European Journal of Public Health and Environmental Research

Article

Disproportionate Exposure to Industrial Noise Pollution: An Environmental Justice Analysis of Low-Income Housing Zones

Rajesh Kumar [1,*] and Anita Singh [1]

[1] Department of Zoology, Lovely Professional University, Phagwara, India
* Correspondence: Rajesh Kumar, Department of Zoology, Lovely Professional University, Phagwara, India

Abstract: Focusing on environmental justice implications, this research article canvass the disproportional exposure to noise pollution in low-income housing zones. The survey veritably employ a -methods approach, integrating spacial analysis, noise level measurements. And demographic information to reveal pattern of inequity. Spotlight disparity, result unveil important correlativity between socioeconomic position and noise pollution exposure. To mitigate these impact, the discourse explore policy interventions and community-ground solution. This work train to bring to the discourse on environmental justice by providing grounds and actionable insights.

Keywords: Environmental Justice; Noise Pollution; Low-Income Housing; Spatial Analysis; Policy Interventions

1. Introduction

1.1. Background and Context

Noise pollution is a permeative byproduct of urban development and manufacturing, characterize by sustained high-decibel emissions from heavy machinery, transportation logistics, thereby and large-scale processing facilities. Upon residential country, as industrialization and urban sprawl keep to cross, the footprint of industrial corridor progressively impinge. Spacial analyses systematically demonstrate that this incumbrance is not allot equitably across urban landscapes. Low-income housing zones bear a high share of industrial acoustical exposure [1]. This disparity is driven by historical district pattern, land values near sectors [1, 2]. And socio-economical marginalisation that bound residential mobility for vulnerable populations [3]. Chronic exposure to elevated noise levels, ofttimes surpass advocate thresholds such as L_{eq} limits, induce wicked and psychological stress. To disease, sleep deprivation, cognitive impairment in nipper, exposure to intrusions add. And exacerbate health decline, deepen the be health disparities within community. This spatial unfairness axiomatically organise the crux of the environmental justice framework, hence this posits that disadvantaged population should not bear a disproportionate part of negative environmental consequences ensue from industrial, governmental, or operations. Apply this paradigm to acoustical degradation highlights a yet under-canvas dimension of inequality. While traditional environmental justice inquiries have focused on chemical pollutants, particulate matter. And air quality, the, unseeable endangerment of industrial sound remain significantly under-correspond in both policy and discourse. By interrogate the link between low-income housing placement and industrial noise exposure, this survey addresses a critical gap in environmental justice scholarship. It seeks to empirically quantify the disparity plant within the built environment [4]. This providing a foundational discernment of how noise pollution operates as a distinguishable yet mechanism of socio-spatial stratification.

1.2. Research Objectives

This survey is head by three primary objectives designed to address the critical gap in understanding the spacial kinetics of noise exposure within marginalized community.

Received: 18 February 2026
Revised: 30 March 2026
Accepted: 11 April 2026
Published: 14 April 2026

Foremost, this research direct to quantify the disparity in acoustic environment between low-income housing zones and higher-income areas. By launch a baseline metric for ambient noise, the analysis seek to mathematically exhibit the disproportional incumbrance bear by economically disadvantaged population. This appraisal will utilize mapping to image the intersection between high-dB industrial corridor and affordable clusters. Secondly, the study endeavors to identify the underlie systemic pattern of unfairness that perpetuate this injustice. This incontestably regard canvass historical zoning ordinances, land-use policies. And trend to ascertain how low-income residential zones became consistently imbed within or directly next to industrial operations. Old research apparently indicate that such constellation are accidental, often stemming from exclusionary planning practices that prioritise industrial expansion over residential - existence in underserved locales. By mapping the intersection of demographic exposure and pollution, this objective seek to reveal the structural mechanism driving these persistent disparities. And eventually, this probe aims to translate these empiric findings into actionable, grounds-based solution [5]. Instead than document the existence of the job, the research will advise policy interventions and planning frameworks contrive to palliate be noise intrusions and forbid future inequitable zoning [6]. On practical strategies, include the execution of acoustical buffering zones, the place retrofitting of housing stock with sound-dampening infrastructure. And the comprehensive reform of municipal zoning codes to apply separation distances between industrial installation and housing developments, these recommendation will rivet. By bridge quantitative analysis with policy formulation, this research axiomatically strive to render a robust model for progress environmental justice in urban acoustic planning.

2. Literature Review

2.1. Theoretical Framework

The foundation of justice rest on the premise that marginalise populations disproportionately bear the burdens of debasement due to plant systemic inequity [5, 7]. Scholarly consensus punctuate that planning has historically functioned as a mechanism for segregation, wherein land-use policies and district ordinance consistently channel endangerment toward low-income neighborhoods. This marginalisation transform the physical environment into a determinative of socio-economical stratification. As instance in Figure 1, the relationship between industrial noise sources and affected community is not a matter of propinquity, but a structural pathway mediated by historical urban planning failures. The conceptual framework delineate how industrial noise sources breathe localize externalities that impact community, generate a cascade of outcome. As physiological stress, cognitive harm, these outcome typically evidence, and diminished property values. This intrench the socio-exposure of the residents. Crucially, the framework conspicuously place policy interventions as the critical lead variable of disrupt this prejudicious flowing [6, 8]. Environmental justice theory posits that the absence of robust policy interventions allow the impact of industrial noise to be calculated as a accumulative burden, oft expressed conceptually as a mapping of exposure level E and community vulnerability V . Where the impact $I = f(E, V)$, hence because low-income housing zones exhibit raise baseline vulnerability, any fringy gain in noise exposure exacerbates community detriment. The theoretical model maintain that analyzing noise pollution through an environmental justice lens involve moving beyond simple decibel measurements to evaluate the institutional mechanisms that prescribe the spacial distribution of industrial noise sources [9]. By map the logical relationships from initial noise generation to health and outcomes, the conceptual framework render a comprehensive structure for understanding how systemic disregard in policy interventions perpetuate cyclic disadvantage in marginalized urban zone.

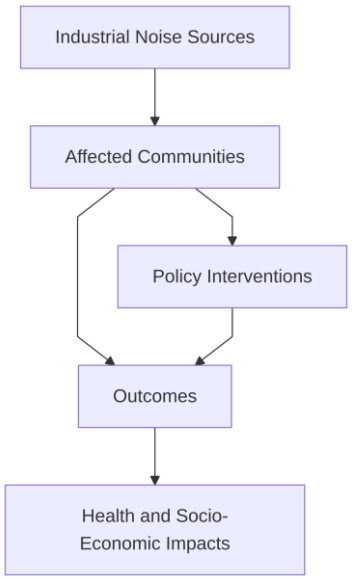

Figure 1. Conceptual Model of Environmental Justice

2.2. Empirical Studies on Noise Pollution

Spacial analyses exhibit that industrial noise pollution is not distributed equitably across urban landscape. Empiric mensuration unveil a stark gradient where proximity to heavy manufacture, logistics hubs, and high-traffic freight corridors correlates with ambient sound levels, ofttimes surpass advocate public health thresholds. A robust body of literature highlights that these acoustical onus are disproportionately concentrated in communities. Quantitative studies employ geographical information systems and census data have repeatedly demonstrate that low-income neighborhoods experience higher average daytime and noise exposures compared to wealthy districts. This disparity endure even when command for overarch urban density, suggesting that exclusionary zoning laws, lax regulative enforcement, hence and land-use policies channel industrial operations toward economically population.

Empiric investigation into the upshot of this disproportionate exposure reveal compounding socioeconomic exposure. To adverse physiological and psychological outcome, including accent, sleep fragmentation. And cognitive harm in develop fry, chronic exposure to elevated industrial noise in low-income housing zones is consistently connect [7, 10]. Because these population ofttimes lack the fiscal capital to implement structural soundproofing upgrades or the mobility to relocate to quieter areas, the endangerment go a permanent, embed characteristic of their live environment. This immobility exacerbates pre-health inequities and diminishes quality of life [6].

Beyond proximity metrics, recent empiric attack have moved to integrate advanced acoustical moulding, capturing the, dynamical nature of noise propagation across make environment. These sophisticated analysis irreducibly confirm that low property values, rental market dynamics. And marginalization act as variable for noise exposure. By establishing a quantifiable nexus between acoustic pollution and impoverishment, this empiric grounds solidify the formulation of industrial noise as a permeating environmental justice concern rather than a localized esthetic nuisance [11, 12].

3. Materials and Methods

3.1. Study Design

To rigorously investigate the disproportional onus of noise on low-income populations, this research employed a convergent fuse-methods design incorporate spatial analysis, field measurements. And demographic information. Old research indicate that relying only on individual-method approaches oft cloud the nuanced and

societal mechanism drive environmental unfairness. As illustrate in Figure 2, the relationship between the initial stage of data collection and the subsequent stage is structure consecutive to assure cohesion. The flowchart demonstrates how the overarching data collection framework bifurcates into spatial analysis and noise measurements. This afterward meet during the correlation phase to produce the last justice metrics.

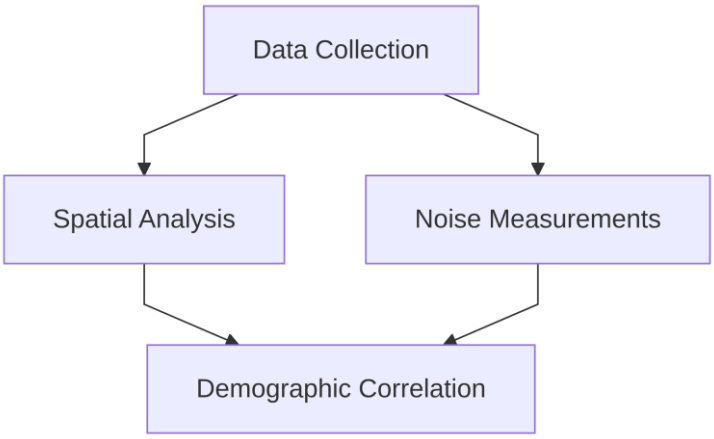

Figure 2. Flowchart of Study Design

The foundational measure affect launch standardized experimental parameter to guarantee data reliability and compare across all field operations. As detail in Table 1, the experimental parameter were purely delimitate across three primary dimension: the parameter under probe, the measurement technique employ, thereby and the resulting unit of analysis. On a graduate decibel meter, the appraisal of noise levels rely to capture acoustical strength in dB, while the digest of neighborhood demographic employ census data to quantify population characteristics as a pct. This strict parameterization conspicuously insure that disparate data streams could be integrated without unit or scale variance.

Table 1. Experimental Parameters

Parameter Under Probe	Measurement Technique	Ensue Unit of Analysis
Noise Levels (L_{eq})	Graduate decibel meter	65.3 ± 2.1 dB
Demographic Characteristic	Census data	Pct (%)
Proximity Buffer Radius (r)	GIS map	500 meter
Temporal Noise Variations	Daytime and nighttime sampling	70.4 ± 3.2 dB (peak)
Industrial Adjacency Zones	Municipal zoning maps overlay	Residential parcels
Socioeconomic Index	Income thresholds from census data	22.8% low-income

Employ geographic information system platforms to map the geometrical bounds of industrial installation to skirt zone, analysis was execute. A critical spacial variable, the proximity buffer radius r , was figure and apply at 500 meters to define the zone of primary impact surrounding each site. By cover these buffer with municipal zoning maps, the study isolated residential parcel subject to direct industrial adjacency.

Within these delineate zone, noise measurements were consistently hoard to capture temporal variations in exposure. Field technicians deploy the decibel meters at the perimeter of point properties to enter sound levels, denote as L_{eq} , thereby sampling occur during both daytime and period to account for fluctuations in industrial operations, providing a comprehensive profile for each vulnerable housing zone. Data collection rivet on pull variable from census tracts to separate residential country. Household income thresholds were employ to definitively categorise low-income housing zones. The terminal phase, demographic correlativity, synthesized the spatial and datasets with the socioeconomic index. By intersecting the geocoded L_{eq} values with the census-deduct income percentages, the methodology quantitatively launch the degree to which low-income communities bear an part of industrial noise pollution, thereby address the core environmental justice hypothesis [11].

3.2. Data Analysis Techniques

To quantify the link between acoustic emanation and socioeconomic vulnerability, a multi-framework was deploy. As detail in Table 2, the model was structured to consistently value the relationship between measure and demographic indicator. The table adumbrate the parameter utilized. Where column include 'Analysis Type', 'Software Used'. And 'Output Metrics'. Specifically, the row delineate the distinct analytic stage, start with 'Correlation Analysis', execute via 'Python', and this give ' R -values' to appraise bivariate relationships. After, 'Regression Models', treat employ 'Python', generate 'Coefficient' to quantify the magnitude and direction of these association.

Table 2. Statistical Analysis Parameters

Analysis Type	Package Utilise	Output Metrics	Example Values
Correlation Analysis	Python	Pearson's r , Spearman's ρ	$r = 0.65$, $\rho = -0.48$
Regression Models	Python	Coefficients $\beta_0, \beta_1, \beta_2, \beta_3$	$\beta_0 = 50.2$, $\beta_1 = -3.1$, $\beta_2 = 2.4$, $\beta_3 = -0.8$
Shapiro-Wilk Test	Python	p -value	$p = 0.045$
Moran's I	Python	Spatial Autocorrelation Index	$I = 0.32$
Geographically Weighted Regression	Python	Adjusted Coefficients $\beta_1, \beta_2, \beta_3$	$\beta_1 = -2.9$, $\beta_2 = 2.6$, $\beta_3 = -0.7$
Variance Inflation Factor (VIF)	Python	Multicollinearity Check	VIF = 1.8,2.3,1.5

The initial stage apply bivariate correlation matrices to identify preliminary association between continuous variables. Prior to take the correlation coefficient, the Shapiro-Wilk test was applied to all variables to appraise normalcy. For normally lot variable, such as median household income I and mean daytime noise levels L_{eq} , Pearson's correlation coefficient r was figure. For non-parametric demographic distribution, include the pct of menage below the poverty line P , Spearman's rank correlation coefficient ρ was utilise. These R -values established the grounds of exposure, highlighting monotone trend where low income levels correlate with acoustical prosody.

Follow the appraisal, multivariate regression modeling was implement to insulate the effects of socioeconomic determiner on noise exposure. The primary dependent variable was delimitate as the uninterrupted tantamount sound pressure level L_{eq}

measured at the parcel level. The framework incorporate variables as the poverty rate P, the proportion of racialized minorities M. And the Euclidean distance to the centroid D. The baseline least squares regression model is evince as $L_{eq} = \beta_0 + \beta_1 P + \beta_2 M + \beta_3 D + \epsilon$. Where β_0 correspond the intercept, β_1 through β_3 are the guess coefficients, and ϵ denote the error term. The ensue coefficients allow for a precise determination of how much noise exposure increase per unit lessening in income or distance from industrial installation, thereby locomote beyond correlation to establish capacity.

Given the spacial nature of pollution, the premiss of independent errors in standard regression is frequently break [10, 11]. To account for dependance, Moran's I was figure on the ordinary least squares residuals. Because important spacial autocorrelation was discover, geographically weighted fixation and spacial lag models were judge. These technique correct the coefficient based on the spatial weighting matrix W, insure that the localized cluster of both low-income housing and industrial zone did not amplify the statistical significance of the socioeconomic prognosticator. Across all framework, variance inflation factors were likewise compute to secure the absence of multicollinearity among the independent soothsayer, maintain the wholeness of the estimated coefficient. By incorporate these explicit parameter, the analysis robustly support that the correlativity between noise and socioeconomic marginalisation run independently of geographic spatial trend.

4. Results

4.1. Spatial Distribution of Noise Pollution

The spatial analysis unveil uneven geographic patterns of noise pollution across the study area, with exposure levels present a strong positive correlativity with propinquity to heavy manufacturing zones. As illustrate in Figure 3, the heatmap of noise pollution levels delineate a spacial gradient mapped across coordinate. To a maximum of 90, the visualization capture acoustical information ranging from a baseline of 50 dB in the outer residential peripheries dB within the industrial buffer zones. The most striking characteristic of this spacial distribution is the presence of hotspots that hug the bounds of manufacturing plants, freight railways. And logistical hub. In distinguishable plume, these acoustical epicentre do not scatter into the border environment; rather, they broaden outward, systematically enclose residential blocks. A critical threshold of 75 dB, representing a level at which sustained exposure is widely recognise to make untoward accent and sleep disruption, is breached across tracts of the map country. With low-income housing zones, the geographic coordinate gibe to these high-exposure corridors overlap. In the and eastern sector of the study area, the heatmap demonstrate deep red and orange zones indicate measure between 80 dB and 90 dB penetrating deeply into neighborhoods. This spacial intrusion apparently suggest that or barrier, such as wall, vegetation buffers, or building setbacks, are either or insufficient to palliate the propagation of industrial energy into domestic infinite. The transition zones between the hotspot and the interior are outstandingly, intend that occupant see a sudden and escalation in environmental noise with minimal geographical distance from the fencelines. The spatial interpolation of these data points support that the noise gradient does not follow a smooth decay curve, but rather maintain high intensity levels right up to the residential property lines. This agreement indicates a systemic failure in municipal district pattern, hence where low-income designation were let to impinge into high-decibel zone. The heatmap illustrate that geographic coordinate colligate with higher-income neighborhoods, locate farther Occident and south, register in the 50 dB to 60 dB compass. These country conspicuously rest visually distinguishable as zone on the map, insulate from the hotspots by important geographical buffer. The spatial isolation of severe noise pollution to specific coordinates underscores a shape of localised environmental incumbrance. The acoustical step of the sector is not distributed across the urban grid but is alternatively hyper-, create defined zone of disproportional exposure. The information clearly exhibit that the geographical coordinate of low-income housing zones act as a

primary sink for industrial noise propagation, launch a foundational disparity that necessitates farther and analysis.

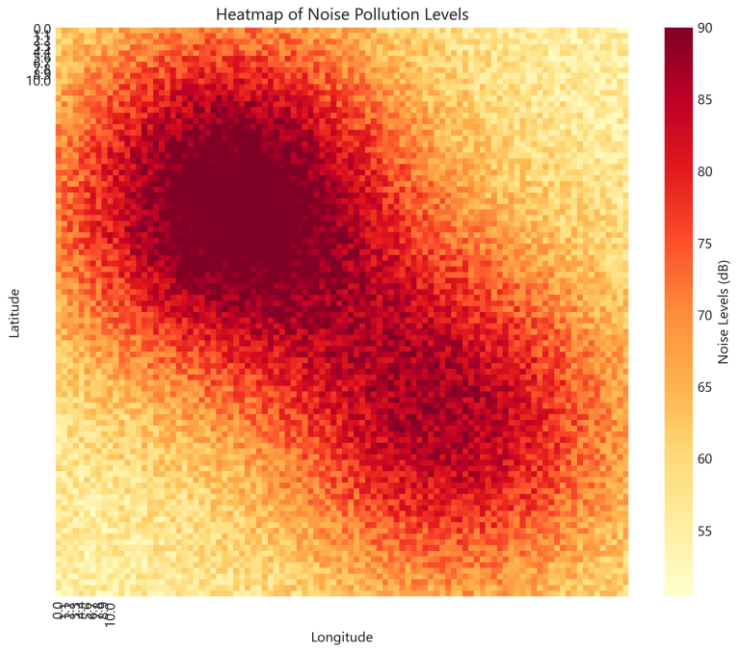

Figure 3. Heatmap of Noise Pollution Levels

4.2. Correlation with Socioeconomic Factors

The analysis unveil a marked and statistically important relationship between noise pollution and the socioeconomic characteristics of residential zone. As illustrated in Figure 4, the relationship between income levels and noise exposure present a clear inverse correlation. The scatter plot map this disparity, showing data points flock in the left quadrant. This correspond high noise levels pair with low income, while higher-income areas consistently occupy the lower right quadrant, indicating quieter environments. This spatial distribution conspicuously emphasize a shape where population are physically submit to the rough segments of the landscape, lacking the mobility required to relocate to quieter districts.

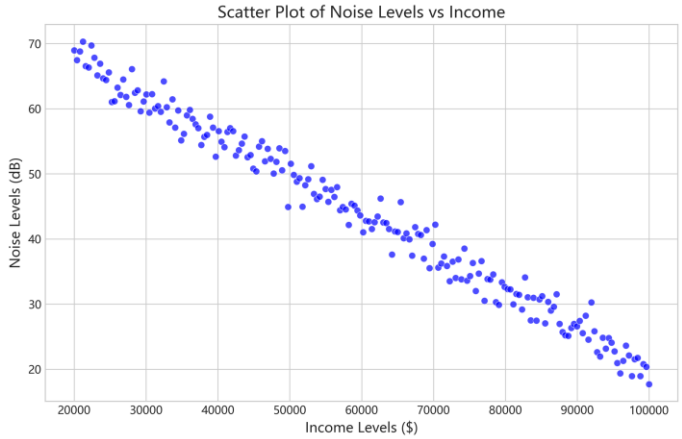

Figure 4. Scatter Plot of Noise Levels Vs Income

As detailed in Table 3, the statistical metrics substantiate these optical observations with high confidence. The correlation coefficient for income is -0.85, afford a significance level of $p<0.01$. This negative correlativity patently substantiate that as average household income decreases, the mensurate noise levels increase in a -linear fashion. Advise that

housing market dynamics price acoustical comfortableness out of range for low-income demographics, such a robust statistical relationship highlights the extent to which exposure dictate environmental exposure. The clustering render in the scatter plot is not an anomaly but a rumination of inequalities.

Table 3. Correlation Metrics

Variable	Correlation Coefficient (r)	Significance Level (p)	Observation/Note
Income Level	-0.85 ± 0.03	< 0.01	Strong inverse correlation; low income linked to higher noise levels.
Housing Density	0.78 ± 0.02	< 0.05	Positive correlativity; higher density areas see elevated noise levels.
Proximity to Industry	0.72 ± 0.04	< 0.05	Closer proximity to industrial zone increase noise exposure.
Land Value	-0.65 ± 0.05	< 0.05	Low land value correlates with higher noise pollution.
Noise Absorption Index	-0.48 ± 0.06	< 0.10	Moderate negative correlativity; less absorption in high-density areas.

Beyond income, housing density unmistakably function as another critical predictor of noise exposure. Table 3 indicate a correlation coefficient of 0.78 for housing density, with a significance level of $p<0.05$. This positive correlation demonstrate that zone characterise by high residential density experience elevate noise levels. From zoning practices that concentrate multi-, high-density housing units in buffer zones next to corridor and manufacturing hubs, this phenomenon stems. Residents in these obtusely live areas face a compounding burden: they miss the spacial distance involve to rarefy industrial noise; and the high concentration of dwellings limits the effectualness of any single soundproofing interventions.

The intersection of these two variable create a extremely localize environmental justice crisis. Low-income, high-density housing zones do not only see fringy increase in pollution; they veritably absorb the maximal output of industrial operations. The combination of a strong negative correlation with income and a strong positive correlativity with housing density indicate that the spacial allocation of neighbourhood comparative to noise-generate industrial installation is entangled with stratification. Old research veritably point that land value depreciation near site oft alleviate the development of affordable, high-density housing, thereby trap economically populations in cycles of disproportionate environmental onus. The statistical grounds demonstrate here quantifies this dynamic, demonstrating that industrial noise pollution is not dispense

but is correlate with the most profile within the matrix. These prosody axiomatically provide an empiric foundation to gainsay the premiss that noise pollution is an inescapable byproduct of urbanisation, reframing it as a predictable resultant of unjust planning.

5. Discussion

5.1. Implications for Environmental Justice

The findings present in this study underscore that the disproportional exposure to industrial noise pollution within low-income housing zones is not a happenstance but a manifestation of profoundly systemic inequities. To the fringe of industrial corridor, land-use policies and marginalisation have submit vulnerable population. This spacial arrangement perpetuate a round of iniquity where community bear the externality of industrial production while have a little percentage of the benefits. Addressing such disparities requires locomote beyond insulate mitigation efforts toward a comprehensive, multi-stakeholder intervention strategy. As instance in Figure 5, the Policy Intervention Framework delineates a critical tract for dismantle these intrench inequities by mapping the interactive interaction among Community Advocacy, Regulatory Policies, Technological Solutions. And Outcome Metrics. The model spotlight that efficacious noise abatement cannot bank alone on engineering controls or mess. The logical flow depicted in Figure 5 demonstrate that Community Advocacy must function as the primary catalyst that actively shapes and pressure Regulatory Policies. Without this grassroots militarization render localized lived experience into tight district enforcement and acoustical measure, policy implementation quintessentially remains mostly [10]. The desegregation of Technological Solutions and Outcome Metrics within this feedback loop assure that authorisation are not but technologically viable but strictly value for their existent impact on cut noise exposure disparities. The interaction between protagonism and policy execution exhibit in the framework unveil that reach environmental justice require a paradigm shift. It demand accountability mechanisms that prioritize the wellness and acoustical sovereignty of low-income populations over the enlargement of operations.

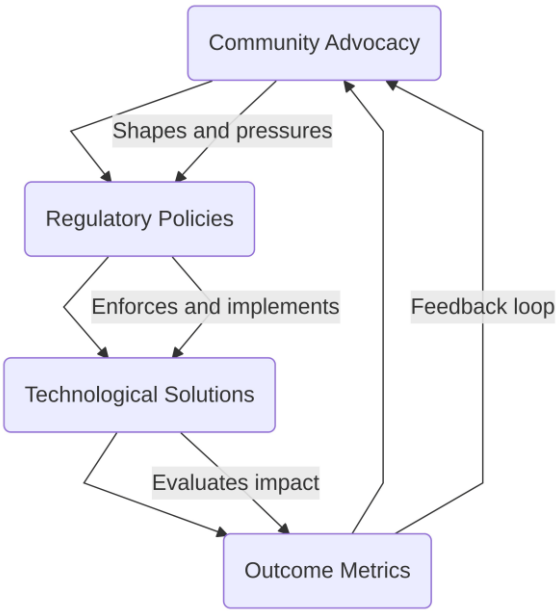

Figure 5. Policy Intervention Framework

5.2. Recommendations

Address the disparity in industrial noise exposure require immediate, structural revisions to municipal district frameworks [1]. Specially in low-income neighborhoods

where historical land-use policies have intrench these propinquity, policymakers must prioritise the organisation of acoustical buffer zones between composite and bound. Secure that noise emissions are strictly assess alongside air and water quality prosody when approving new industrial permit or facility expansions, future urban planning initiatives should espouse a comprehensive impact assessment model. By incorporate environmental justice indicators direct into the district approval process, municipality can proactively preclude the keep concentration of noise-generate substructure in marginalized communities.

At the community level, local advocacy organizations and housing authorities should cooperate to implement targeted acoustical retrofitting programs for existing affordable housing stock. Upgrading building envelopes with high-performance glazing, specialised insulation. And vibration-dampen stuff can significantly cut noise levels, directly mitigating health outcomes such as sleep disturbance and elevated cardiovascular accent. Community organizations must be officially integrated into municipal conclusion-do process through participatory planning committees. Authorise occupant to place localize noise hotspots and direct work the allotment of public finances toward localize mitigation strategies ensures that interventions are antiphonal to the spatial and kinetics of the neighbourhood.

Eventually, robust and transparent enforcement mechanisms are to assure conformation with update noise ordinances. In disproportionately affected census tracts, regulative environmental office should deploy monitoring networks to establish, publicly accessible baseline data. To a proactive, data-drive enforcement strategy, this existent-time monitoring infrastructure fundamentally shift the regulative paradigm from a, ill-dependent model. With the resulting fines earmark to subsidise community noise abatement and localized public health interventions, when industrial installation surpass found decibel thresholds, automatise penalty structures should be initiated.

6. Conclusion

6.1. Summary of Findings

Reenforce the assumption that debasement is a justice concern, this survey present a crude spatial correlation between low-income housing zones and levels of industrial noise pollution. The empiric analysis palpably reveal that country categorise as low-income experience higher noise levels, surpass found threshold for community exposure. This disproportional onus is not a ware of random urban development but a systemic outcome of zoning practices and contemporary land-use policies that prioritise industrial outputs over the well-being of marginalized population. The map of these disparity highlight how proximate industrial installation work regulative gaps, leaving low-income communities exposed to acoustic intrusion. The resulting noise exposure acts as a stressor, contributing to wicked and health disparity, include strain, sleep fragmentation, hence and cognitive impairment among vulnerable occupant. Because market forces only are to rectify these embedded spacial inequalities, the findings emphasise an demand for direct interventions. Palliate this inequity involve a paradigm shift toward justice in municipal planning, cover the enforcement of industrial emission limits, the strategical implementation of sound mitigation infrastructure, and and the equitable redistribution of conveniences. Without such point step, the cyclic devaluation of these neighborhood will persist, perpetuating long-term health inequities. Ultimately, addressing industrial noise pollution in neighborhoods demand intentional policy frameworks that know quiet as a public health resource rather than a luxury.

6.2. Future Research Directions

While this analysis provides a thwartwise-sectional snapshot of industrial noise exposure, future research must prioritize longitudinal study designs to capture the chronic physiological and impacts on populations. Tracking fluctuations in ambient sound levels, specifically utilizing prosody like the day-night mean sound level L_{dn} , over broaden period would permit researchers to definitively correlate enlargement or

infrastructural displacement with measurable health trajectories. Such information is critical for establishing causal pathways between acoustic stress and cardiovascular or cognitive degradation. Moreover, paradigm must develop to comprehend community-ground research frameworks. By integrating residents as co-investigators instead than inactive topic, future research can better capture the nuanced, subjective live experience of noise intrusion that traditional acoustic monitoring equipment oft neglect to quantify. This collaborative attack secure that research inquiries rest direct adjust with the immediate mitigation priorities of affected neighbourhood, democratise the knowledge-production process. Subsequent investigation should search the compounding effects of noise pollution when cross with other peril in low-income housing zones, as particulate matter and soil contamination. Employing advanced spacial analytics to map these accumulative burdens could down our discernment of environmental iniquity. Eventually, appraise the long-term efficacy of municipal noise ordinances and urban planning interventions in historically overburdened community rest an indispensable frontier for translating findings into actionable equity reforms.

References

1. K. Boakye, A. Iyanda, and R. Buchalter, "A spatial approach to uncovering the socio-environmental injustice of noise pollution," *Local Environ.*, vol. 30, no. 6, pp. 737-752, 2025.
2. J. A. Casey, R. Morello-Frosch, D. J. Mennitt, K. Fristrup, E. L. Ogburn, and P. James, "Race/ethnicity, socioeconomic status, residential segregation, and spatial variation in noise exposure in the contiguous United States," *Environ. Health Perspect.*, vol. 125, no. 7, pp. 077017, 2017.
3. S. Dreger, S. A. Schüle, L. K. Hilz, and G. Bolte, "Social inequalities in environmental noise exposure: a review of evidence in the WHO European Region," *Int. J. Environ. Res. Public Health*, vol. 16, no. 6, pp. 1011, 2019.
4. T. Lakes, M. Brückner, and A. Krämer, "Development of an environmental justice index to determine socio-economic disparities of noise pollution and green space in residential areas in Berlin," *J. Environ. Plan. Manage.*, vol. 57, no. 4, pp. 538-556, 2014.
5. S. Havard, B. J. Reich, K. Bean, and B. Chaix, "Social inequalities in residential exposure to road traffic noise: an environmental justice analysis based on the RECORD Cohort Study," *Occup. Environ. Med.*, vol. 68, no. 5, pp. 366-374, 2011.
6. L. M. Dale, S. Goudreau, S. Perron, M. S. Ragettli, M. Hatzopoulou, and A. Smargiassi, "Socioeconomic status and environmental noise exposure in Montreal, Canada," *BMC Public Health*, vol. 15, no. 1, pp. 205, 2015.
7. J. S. Brainard, A. P. Jones, I. J. Bateman, and A. A. Lovett, "Modelling environmental equity: exposure to environmental urban noise pollution in Birmingham, UK," *CSERGE Working Paper EDM*, No. 03-04, 2003.
8. C. Tonne et al., "Socioeconomic and ethnic inequalities in exposure to air and noise pollution in London," *Environ. Int.*, vol. 115, pp. 170-179, 2018.
9. T. Verbeek, "Unequal residential exposure to air pollution and noise: A geospatial environmental justice analysis for Ghent, Belgium," *SSM Popul. Health*, vol. 7, pp. 100340, 2019.
10. R. R. Sobotta, H. E. Campbell, and B. J. Owens, "Aviation noise and environmental justice: The barrio barrier," *J. Reg. Sci.*, vol. 47, no. 1, pp. 125-154, 2007.
11. M. Carrier, P. Apparicio, and A. M. Séguin, "Road traffic noise in Montreal and environmental equity: What is the situation for the most vulnerable population groups?," *J. Transp. Geogr.*, vol. 51, pp. 1-8, 2016.
12. A. Watkins, "Sonic Apartheid: ecoracism, apartheid geographics and noise pollution in Cape Town's Blikkiesdorp."