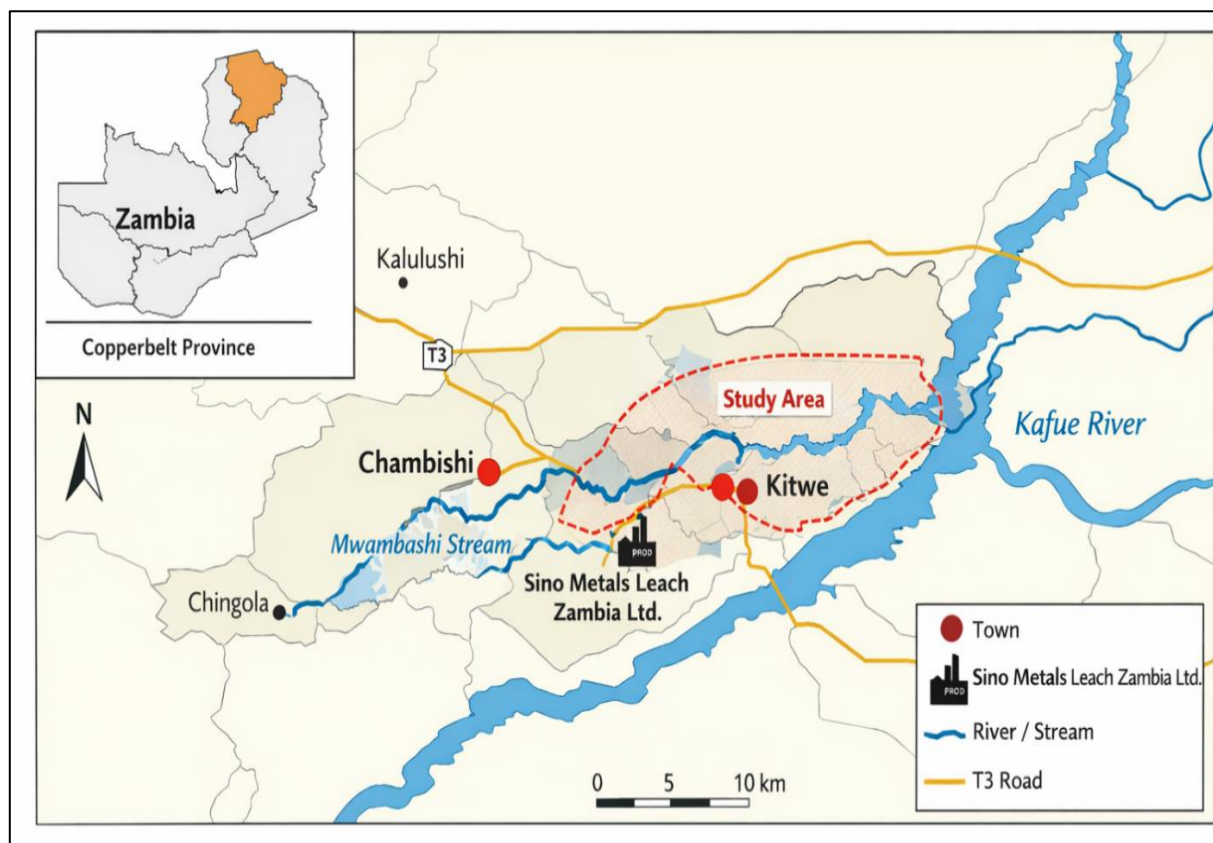


Fig 1 Location of Study Area in the Chambishi-Kitwe Corridor, Copperbelt Province, Zambia

➤ Target Population

The target population comprised 65 participants, including 50 small-scale fish farmers, 5 community leaders, 3 agricultural extension officers, 4 government officials, and 3 representatives from environmental NGOs. These participants were selected because they possessed direct knowledge and experience of the pollution disaster and its effects on livelihoods and environmental governance.

➤ Sampling and Sample Size

The study employed purposive and convenience sampling to select all 65 participants, comprising 50 fish farmers for the survey and 15 key informants for interviews. The sample was considered adequate because it represented the major stakeholders affected by the pollution disaster while providing sufficient data for statistical analysis and qualitative saturation.

➤ Data Collection Instruments and Procedures

Data were collected using structured questionnaires for small-scale fish farmers and semi-structured interview guides for key informants, supported by a review of relevant government reports, policy documents, and published literature. These instruments generated quantitative and qualitative data on pollution impacts, climate variability, environmental justice, governance, and rural livelihoods.

➤ Data Analysis

Quantitative data were analysed using SPSS and Microsoft Excel through descriptive statistics and regression analysis to determine the effects of pollution and climate

variability on rural livelihoods. Qualitative data were analysed using thematic analysis, and the findings were integrated with quantitative results to provide a comprehensive interpretation of the study.

➤ Ethical Considerations

The study observed ethical principles of informed consent, confidentiality, anonymity, and voluntary participation to protect the rights and welfare of all participants. Participants were informed of the study's purpose, assured that their information would be used solely for academic purposes, and allowed to withdraw from the study at any stage without penalty.

IV. DATA PRESENTATION

➤ Examining how the Pollution Disaster has Created Unequal Environmental Burdens Among Rural Communities

• Sustainable Livelihoods Framework (SLF) Analysis

The Sustainable Livelihoods Framework (SLF) helps to understand how pollution affected the livelihood assets and created unequal environmental burdens for communities along the Mwambashi-Kafue River corridor. It has been determined that the spill in February 2025 caused considerable damage including widespread fish mortality, contamination of water sources, and disruption of aquaculture activities, thereby affecting natural, financial, human, social, and physical capital among rural households.

- *Environmental Stressors*

Table 3 Environmental Stressors

Pollution Exposure Index (POLL)	Frequency	Percentage (%)
7	14	28.0
8	17	34.0
9	12	24.0
10	7	14.0
Total	50	100.0
Mean POLL Score	8.24	

Source: Researcher Compilation

The findings indicate that respondents experienced relatively high levels of pollution exposure. The largest proportion of respondents (34%, n = 17) reported a pollution exposure score of 8, followed by 28% (n = 14) who reported a score of 7. Respondents reporting severe pollution exposure

levels of 9 and 10 accounted for 24% (n = 12) and 14% (n = 7), respectively. The mean pollution exposure score of 8.24 suggests that most fish farmers were exposed to substantial pollution-related impacts following the Kafue River contamination incident.

- *Livelihood Outcomes*

Table 4 Fish Production Before and After the Kafue River Pollution Incident

Indicator	Before Pollution (kg)	After Pollution (kg)	Change (kg)
Mean Fish Production	945	519	-426
Minimum	600	315	-285
Maximum	1,250	720	-530

Source: Researcher Compilation

The findings indicate that average fish production declined from approximately 945 kg before the pollution incident to 519 kg after the incident, representing a reduction of 426 kg, equivalent to a 45.1% decrease. This substantial decline suggests that the pollution event severely disrupted

aquaculture production through fish mortality, deterioration in water quality, and reduced productivity of fish ponds. The findings support reports in the study area that fish stocks were significantly affected following the contamination of the Kafue River.

- *Household Income Before and After the Kafue River Pollution Incident (n = 50)*

Table 5 Household Income Before and After the Kafue River Pollution Incident (n = 50)

Indicator	Before Pollution (ZMW)	After Pollution (ZMW)	Change (ZMW)
Mean Annual Income	29,800	16,300	-13,500
Minimum	19,500	10,800	-8,700
Maximum	39,000	21,500	-17,500

Source: Researcher Compilation

The results show that average annual household income decreased from approximately ZMW 29,800 before pollution to ZMW 16,300 after pollution, representing a decline of 45.3%. The reduction in income reflects the direct

dependence of many households on fish farming as a primary source of livelihood. As fish production declined, household earnings also fell substantially, increasing economic vulnerability among affected communities.

- *Household Food Security Before and After the Kafue River Pollution Incident*

Table 6 Household Food Security Before and After the Kafue River Pollution Incident

Food Security Score (1–10)	Before Pollution	After Pollution	Difference
Mean Score	7.8	4.0	-3.8

Source: Researcher Compilation

The mean food security score declined from 7.8 before the pollution incident to 4.0 after the incident, indicating a substantial deterioration in household access to food. The reduction suggests that lower fish production and declining

incomes negatively affected the ability of households to secure adequate food supplies, thereby increasing food insecurity within the study area.

- *Livelihood Resilience Before and After the Kafue River Pollution Incident*

Table 7 Livelihood Resilience Before and After the Kafue River Pollution Incident

Resilience Score (1–10)	Before Pollution	After Pollution	Difference
<i>Mean Score</i>	7.5	4.1	-3.4

Source: Researcher Compilation

The findings indicate that average livelihood resilience declined from 7.5 before pollution to 4.1 after pollution. This decline suggests that the disaster weakened households' capacity to absorb shocks, adapt to changing conditions, and recover from livelihood disruptions. Reduced savings, limited alternative income sources, and inadequate institutional support may have contributed to the observed reduction in resilience.

➤ *Exploring the Environmental Justice Dimensions of the Disparities Created by the Pollution Disaster Among Rural Communities*

- *Environmental Justice Analysis*

The results of the study show clear indicators of environmental injustice. As already show the damage was caused by industrial scale pollution from a mining firm while the most affected are rural communities that contributed little to environmental degradation.

The thesis identifies this as a classic environmental justice problem where vulnerable communities bear disproportionate environmental burdens.

- *Economic Burdens*

Table 8 Economic Burdens

Indicator	Frequency	Percentage (%)
<i>Married and supporting family households</i>	34	68.0
<i>Primarily dependent on fish farming income</i>	21	42.0
<i>Operated only 1–2 fish ponds</i>	24	48.0
<i>Reported relatively low food security scores</i>	23	46.0

Source: Researcher Compilation

The findings indicate that 34 respondents (68%) were married and responsible for supporting family households, suggesting that any disruption to livelihoods would have implications not only for individuals but also for household dependents. Furthermore, 21 respondents (42%) reported that fish farming was their primary source of income, highlighting the sector's importance for household economic well-being.

The results also show that 24 respondents (48%) operated only one to two fish ponds, reflecting the small-scale nature of fish farming activities among many respondents. Such limited production capacity may reduce the ability of farmers to absorb environmental and economic shocks. Additionally, 23 respondents (46%) reported relatively low food security scores, indicating challenges in accessing sufficient and stable food supplies.

- *Gendered Burdens*

Table 9 Gendered Burdens

Indicator	Frequency	Percentage (%)
<i>Female respondents</i>	18	36.0
<i>Male respondents</i>	32	64.0
<i>Women experiencing direct income losses from fish processing and marketing disruptions</i>	15	30.0
<i>Women reporting increased household food security responsibilities</i>	16	32.0

Source: Researcher Compilation

The demographic findings indicate that 18 respondents (36%) were female, while 32 respondents (64%) were male. Although women constituted a smaller proportion of the sample, the study findings suggest that they were disproportionately affected by the pollution incident due to their significant involvement in fish processing, trading, and household food provisioning activities.

The results further indicate that 15 respondents (30%) reported that women experienced direct income losses resulting from reduced fish availability, declining fish sales, and diminished consumer confidence in fish products following the pollution incident. In addition, 16 respondents (32%) indicated that women faced increased household food security responsibilities, as they were often responsible for ensuring that households had access to sufficient food despite declining income and fish production.

These findings highlight the gendered dimensions of environmental disasters. Women not only suffered economic losses through disrupted fish-related activities but also bore additional burdens associated with maintaining household welfare and food security. Consequently, the Kafue River pollution incident appears to have exacerbated existing socio-

economic vulnerabilities among women in affected fishing communities.

- *DPSIR Integrated Analysis*

The DPSIR framework allows the three objectives to be synthesised into one coherent explanation.

Table 10 DPSIR Integrated Analysis

DPSIR Component	Findings
<i>Drivers</i>	Mining activities and increasing climate variability
<i>Pressures</i>	Acidic mine effluent, heavy metal contamination, extreme weather events
<i>State</i>	Reduced water quality, fish mortality, ecosystem degradation
<i>Impacts</i>	Reduced fish production, income losses, food insecurity, social inequalities
<i>Responses</i>	Government intervention, regulatory action, community coping strategies

The evidence suggests that industrial mining activities combined with climate variability generated environmental pressures that severely degraded the ecological condition of the Kafue River. This degradation resulted in widespread fish mortality and reduced aquaculture productivity. The resulting livelihood losses disproportionately affected small-scale fish farmers, particularly women, poorer households, and communities with limited adaptive capacity. Governance weaknesses further amplified these impacts by delaying effective responses and limiting community participation in environmental decision-making.

V. DISCUSSIONS

➤ *To Examine How the Pollution Disaster has Created Unequal Environmental Burdens Among Rural Communities*

The findings show that the damage caused by the Kafue River Pollution disaster disproportionately affected rural communities' households whose livelihoods depended on the river. Fish production declined by 45.1%, household income by 45.3%, food security scores fell from 7.8 to 4.0, and livelihood resilience decreased from 7.5 to 4.1 following the pollution incident. Furthermore, 42% of respondents depended primarily on fish farming, while 68% supported family households, indicating that the impacts of the disaster extended beyond environmental degradation to affect household welfare, economic security, and community resilience. Women also experienced greater burdens through disruptions in fish processing and marketing activities and increased responsibility for household food security. Collectively, these findings demonstrate that the pollution disaster did not affect all rural communities equally but imposed greater environmental, economic, and social burdens on the most resource-dependent and vulnerable households.

These findings are consistent with studies showing that industrial pollution disproportionately affects economically marginalised communities that depend directly on natural resources for their livelihoods (Agyeman, 2013; United Nations, 2019). They also agree with Mwase (1998), who found that heavy metal contamination in the Kafue River reduced fish productivity and threatened household food security. Likewise, Zulu (2025) and Maulu et al. (2024) reported that the 2025 Kafue River pollution disaster severely

affected small-scale fish farmers because of their dependence on natural water systems and limited adaptive capacity. The gender disparities identified in this study further support Galappaththi et al. (2020), who observed that environmental disasters disproportionately affect women through disruptions in fisheries value chains and increased household responsibilities. Unlike previous studies that primarily described environmental degradation, this study quantifies the unequal environmental burdens experienced by affected rural households, thereby providing stronger empirical evidence of the socio-economic consequences of industrial pollution.

The findings support the Environmental Justice Framework (Schlosberg, 2007), particularly the principle of distributive justice, which explains how environmental harms are often borne disproportionately by socially and economically vulnerable populations. They also align with the DPSIR Framework by demonstrating that industrial mining activities (drivers) generated pollution pressures that degraded environmental conditions, resulting in fish mortality, declining livelihoods, food insecurity, and widening socio-economic inequalities. The findings therefore demonstrate that pollution disasters create unequal environmental burdens that extend beyond ecological damage to undermine sustainable rural livelihoods and community wellbeing.

➤ *To Explore the Environmental Justice Dimensions of the Disparities Created by the Pollution Disaster Among Rural Communities*

The findings reveal that the disparities created by the Kafue River pollution disaster are best understood through the three dimensions of environmental justice: distributive, procedural, and recognition justice. From a distributive justice perspective, rural communities experienced the greatest environmental and economic losses despite contributing little to the pollution. Procedural justice concerns were evident through weak environmental monitoring, inadequate regulatory enforcement, limited community participation, poor transparency, and insufficient compensation mechanisms during the disaster response. Recognition justice was reflected in the inadequate acknowledgement and protection of women, small-scale fish farmers, and other vulnerable households despite their

bearing the greatest livelihood losses. These findings suggest that institutional and governance failures intensified the disparities created by the pollution disaster.

These findings agree with Schlosberg (2013), who argues that environmental justice extends beyond unequal exposure to environmental hazards and encompasses fair participation in environmental decision-making and recognition of vulnerable communities within governance systems. Similarly, Martínez-Alier (2016) observed that weak environmental institutions frequently shift the environmental costs of industrial development to politically and economically marginalised communities while the associated economic benefits accrue elsewhere. The findings also support Kambole (2003), who identified longstanding weaknesses in Zambia's environmental governance, including inadequate environmental monitoring, limited community participation, and weak regulatory enforcement. However, while earlier studies largely concentrated on ecological damage or governance shortcomings independently, this study integrates distributive, procedural, and recognition justice into a single analytical framework, thereby providing a more comprehensive understanding of how environmental injustice emerged following the pollution disaster.

The findings strongly validate the Environmental Justice Framework by demonstrating that distributive, procedural, and recognition injustices operate simultaneously to shape environmental outcomes. Similarly, the DPSIR Framework explains how inadequate institutional responses failed to interrupt the progression from pollution pressures to severe social and livelihood impacts, thereby reinforcing environmental injustice. The study therefore demonstrates that addressing the disparities created by pollution disasters requires more than pollution control; it requires equitable governance characterised by transparent decision-making, meaningful community participation, effective regulatory enforcement, fair compensation mechanisms, and explicit recognition of vulnerable rural communities within environmental policy and disaster response systems.

VI. CONCLUSION AND RECOMMENDATIONS

➤ Conclusion

The study concludes that the 2025 Kafue River pollution disaster disproportionately transferred environmental, economic, and social burdens to rural communities dependent on the Kafue River for their livelihoods. The findings further demonstrate that distributive, procedural, and recognition injustices, characterised by unequal livelihood losses, weak institutional responses, limited community participation, and inadequate recognition of vulnerable groups, exacerbated the impacts of the disaster, highlighting the need for more equitable environmental governance.

➤ Recommendations

Government should strengthen environmental monitoring and enforcement to prevent future industrial

pollution and ensure compliance with environmental regulations.

Environmental governance should promote meaningful participation of affected rural communities in environmental decision-making, disaster response, and recovery planning.

Transparent and equitable compensation mechanisms should be established to support small-scale fish farmers and other households affected by environmental pollution.

Targeted livelihood restoration programmes, including financial assistance and support for alternative income-generating activities, should be implemented to improve community resilience.

Environmental policies should explicitly recognise and protect vulnerable groups, particularly women and resource-dependent rural households, to promote environmental justice and sustainable livelihoods.

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