



Climate vulnerability and urban slums: A sociological study of livelihoods and adaptation

Aaisha Raza

Department of Sociology, Patna University, Bihar, India

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Abstract

Climate change is increasingly affecting urban communities, but its consequences are not experienced equally by all sections of society. Urban slum communities are particularly vulnerable because they often live in environmentally fragile locations, depend heavily on informal employment, and have limited access to secure housing, healthcare, sanitation and other essential services. This study examines the relationship between climate vulnerability, livelihood insecurity and adaptation among urban slum communities. It focuses on how extreme heat, flooding, water scarcity, heavy rainfall and other climate-related stresses affect everyday life and income-generating activities. From a sociological perspective, the study argues that climate vulnerability is not merely an environmental problem but is closely connected with poverty, social inequality, insecure employment, inadequate housing and limited institutional support. The study also examines the coping and adaptation practices developed by slum residents, including changes in working hours, diversification of occupations, temporary migration, borrowing, social networks and modifications to housing. The article proposes a mixed-method approach combining household surveys, interviews and observation to understand both measurable vulnerability and lived experiences. It argues that the resilience of slum communities should not be understood simply as their ability to survive crises; rather, it should be examined in relation to structural inequalities that shape their choices and opportunities. The study concludes that inclusive urban planning, secure housing, improved basic services, livelihood protection and community participation are essential for building climate-resilient cities.

Keywords: Climate vulnerability, urban slums, livelihoods, urban poverty, social inequality

Introduction

Climate change has emerged as one of the most significant social, economic and environmental challenges of the twenty-first century. Increasing temperatures, extreme heat events, irregular rainfall, urban flooding, water shortages and other environmental changes are affecting human settlements across the world. Although climate change is a global phenomenon, its consequences are experienced differently by different social groups. People who possess greater economic resources, secure housing, access to healthcare and strong institutional support are generally better positioned to cope with environmental shocks^[1]. In contrast, socially and economically disadvantaged communities often experience greater exposure and have fewer resources with which to respond. Urban slum communities represent one of the most important examples of this unequal distribution of climate vulnerability. Urban slums are generally characterised by inadequate housing, overcrowding, insecure tenure, limited access to clean water and sanitation, poor drainage, insufficient waste management and restricted access to public services. Many slum settlements develop in locations that are particularly vulnerable to flooding, waterlogging, landslides, extreme heat or other environmental hazards^[2]. Their residents frequently depend on informal and low-paid occupations such as street vending, domestic work, construction labour, waste collection, transport services and casual employment. These occupations are often directly affected by weather conditions. A flood, heatwave or heavy rainfall event can therefore affect not only the physical environment but also the income and livelihood security of households^[3].

Climate vulnerability among urban slum communities is consequently not simply a question of geographical exposure. It is closely connected with poverty, social inequality, insecure employment, gender relations, access to public services and political marginalisation. A household living in a flood-prone settlement may experience greater vulnerability because it lacks savings, insurance, secure employment and access to alternative housing. Similarly, an informal worker may lose daily income during extreme weather because outdoor work becomes difficult or impossible. Thus, the effects of climate hazards can deepen existing forms of social and economic inequality^[4]. From a sociological perspective, climate vulnerability should therefore be understood as a socially produced condition. People are not vulnerable simply because they live in a particular geographical location. Their vulnerability is shaped by social structures and unequal access to resources. Class, occupation, gender, housing status, social networks and institutional access can influence the ability of households to prepare for, cope with and recover from environmental shocks. Understanding these dimensions is essential for developing effective and socially just climate adaptation policies. This article examines climate vulnerability among urban slum communities with particular attention to livelihoods and adaptation strategies^[5]. It seeks to understand how climate-related stresses influence everyday life, employment, household income, health and housing conditions. It also examines how residents respond to these challenges through individual, household and collective strategies. The central argument of the article is that urban climate adaptation

cannot be separated from questions of poverty, livelihood security and social inequality ^[6].

Conceptual Understanding of Climate Vulnerability

Climate vulnerability refers to the extent to which individuals, households or communities are exposed and susceptible to harm from climate-related hazards and their ability to cope with, adapt to and recover from such impacts. It is shaped by three interconnected dimensions: exposure, sensitivity and adaptive capacity. Exposure refers to the degree to which people experience hazards such as flooding, extreme heat, drought, water scarcity and heavy rainfall, while sensitivity indicates how severely these hazards affect their lives, health, housing and livelihoods ^[7]. Adaptive capacity refers to the ability of individuals and communities to adjust to changing environmental conditions, reduce potential losses and recover from climate-related shocks. In urban slum communities, these dimensions often overlap and reinforce one another. Residents may face greater exposure because informal settlements are frequently located near drains, rivers, railway tracks, industrial areas, low-lying land or other environmentally vulnerable locations. Their sensitivity may be further increased by overcrowded and poorly constructed housing, inadequate sanitation, limited access to clean water and healthcare, and dependence on informal livelihoods ^[8]. At the same time, their capacity to adapt may be constrained by low and unstable incomes, insecure employment, lack of savings, limited access to credit, weak social protection and inadequate institutional support. Thus, climate vulnerability in urban slums should not be understood merely as exposure to environmental hazards; rather, it is a socially produced condition arising from the interaction between environmental risks, poverty, social inequality, insecure livelihoods and unequal access to resources and opportunities ^[9].

Urban Slums and Social Inequality

Urbanisation creates employment opportunities and attracts migrants and low-income workers in search of better livelihoods, but its benefits are not equally distributed across different social groups. Poor households often find formal housing markets inaccessible because of high rents, rising property prices, insecure employment and restrictive documentation requirements, forcing many to live in informal settlements where housing is relatively affordable but tenure and living conditions are often insecure. The location of these settlements can further increase vulnerability, as they are frequently established near drains, waste disposal sites, railway lines, transport corridors, industrial areas, rivers and low-lying land, which may provide convenient access to employment while simultaneously exposing residents to flooding, pollution, extreme heat and other environmental hazards ^[10]. Social inequality also affects access to essential urban infrastructure and public services. Wealthier neighbourhoods generally have better roads, drainage systems, electricity, clean water, sanitation, waste management, healthcare and emergency services, whereas slum settlements may receive these facilities irregularly or inadequately. Consequently, climate-related hazards do not affect all urban residents in the same way; the same flood, heatwave or heavy rainfall event may cause relatively limited disruption in a well-serviced neighbourhood but

result in severe livelihood losses, health problems, housing damage and displacement among slum residents. Thus, urban climate vulnerability is closely linked with patterns of social inequality, unequal access to resources and the marginal position of low-income communities within the urban social and spatial structure ^[11].

Climate Risks in Urban Slum Communities

Urban slum communities face multiple and interconnected climate-related risks that affect their housing, livelihoods, health, income and everyday social life. Extreme heat is becoming an important concern in densely populated settlements where houses are often constructed with tin sheets, plastic, asbestos or other heat-retaining materials and have limited ventilation. The shortage of trees, open spaces and proper cooling facilities can further increase heat exposure. Extreme temperatures also directly affect livelihoods, particularly for construction workers, street vendors, rickshaw pullers, delivery workers, domestic workers and other people engaged in outdoor or physically demanding occupations. During periods of severe heat, workers may have to reduce their working hours or stop work temporarily, resulting in loss of daily income. Urban flooding is another major risk, particularly in settlements located near drains, rivers, railway lines, low-lying areas and poorly maintained drainage systems. Heavy rainfall can cause waterlogging and flooding, damaging houses, household belongings, food supplies, work equipment and other livelihood assets ^[12].

Floodwater may also contaminate drinking-water sources and increase the risk of waterborne and infectious diseases. For households with limited savings, even relatively small losses can create serious financial pressure and may force them to borrow money or sell household assets. Water scarcity represents another growing challenge, particularly during prolonged periods of heat and irregular rainfall. Many low-income households depend on public taps, shared water sources, tankers or other informal arrangements, and shortages can increase the time and effort required to obtain adequate water. Women and children may bear a disproportionate share of this responsibility, which can affect women's employment and children's education ^[13]. In addition, climate-related health risks can become more severe because of overcrowding, poor sanitation, inadequate drainage and limited access to healthcare. Heat stress, dehydration, contaminated water, vector-borne diseases, respiratory problems and other climate-sensitive health conditions may place additional pressure on vulnerable households. Medical treatment and loss of working days can further reduce household income and savings, increasing dependence on borrowing and informal support networks. Thus, climate risks in urban slums are not isolated environmental events; they are interconnected social and economic challenges that can reinforce existing poverty, livelihood insecurity and inequality ^[14].

Impact of Climate Change on Livelihoods

Livelihood is a central dimension of climate vulnerability because the stability of household income largely determines the ability of families to cope with environmental shocks and recover from unexpected losses. A large proportion of urban slum residents depend on informal, temporary and low-paid occupations in which income is closely linked to daily work and regular physical

presence at the workplace. Street vendors, construction workers, domestic workers, rickshaw and auto drivers, waste collectors, delivery workers, casual labourers and small traders are particularly vulnerable because their occupations are often directly influenced by weather conditions^[15]. Heavy rainfall and urban flooding may prevent street vendors and small traders from operating, interrupt construction activities, damage goods and equipment, and reduce the movement of customers and transport workers. Similarly, extreme heat can make outdoor and physically demanding work difficult and unsafe, forcing workers to reduce their working hours or remain absent from work, thereby reducing their daily earnings. Flooding may also damage livelihood assets such as handcarts, tools, stocks, vehicles and small shops, creating additional financial losses for households that have limited savings or insurance coverage. In this way, climate change directly affects the income-generating capacity of vulnerable households and makes their livelihoods increasingly uncertain^[16].

The consequences of climate-related livelihood disruption extend beyond the immediate loss of income and can create a wider chain of social and economic problems. When earnings decline, households may reduce expenditure on food, education, healthcare and other essential needs, postpone medical treatment, borrow money from relatives or informal lenders, sell household assets or send family members to other places in search of employment. Children may experience interruptions in education, while women may increase their participation in informal work or unpaid household activities to compensate for declining family income. Repeated climate-related shocks can therefore push already vulnerable households into deeper poverty, indebtedness and livelihood insecurity and reduce their ability to invest in better housing, education, healthcare and alternative employment opportunities. A temporary climate event may thus have long-term consequences for household well-being and social mobility^[17]. Therefore, the impact of climate change on livelihoods in urban slums should be understood not merely as a temporary reduction in income but as a process that can reinforce existing poverty and social inequality. Strengthening livelihood security through diversified employment, social protection, access to affordable credit, skill development, insurance and climate-resilient livelihood opportunities is essential for improving the adaptive capacity and long-term resilience of urban slum communities^[18].

Gender Dimensions of Climate Vulnerability

Climate vulnerability is also deeply influenced by gender relations, as women and men often have different responsibilities, occupations, access to resources and capacities to respond to environmental stress. Women living in urban slums frequently carry a substantial share of household responsibilities, including cooking, childcare, cleaning, water collection, household management and caring for sick or elderly family members. Climate-related disruptions can significantly increase these responsibilities^[19]. During periods of water scarcity, women may have to spend additional time collecting water from distant or shared sources, reducing the time available for paid employment, education and other activities. Similarly, during floods, heatwaves or periods of illness, women's unpaid care work within the household may increase

considerably. Poor housing conditions, inadequate sanitation, overcrowding and limited access to healthcare can further intensify the everyday burdens experienced by women. Thus, climate-related hazards can affect women not only through direct exposure to environmental risks but also through the expansion of unpaid domestic and care responsibilities^[20].

At the same time, many women in urban slum communities contribute significantly to household income through domestic work, street vending, home-based work, small-scale trading, waste collection, food preparation and other informal occupations. These livelihoods are often insecure and highly sensitive to weather conditions. Heavy rainfall, flooding and extreme heat may prevent women from travelling to workplaces, reduce customer demand or interrupt home-based production, resulting in loss of income. Women may also have less access to savings, formal credit, property ownership, insurance and other financial resources, which can limit their ability to recover from climate-related losses. In some households, declining income may force women to increase their paid or unpaid labour while simultaneously reducing their own consumption of food, healthcare and other essential resources. Therefore, gender must be treated as an important dimension of climate vulnerability in urban slums. Understanding women's experiences is essential for developing equitable adaptation policies that recognise unpaid care work, strengthen women's livelihood opportunities, improve access to financial and social protection, and increase their participation in household and community-level climate decision-making^[21].

Adaptation Strategies among Urban Slum Households

Despite their high exposure to climate-related risks and limited access to formal resources, urban slum communities are not passive victims of climate change. Residents actively develop a range of individual, household and community-level strategies to cope with environmental stresses and protect their livelihoods. These strategies are often based on local experience, available resources, social relationships and practical knowledge. One important strategy is livelihood diversification, through which households reduce their dependence on a single source of income by combining different forms of employment^[22]. For example, a household member may combine daily wage labour with street vending, transport work, domestic service, waste collection or small-scale business activities. Such diversification can provide some income security when one occupation is disrupted by extreme heat, heavy rainfall or flooding. Temporary migration is another important strategy, particularly when local employment opportunities decline. Some households may send one or more members to nearby towns, cities or other regions in search of work, while the remaining family members continue to live in the settlement. Income earned through migration may help households meet daily expenses, repay debts and recover from climate-related losses. Migration, however, may also create social costs, including family separation, insecure employment and additional living expenses^[23].

Social networks represent another important source of support for vulnerable households. Family members, neighbours, friends, community groups and local organisations may provide assistance during periods of crisis by sharing food and water, lending money, offering

temporary shelter, helping to repair damaged houses or supporting households that have lost their income. These relationships constitute an important form of social capital and can strengthen the collective capacity of communities to respond to climate-related shocks. Housing modification is also commonly used as a practical adaptation strategy. Residents may raise floors or household platforms, strengthen roofs, improve ventilation, install temporary protective barriers or use locally available materials to reduce exposure to flooding and extreme heat ^[24]. Although such measures are often small-scale and low-cost, they can provide immediate protection to vulnerable households. Finally, financial coping strategies play an important role when families face sudden expenses resulting from illness, flooding, loss of employment or damage to household and livelihood assets. Households may borrow money from relatives, neighbours, community groups or informal lenders to meet immediate needs. While such borrowing can provide short-term relief, repeated dependence on loans may increase household debt and create additional economic vulnerability. Therefore, adaptation strategies among urban slum households demonstrate considerable agency and resilience, but their effectiveness is often limited by poverty, insecure livelihoods and inadequate institutional support. Sustainable adaptation requires strengthening these existing community capacities while also providing secure housing, livelihood opportunities, social protection, affordable financial services and accessible public infrastructure ^[25].

Sociological Interpretation of Adaptation

Adaptation to climate change should not be understood simply as a technical or environmental response; it is also a deeply social process shaped by people's economic conditions, social relationships, cultural practices and access to institutions and resources. The ability of individuals and households to prepare for, cope with and recover from climate-related hazards varies according to their social and economic position ^[26]. For example, two households living in the same urban slum may experience the same flood, heatwave or period of water scarcity but may face very different consequences and recovery processes. A household with stable employment, regular income, savings, secure housing and strong social networks may be able to repair its house, replace damaged belongings and resume normal activities relatively quickly. In contrast, a household dependent entirely on daily wage labour, with little or no savings and insecure housing, may experience prolonged income loss, indebtedness and difficulty in meeting basic needs. This demonstrates that adaptive capacity is socially differentiated and is influenced by factors such as class, occupation, gender, education, housing security, income, social networks and access to government institutions and welfare programmes. Women, elderly people, children and households dependent on informal employment may face additional barriers because of their limited access to economic and institutional resources ^[27].

Community relationships also play an important role in shaping adaptation and resilience among urban slum populations. During floods, fires, extreme heat or other emergencies, neighbours, relatives, local groups and community organisations may provide food, drinking water, temporary shelter, financial assistance, childcare and support for repairing damaged houses. Such forms of mutual assistance are particularly important when formal

institutional support is delayed or inadequate ^[28]. These collective practices demonstrate the importance of social capital in strengthening community resilience. Adaptation, therefore, is not merely an individual responsibility but can emerge through cooperation, trust, reciprocity and shared community experiences. At the same time, community-based coping has its limitations and cannot replace adequate public infrastructure and institutional support. Sustainable climate adaptation requires a combination of community participation and effective government intervention. From a sociological perspective, resilience should consequently be understood as a collective and socially embedded capacity that depends not only on the ability of individuals to respond to climate risks but also on the distribution of resources, opportunities and institutional support within society ^[29].

Role of Government and Institutions

Government institutions and urban authorities have a crucial role in reducing climate vulnerability among urban slum communities because effective adaptation requires both immediate responses to climate-related hazards and long-term action to address the structural conditions that produce vulnerability. Important interventions include improving drainage and flood-management systems, ensuring regular access to safe drinking water, providing affordable and climate-resilient housing, strengthening sanitation and waste-management services, developing effective heat-action plans, improving access to affordable healthcare, extending social-security measures to informal workers, providing livelihood and skill-development opportunities, ensuring access to affordable insurance and emergency financial assistance, strengthening early-warning and disaster-response systems, and promoting inclusive and participatory urban planning ^[30]. However, the success of these measures depends not only on the availability of government programmes but also on their effective implementation at the local level. Urban slum residents should be treated as active participants rather than merely as beneficiaries of government schemes. Local communities possess valuable knowledge about their settlement, seasonal environmental changes, recurring floods, heat conditions, water shortages and locally effective coping practices. Their participation in identifying risks, planning interventions, monitoring services and evaluating adaptation programmes can make policies more responsive, practical and socially appropriate. Therefore, an effective institutional approach to climate adaptation should combine adequate infrastructure and social protection with community participation, accountability and inclusive governance, ensuring that the needs and experiences of vulnerable urban populations are incorporated into broader urban climate policies ^[31].

Research Methodology

The study adopts a mixed-method sociological research design to examine climate vulnerability, livelihood insecurity and adaptation strategies among urban slum households. The study will be conducted in selected urban slum settlements of a medium-sized or large Indian city, with settlements selected on the basis of their location, socioeconomic characteristics, livelihood patterns, housing conditions and exposure to climate-related hazards such as flooding, extreme heat, water scarcity and heavy rainfall. Approximately 200–300 households may be selected

through a multistage sampling method to represent different income groups, occupations, household structures and levels of climate exposure. Primary data will be collected through structured household schedules, semi-structured interviews, focus group discussions, key-informant interviews, direct observation and participatory mapping of climate-risk locations^[32]. The household schedule will cover variables such as household income, occupation, housing conditions, access to water and sanitation, exposure to flooding and extreme heat, health impacts, livelihood losses, migration, household expenditure, social networks, access to government schemes, disaster preparedness and adaptation strategies. Secondary information will be obtained from government reports, municipal records, Census publications, academic studies, climate reports and relevant policy documents. Quantitative data will be analysed using descriptive statistics, frequency and percentage distributions, cross-tabulation, correlation and, where appropriate, regression analysis to examine relationships between socioeconomic conditions, climate exposure and adaptive capacity. Qualitative information obtained from interviews, focus group discussions and observations will be analysed thematically to identify recurring patterns related to climate perceptions, livelihood insecurity, gender differences, community support, migration, financial coping and local adaptation practices. The study will also maintain appropriate ethical standards by obtaining informed consent, ensuring voluntary participation and protecting the privacy, anonymity and confidentiality of respondents. The mixed-method approach will enable the study to connect measurable patterns of climate vulnerability with the everyday experiences, social relationships, livelihood challenges and adaptation practices of urban slum households^[33].

Proposed Analytical Framework

The proposed analytical framework conceptualises climate vulnerability among urban slum households as a dynamic process in which environmental hazards interact with social and economic conditions. The framework follows the relationship Climate Hazards → Exposure → Social and Economic Sensitivity → Livelihood Disruption → Household Stress → Coping and Adaptation → Recovery/Resilience. Climate hazards such as extreme heat, flooding, heavy rainfall and water scarcity first create conditions of exposure, while poverty, insecure housing, informal employment, poor health and limited access to basic services increase the sensitivity of households to these hazards. Climate-related disruptions can then affect livelihoods, income, health and household security, producing financial and social stress. In response, households develop different coping and adaptation strategies, including livelihood diversification, migration, borrowing, housing modification, reliance on social networks and access to government assistance. The final outcome may range from temporary recovery to longer-term resilience or, in cases of repeated shocks and limited resources, deeper vulnerability and poverty. However, this process is influenced by several mediating factors, including income, occupation, housing conditions, gender, education, social networks, access to public services and institutional support. The framework therefore highlights that climate vulnerability is not produced by environmental hazards alone but emerges through the interaction between

environmental risks and existing social, economic and institutional inequalities^[34].

Discussion

The sociological understanding of climate vulnerability demonstrates that environmental hazards cannot be separated from existing patterns of social and economic inequality^[35]. Urban slum communities often live in locations that provide relatively affordable housing and convenient access to employment but simultaneously expose residents to flooding, extreme heat, water scarcity, pollution and other environmental risks. Their vulnerability is therefore closely connected with the broader structure of urban development, poverty and unequal access to land, housing and public infrastructure^[36]. Livelihood insecurity further increases this vulnerability because many slum residents depend on informal occupations that provide unstable incomes and limited social protection. Informal workers often lack employment contracts, paid leave, insurance and secure working conditions, and climate-related disruptions can immediately affect their daily earnings. At the same time, these communities demonstrate considerable adaptive capacity through social networks, occupational diversification, temporary migration, informal financial arrangements, housing modifications and collective action^[37]. Such strategies enable households to manage immediate environmental stresses and recover from some forms of loss, but they also have significant limitations. Borrowing can increase indebtedness, migration may create family and social pressures, and livelihood diversification may continue to involve insecure and poorly paid work. Therefore, community resilience should not be romanticised or treated as evidence that structural vulnerability has disappeared. The ability of poor households to cope with repeated climate shocks often depends on their limited resources and may involve significant social and economic costs^[38]. Long-term resilience requires improvements in secure housing, basic infrastructure, healthcare, livelihood opportunities, social protection, financial security and institutional support. Climate adaptation must therefore address both immediate environmental risks and the deeper social conditions that make certain communities more vulnerable than others^[39]. Climate vulnerability in urban slums is both an environmental and a social problem. Residents are exposed to climate-related hazards such as extreme heat, flooding, water scarcity and heavy rainfall, but the consequences of these hazards are intensified by poverty, insecure housing, informal employment, inadequate infrastructure, poor access to healthcare and limited institutional support. The study highlights the importance of examining climate change through a sociological perspective because vulnerability is not equally distributed across urban populations. Social and economic inequalities influence who is exposed to environmental hazards, who suffers the greatest livelihood and health impacts, and who possesses the resources necessary to recover. Urban slum residents employ a range of adaptation strategies, including livelihood diversification, temporary migration, housing modification, borrowing, social networks and community-based cooperation. These strategies demonstrate agency, local knowledge and resilience, but they cannot replace the need for structural and institutional support. Therefore, climate adaptation policies should move beyond purely technical approaches

and address the social determinants of vulnerability through secure and affordable housing, livelihood protection, accessible healthcare, improved drainage and water infrastructure, social security, financial support and participatory governance. Ultimately, addressing climate vulnerability in urban slums requires a shift from viewing poor communities merely as beneficiaries of climate programmes to recognising them as active participants in climate adaptation and urban planning. A socially just climate policy must ensure that urban poor communities are not only protected from climate risks but are also provided with meaningful opportunities to build secure, dignified and sustainable livelihoods.

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