Housing, Hazards, And Nature: Reviewing Disaster Preparedness in Gujarat's Peri-Urban Regions

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Abstract: India's post-1990 urbanization has rapidly reshaped peri-urban regions, the dynamic transition zones where rural agricultural landscapes are quickly absorbed into expanding city fringes. In Gujarat, one of India's most industrialized states, peri-urbanization has intensified over the last four decades, driven by migration, rapid industrial and infrastructure development. Gujarat has endured major disasters for decades, prompting stronger institutions and early warning systems. However, significant gaps remain in peri-urban land-use planning, water management, and community preparedness. Rapidly growing peri-urban areas thus continue to face high vulnerability and uneven resilience. The peripheral regions of large urban centres of Gujarat exhibit fragmented land-use patterns, rapid conversion of farmland to non-agricultural landuses and weakened ecological buffers, creating built environments that are highly vulnerable to disasters. Drawing on a PhD study supported further by primary and secondary data analysis, this paper reviews peri-urban development patterns, disaster vulnerabilities, and the level of preparedness across Gujarat's cities. The study finds that peri-urban areas are increasingly exposed to climate-induced hazards, with rising temperatures and intensified urban heat island (UHI) effects amplified by extensive hard paving. These conditions elevate local temperatures by 3–5°C, increase runoff, and reduce water percolation, leading to groundwater decline, low soil moisture, and diminished greenery. The resulting loss of natural cooling and continuous surface heating heighten heat stress, while excess runoff causes waterlogging and flood-like situations. Higher temperatures further increase dependence on mechanical cooling, reinforcing a cycle of heat buildup, energy use, and reduced ecological resilience in disaster-prone peri-urban regions. Study findings also highlight uneven implementation of resilience strategies and limited adoption of nature-based solutions (NbS). The study recommends integrating ecological resources into Development Plans (DP) and Town Planning Schemes (TPS), strengthening resilience-focused bylaws, and mainstreaming NbS to build safer and climate-resilient peri-urban development in Gujarat.

Keywords: Climate Resilience, Disaster, Infrastructure, Nature-based Solution (NbS), Peri-Urban Region, Residential Development

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1 Introduction

Since economic liberalization in the 1990s, India's urbanization has seen a period of unparalleled change. Cities are growing both geographically and demographically. The expansion of urban activities has been rapidly transforming the peri-urban regions of Indian cities. The peri-urban areas are new areas of risk and growth.

These regions, which lie between the rural hinterlands and the urban core, are dynamic landscapes with quickly shifting infrastructure, natural systems, and land-use patterns.

It is observed that the changes in land use and the built environment of the urban periphery are not a natural process. The decentralization of population and spatial expansion of growing urban centers takes place in the comparatively less expensive urban peripheries [1][2][3][4][5]

Major cities' outward growth shapes peri-urban landscape in India, creating transitional zones where rural agricultural land is quickly transformed into residential layouts, semiresidential facilities, industrial clusters, and service-based economic areas [6][7][5]

Due to migration, real estate expansion, and infrastructure corridors like roads and metro expansions, these places exhibit fragmented land-use patterns, varied sources of income, and demographic diversity [8]. Similar periurbanization dynamics has been evident in Gujarat state which is one of the most industrialised state in India.

Urbanization in Gujarat has accelerated in the last four decades, fueled by industrial growth, migration, and improved infrastructure. In most of the cities and large towns of Gujarat, the expansion has extended beyond the core city into the peri-urban region, where new residential and semi-residential developments are rapidly transforming farmland and natural landscapes into built-up environments. The periurban areas surrounding Ahmedabad, Surat, and Vadodara, where peri-urban transformation is intensified by construction of ring roads, expressways, highways, industrial estates, and large-scale urban planning projects most notably the Dholera Special Investment Region [9].

Farming land decline, increased employment in the industrial and service sectors, fast real estate growth, and changing sociocultural disposition are all present in these areas [10]. Peri-urban development in Gujarat and India as a whole exposes a complex urban–rural continuum characterized by unequal growth, environmental concerns, and governance issues that necessitate coordinated spatial planning. While peri-urban growth supports housing demand and economic development, it also introduces vulnerabilities to disasters [11][12].

Gujarat is one of most developed,industrialized and prosperous states in India and uniquely situated on the North-West coast of India with longest coastline bordered in west by the Arabian sea and Rajasthan in the North-East, Maharashtra in South-East and Madhya Pradesh in the East. Gujarat is inherently susceptible to natural disasters due to its unique geography [13].

Various studies highlight that many cities in various districts of Gujarat has seen and endured numerous natural and man-made disasters in the past. Floods, cyclones, heavy rain, lightning, earthquakes, and fires have caused a lot of damage to humans and property. At the same time manmade disasters such as heat stress, fire hazards, water scarcity, and pollution are increasingly observed in both old and newly developed peripheral regions [5].

It is observed by reserachers that newly developed peri-urban areas are more prone to disasters due to rapid construction, limited infrastructure, and inadequate ecological buffers [14][15][16].

2 Research Gaps and Conceptual Framework

Although Gujarat has pioneered urban growth management, technological modernization, and disaster governance reforms, peri-urban regions remain insufficiently examined. Existing studies largely focus on hazards in large metropolitan cities or rural districts, while the peri-urban fringe remains understudied as a distinct socio-ecological and spatial zone. Much of the studies focuses on either urban infrastructure development or disaster risk reduction mechanisms at state and city level, leaving a gap in understanding how rapid land-use conversion, shrinking ecological buffers, industrial expansion, and informal development converge to produce vulnerabilities unique to peri-urban settings [5].

2.1 Research Gaps

Furthermore, while previous research identifies heatwaves, water scarcity, and flooding as major threats, limited work has assessed the combined and cumulative impacts of these hazards on micro-climate, groundwater, and environmental degradation. The literature does not sufficiently explain how peri-urban land use transformations intensify urban heat island effects, alter hydrological flows, and weaken ecological resilience, nor how gaps in planning, institutions, and community-based mechanisms worsen disaster risk. Finally, despite increasing advocacy for nature-based solutions (NbS), existing studies rarely examine their mainstreaming within Development Plans (DP), Town Planning Schemes (TPS), and city–region governance frameworks.

This research addresses these gaps by integrating spatial, environmental, and institutional analysis to examine disaster vulnerability and resilience in peri-urban

Gujarat, focusing on the relationship between land-use change, climate-induced hazards, ecological degradation, and governance responses.

2.2 Conceptual Framework

The conceptual framework for this study positions peri-urban areas as dynamic socio-ecological transition zones, where urban expansion and ecological systems interact to shape disaster risk and resilience. It draws on four interrelated analytical domains (Refer figure 1).

1. Land-use change,
2. Environmental and Climatic Stressors,
3. Built Environment and Infrastructure Development,
4. Institutional Capacity and Resilience Governance

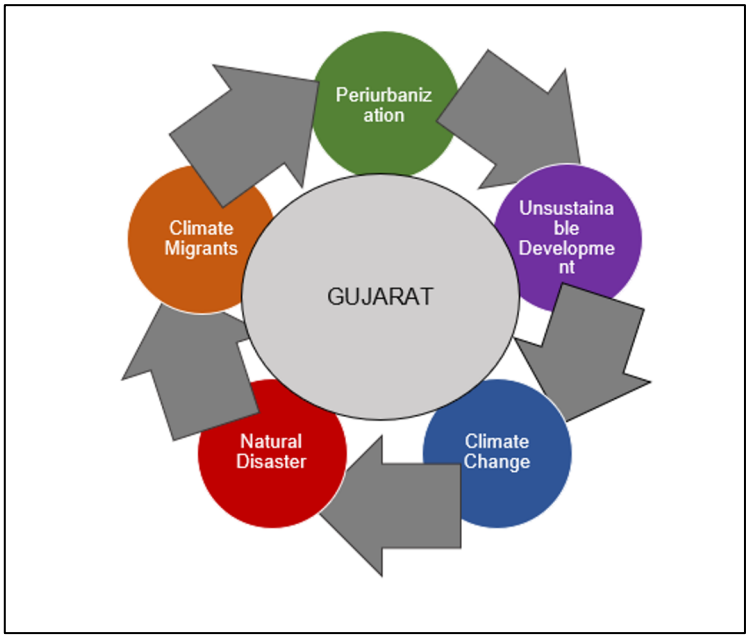

Fig.1.The interrelationship of Climate Change, Natural Disaster, Periurbanization

Source:Developed by the Author from literature review

3 Methodology

In the context of the above the first part of the paper reviews the patterns of development and disasters in selected peri-urban regions in Gujarat. The second part focuses on reviewing the level of disaster preparedness in terms of landuse planning and infrastructure development. The third part reviews the degree to which NbS have been integrated in the recently developed residential and semiresidential development in the periphery. The fourth part of the paper reveals the gaps in existing landuse planning and implementation systems for embedding disaster resilience in future urban planning approaches.

The paper is based on a PhD study conducted in the area of peri-urbanization and further data collected through secondary and primary sources [5]. The data collected mainly through secondary sources was analyzed through descriptive and qualitative analysis (narrative and content analysis). The analysis reflects upon linkages between the physical planning and governance of peri-urban development and peri-urban built environment transformation, challenges of disaster management and prospects of implementation of NbS in the peri-urban region to achieve improved built- environment with disaster resilient planning and infrastructure development.
The study adopted a review-based qualitative design supplemented with case illustrations from Gujarat's major urban centers Ahmedabad, Surat, Vadodara, and Gandhinagar where peri-urban growth is visibly shaping residential and semi-residential landscapes.

3.1 Data Sources

The data was sourced from secondary literature such as research papers, articles, government reports, global case studies on NbS and disaster resilience, urban planning documents like Town Planning Schemes (TPs), Development Plans of Vadodara, Ahmedabad and Surat Urban Development Authorities, and state-level disaster management guidelines. Various reports on past disasters in Gujarat, such as the 2006 Surat flood, Ahmedabad's heatwaves (2010 onwards), and peri-urban flooding in Vadodara have been referred. The field observations procured, including Urban Heat Island Effect measurements, groundwater depletion studies, and fire risk assessments in new peri-urban regions.

4 Literature Review, Data Collection and Analysis

4.1 Peri-urban Development Patterns

The terms 'peri-urban' or 'fringe areas' are often used for such transition zones that are located between the core city and peripheral villages.

The term "peri-urbanization" defines how urban services, diversified land uses, and a variety of inhabitants coexist in rural edges when expanding urban areas infringe on nearby rural areas. Peri-urban areas around the world show comparable trends, such as increased environmental stress, gated residential townships, industrial area expansion, and rapid conversion of agricultural land to non-agricultural land, all of which are frequently caused by rapid urbanization and infrastructure development [8]. These dynamics are particularly noticeable in Beijing, Shanghai, and Guangzhou, where rural peripheries are constantly being reshaped by massive industrial units, highways and expressways, and migration from various states.

Similar processes are seen in South Asian cities like Kathmandu, Colombo, and Karachi, where urban sprawl blends with traditional village settlements. In Bangladesh, Dhaka's growing peri-urban belt exhibits radical land-use change, water stress, and informal settlement growth.

4.2 Peri-urban Development in Gujarat

Peri-urbanization is visible in Gujarat not only around major urban centres like Ahmedabad and Surat, but also on the outskirts of Vadodara, Rajkot, Gandhinagar, and the Dahej-Bharuch-Ankleshwar industrial corridor. In these areas, the conversion of agricultural land to industrial, residential, and institutional landuses is accelerated by GIDC estates, ring roads, and mega projects like Bullet train, Delhi-Mumbai Industrial Corridor (DMIC), and the Dholera Special Investment Region [9].

The large-scale land-use change has occurred in the vicinity of Dholera, Dahej - Bharuch –Ankleshwar, Vadodara, and Sanand, as rural agricultural lands are being transformed into new residential areas, industrial estates, logistics centers, and warehouses [5].

Improved connectivity through the Western Dedicated Freight Corridor and expressway links has made peripheral regions more accessible, stimulating real estate growth and encouraging businesses to relocate from congested urban centers to the periurban areas (See figure 2).

This has led to a diversification of livelihoods, with many rural households shifting from agriculture to industrial and service-sector employment. At the same time, peri-urban areas face challenges such as rising land prices, environmental stress, water scarcity, and governance overlaps between rural and urban authorities. Overall, DMIC has reshaped Gujarat’s peri-urban landscape by intensifying outward urban expansion and creating new economic zones that blur the boundaries between rural and urban spaces.

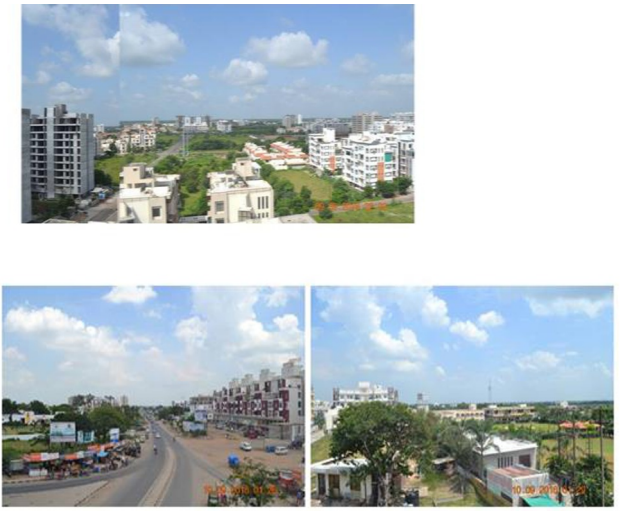

Fig.2. Periurbanization pattern in Gujarat
Source:Photos taken by the Author

4.3 Major Disasters in Gujarat and Periurban Region

Gujarat has experienced a wide range of disasters over the past 50 years, including major cyclonic strikes (such as the devastating 1998 Kandla cyclone), frequent monsoon floods, recurrent droughts (particularly in the 1970s, 1980s, and 2000s), and the historic 2001 Kachchh (Bhuj) earthquake. These events have collectively shaped the state's disaster profile and response systems [17] [18] [19].

These incidents revealed weaknesses in water management, coastal preparedness, urban drainage, and industrial safety throughout peri-urban and rural areas, and they resulted in widespread fatalities, displacement, and economic damages (EM-DAT; NDMA flood study). However, in last decade Gujarat has significantly intensified institutional preparedness in response to disasters. Following the 2001 earthquake, the state created the Gujarat State Disaster Management Authority (GSDMA), created state and district disaster management plans, made investments in early warning and communication systems, and carried out industrial and multi-agency mock drills.

While these actions improved coordination, there are still gaps in peri-urban land-use planning, community-level outreach, and water-resilience strategies [19][20].

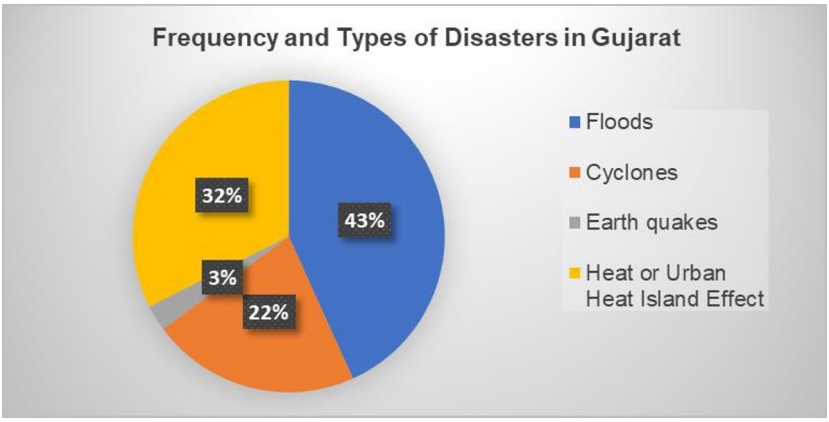

Fig.3. Frequency and types of disasters occurred in Gujarat
Source: Summaried from the data procured from [18] [20] [21].

Fig.4. Photos of disasters (Flood and Earthquake) occurred in Gujarat
Sources: https://en.wikipedia.org/wiki/2001_Gujarat_earthquake; https://www.bizzbuzz.news/national/gujarat-

Recurrent floods, drought episodes, coastal cyclone risk, and industrial accidents (such as recent chemical leaks in port-linked industrial belts) show that preparedness is still uneven despite significant advancements in infrastructure and response capacity. This is especially true in rapidly evolving peri-urban areas where governance overlaps, informal settlements, and strained services increase vulnerability (See figure 3).

The GSDM Act 2003 and GSDM policy provide the legal framework for disaster management in the state and structured a proactive approach for disaster mitigation and risk reduction. Beyond these the revisions and amendments have been made in Gujarat Development Control Regulations (GDCR), Town Planning Act and LandUse Planning systems (refer to figure 4-7).

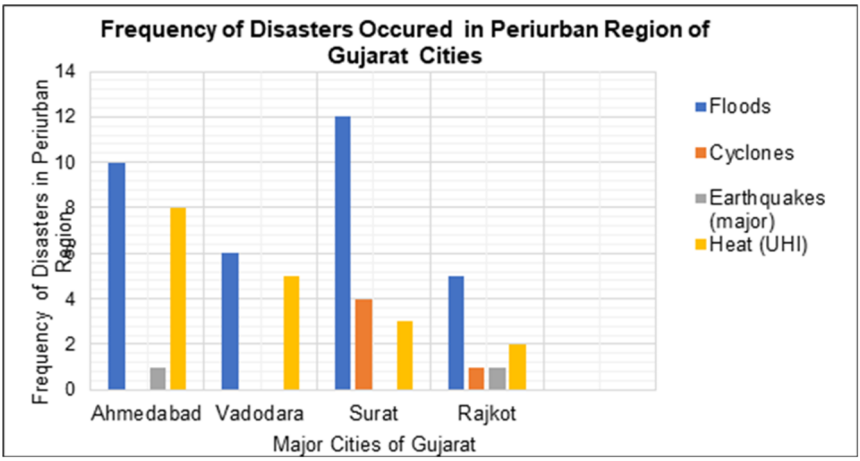

Fig.5. Frequency and types of disasters occurred in periurban regions of Gujarat cities
Source: Summaried from the data procured from [18] [20] [21].

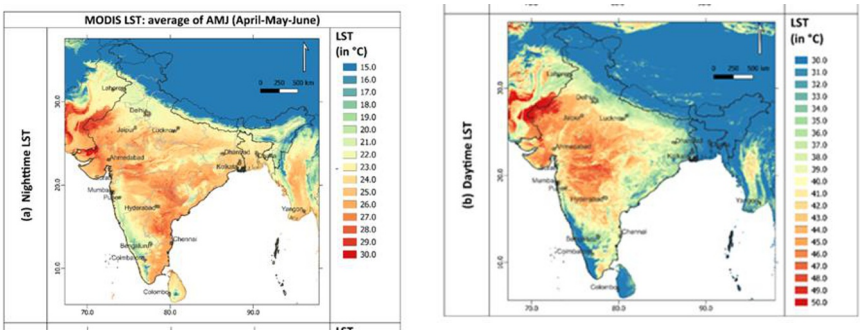

Fig.6. Night time and daytime temperature in India (Urban Heat Island Effect)
Source: Nath, Vohra & Prasad (2023) retrieve from https://www.mdpi.com/2076-3

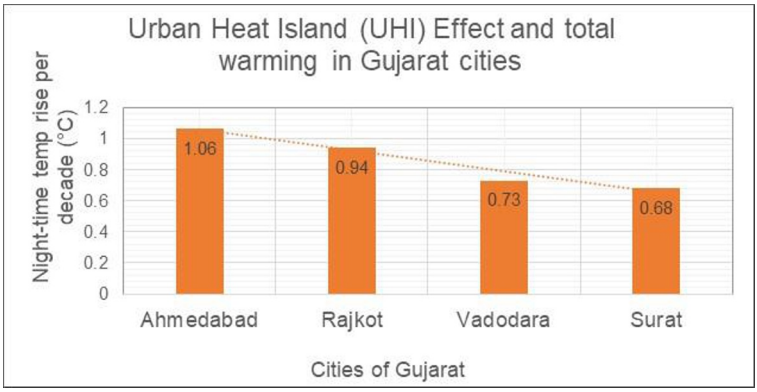

Fig.7. Urban Heat Island (UHI) Effect and total warming in selected Gujarat cities
Source: Summaried from the data procured [18] [20] [21].

Table 1. Comparative analysis of peri-urban change and Urban Heat Island (UHI) / Land Surface Temperature (LST) characteristics across major Gujarat cities (Ahmedabad, Vadodara, Surat, Rajkot) for the "last few years"

City	Study Period	Key LST / SUHI trend (last ~10–20 yrs)	Characteristics in Peri-Urban Region
Ahmedabad	2003–2018 (MODIS), 2003–2014 (other)	Nighttime SUHI increased winter SUHI rose from ~2.96°C in 2003 to ~4.04°C in a peak year; net multi-year increases ~0.3–0.6°C in some analyses). Daytime SUHI smaller.	Peri-urban/suburban areas show lower LST vs dense urban / industrial zones; vegetation (NDVI) strongly moderates LST.
Vadodara	2004–2024 (MODIS/GEE; recent pre-monsoon focus)	Mixed: some recent work shows daytime pre-monsoon LST decreased in parts of the city (e.g., ~41.9°C → ~37.7°C reported for 2004→2024 pre-monsoon in a recent analysis) attributed to NDVI gains; nevertheless hotspots persist and night warming is noted in other studies.	Rapid peri-urban expansion; peri-urban zones can be hotter where natural land is replaced by built surfaces, but targeted greening/peri-urban vegetation can reduce daytime LST.
Surat	1998–2018 (Landsat/LULC)	Urban LST > suburban LST; LST increases associated with built-up growth over two decades.	Peri-urban talukas (e.g., Kamrej) stayed cooler than the Surat urban core; expanding industrial and built land in peri-urban belts increases local LST.

Rajkot	2016–2021 (ward maps, Landsat 8) / HAP analyses	Persistent thermal hotspots; municipal mapping shows LST > 42°C hotspots in certain wards during summer; some long-term ambient warming (~0.3°C per year in one synthesis).	Peri-urban wards show mixed patterns, new built growth increases LST while peri-urban green patches may remain cooler; city HAP uses ward LST maps for targeting.

4.4 Periurbanization and Disaster Management in Gujarat

Peri-urban areas in Gujarat are under increasing pressure from rapid urbanisation, as agricultural land is converted into built-up zones, roads, and infrastructure. This transformation has made many peripheral regions highly impermeable, exacerbating water runoff and elevating the risk of urban flooding. As [22] argues, the existing disaster management framework in Gujarat often fails to integrate risk-reduction measures linked to this land-use change, leaving peri-urban populations especially vulnerable during high-intensity rainfall events [22]. The spread of impervious surfaces in these growing zones amplifies flash flood risk, while institutional capacity for managing these vulnerabilities remains fragmented [22].

Fig.8. Disaster management approaches
Source: https://www.bhujonline.in/guide/bhuj ,http://www.gsdma.org/

In response to these challenges, Gujarat has made concerted efforts to mainstream disaster risk reduction (DRR) within its urban planning strategies. The Gujarat Institute of Disaster Management (GIDM) is actively promoting "risk-informed urban planning" through training programs for architects and town planners, emphasizing resilience to floods, cyclones, earthquakes, and industrial hazards [17]. Furthermore, Gujarat has established institutions like the Gujarat State Disaster Management Authority (GSDMA) to conduct hazard mapping and vulnerability assessments across districts (refer to figure 8,9).

Fig.9. Comparative chart of heat stress and climate response capacity in Gujarat cities
Source: https://www.bhujonline.in/guide/bhuj, http://www.gsdma.org/

4.5 Nature-Based Approach of Planning, Periurbanization and Disaster Management in Gujarat

Gujarat has begun mainstreaming Nature-Based Approaches (NbS) into statutory planning instruments such as Development Plans (DPs), Town Planning Schemes (TPS) and city-level climate resilience projects, especially in coastal and flood-prone zones. The Gujarat Institute of Disaster Management (GIDM) highlights ecosystem-based interventions as part of disaster and climate adaptation planning, encouraging integration of wetlands, bio-shields and mangrove belts as preventive urban resilience strategies. The state is India's leading performer in mangrove restoration under the national MISHTI programme, adding 19,020 hectares of mangroves in two years, which function as a natural buffer against cyclones and storm surges in coastal planning jurisdictions like Kutch, Bharuch and Surat (refer to figure 10,11).

For urban areas, Ahmedabad has initiated green-roof and low-impact-development strategies in flood-prone TP Zones, with research showing that such green-infrastructure reduces runoff and mitigates urban flooding. The research by CEPT University (in collaboration with Indian Institute of Technology, Bombay IIT-Bombay) demonstrates that "green roofs" and other low-impact-development measures can significantly reduce urban flood risk by cutting flood volume by up to 62% and reducing runoff by 24%.

These NbS approaches are now reflected in planning and regulatory actions, including the use of urban waterbody restoration in DP zoning and TP sector-level layouts, incorporation of mangrove and coastal green-belt buffers in coastal city masterplans, and green-infrastructure elements in building-level guidelines and flood-resilient planning directives issued with support from GIDM (See table 2).

Table 2. Integration of Nature-Based Solution in planning, periurbanization and disaster management in Gujarat

City / Region	Major Peri-Urban NbS Intervention	Approx. Coverage (Tentative)	Disaster Risk Targeted
Ahmedabad (Periphery: Bopal–Thaltej–Sanand)	Urban lake rejuvenation, green corridors, bioswales	120–150 ha lake + 20–25 km green corridors	Flooding, Heat Stress
Surat Urban Fringe (Hazira–Dumas–Rander)	Mangrove buffer zones + coastal shelter belts	1,500–2,000 ha mangroves & wetlands	Cyclones, Coastal flooding, Storm surge
Vadodara (Padra–Ajwa–Gotri peri-urban belt)	Check-dams, pond revival, urban forestry	40–60 water bodies & 60,000–80,000 trees	Flash floods, Heat waves
Rajkot (Nana Mava–Kalawad Road)	Green roof pilots + recharge pits	5–10% of new large developments	Waterlogging, Heat stress
Gandhinagar–Adalaj	Riverfront + linear parks + percolation channels	8–12 km of green river edge	Floods, erosion
Coastal Kutch	Mangrove afforestation, dune restoration	2,000–2,500 ha	Cyclone & storm surge
Bharuch–Ankleshwar	Wetland and floodplain conservation	30–50 km river stretch	Floodplain overflow
Jamnagar	Coral-reef and marine sanctuary protection	150–200 km² sanctuary area	Cyclone swell & erosion

Source: [23] [20] [24] [25]

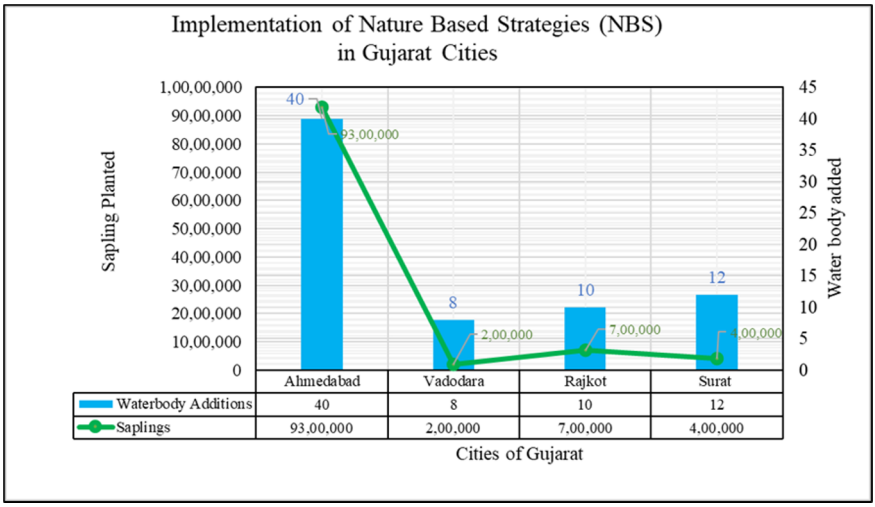

Fig.10. Implementation of Nature Based Strategies (NBS) in Gujarat cities
Source: The graph prepared by the author from the data analysis

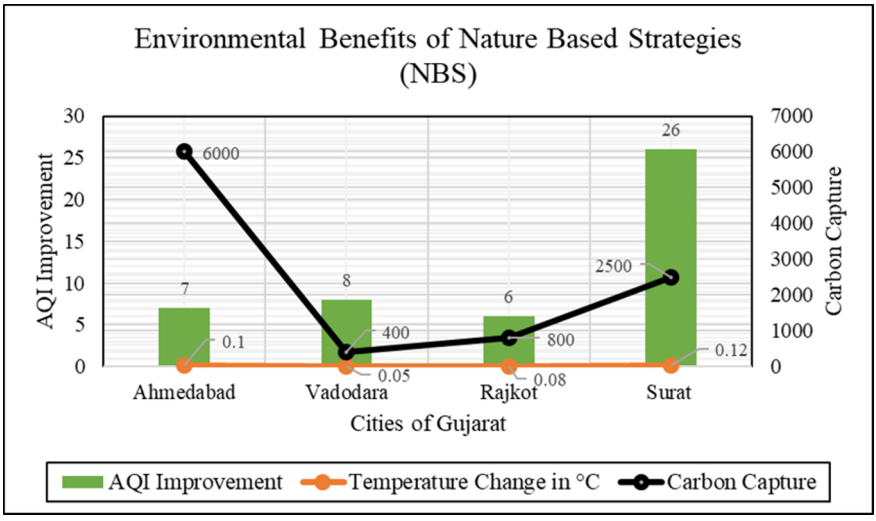

Fig.11. Implementation of Nature Based Strategies (NBS) in Gujarat cities and its benefits.
Source: The graph prepared by the author from the data analysis

5 Results & Discussion

5.1 Intensifying Climate Exposure in Peri-Urban Regions of Cities of Gujarat

The analysis indicates that peri-urban region of Ahmedabad, Surat, Vadodara and Rajkot experience the highest exposure to heat stress, flooding and

hydrometeorological shocks compared to their urban cores. Evidence from IMD and GSDMA reports shows peri-urban areas witnessed rising frequency of extreme heat days, widening impervious cover and reduced ecological buffers. This shows that peri-urban residential and semiresidential development locations function as climate stress amplifiers where unregulated land conversions, limited stormwater networks and expansion of industrial estates accelerate climate vulnerability

5.2 Emerging Disaster Risks Linked to Land Conversion in Peri-Urban Regions

Across all four cities, the pattern of peri-urban growth follows the conversion of agricultural and wetland systems into residential, semiresidential or industrial units . The findings align with previous studies highlighting that this rapid urban expansion increases surface runoff, heat island intensity and drainage stress. Field evidence also reveals higher flood incidences along urban fringes in Vadodara and Surat due to river and rivulet encroachment, while cyclonic exposure is more severe along Surat's coastal periphery. Thus, the risks are differentiated but spatially predictable.

5.3 Effectiveness of Nature-Based Solutions (NbS) for Planning and Housing Development and Disaster Management

Nature-based strategies including mangrove conservation in Surat, greenbelt buffers in Ahmedabad, watershed rejuvenation in Vadodara and peri-urban lake restoration in Rajkot emerge as the most cost-effective interventions compared to purely engineered solutions. NbS projects demonstrate measurable benefits such as reduction in flood intensity, improved infiltration and micro-climatic cooling. These results validate that NbS helps restore ecological functions that peripheral growth has historically degraded. However, the percentage of such initiatives are limited to selected public projects. The common housing and other semiresidential development minimally integrate the Nature-based strategies.

5.4 Institutional and Policy Integration Gaps

Despite progress, the results indicate that the inclusion of climate adaptation and NbS in Development Plans, Town Planning Schemes and building regulations remain partial and implementation dependent. While Ahmedabad Riverfront, Surat Flood Control and Vadodara Vishwamitri corridor projects illustrate integration success, policy frameworks lack unified standards for peri-urban zones. Thus, climate responses remain fragmented and often reactive.

5.5 Increasing Need for Resilient Planning

Overall results show that disaster risks in peri-urban regions are inseparable from city-scale planning decisions and infrastructure systems. The analysis concludes that integrated NbS, green zoning, blue-green networks and land-use regulations are guiding the transition from conventional disaster response toward climate-adaptive planning.

5.6 Policy Implementation Roadmap and Barriers

It is necessary to incorporate climate resilience into statutory planning tools so as to lower the probability of disaster in Gujarat's peri-urban areas.

In order to fulfill SDGs 11, 13, and 15 as well as Sendai Framework Priority 1, peri-urban risk mapping, ecological buffer protection, and climate-sensitive zoning should be incorporated into development plans (DPs) and town planning schemes (TPS). Building bylaws must require water-sensitive urban design, urban planning and heat mitigation methods.

The GSDMA, water and environment agencies, and urban development authorities should work together to lead implementation. The State Disaster Mitigation Fund, National Disaster Mitigation Fund, AMRUT 2.0, Smart Cities Mission, grants from the 15th Finance Commission, Compensatory Afforestation Fund Management and Planning Authority (CAMPA) funds, and public-private partnerships are some of the ways that funding can be raised.

Inadequate institutional coordination, a lack of funding specifically designated for peri-urban areas, slipshod enforcement of laws, a lack of ability in local government, and irregular land tenure are some of the main obstacles. Gujarat can achieve resilient peri-urban development by addressing these issues through targeted investment, integrated governance, and technical capacity building.

6 Conclusion

The comparative assessment of peri-urban regions in Gujarat demonstrates uneven but evolving climate adaptation capacities across cities (See table 1). While Surat leads in flood-resilience systems and early warning infrastructure, its peri-urban coastal ecology and mangrove belts remain under-integrated into mainstream planning.

Ahmedabad’s Heat Action Plan sets a strong benchmark but is inconsistently operationalized in rapidly urbanizing extensions. Vadodara’s wetland and river corridors offer untapped potential as hydrological buffers yet remain threatened by land conversion. Gandhinagar illustrates the value of green zoning and ecological reserves, although enforcement remains fragmented.

Across all cases, peri-urban regions emerge as the most climate-sensitive zones, where infrastructure gaps, rapid land-use change and exposure to hazards congregate.

The findings of the study highlight the urgent need to transform planning and regulatory frameworks into climate-responsive governance tools. Development Plans, Town Planning Schemes (TPS) and building bylaws (GDCR) must systematically embed nature-based solutions, such as wetland retention, floodplains, urban forests, permeable surfaces and coastal shelterbelts as mandatory elements rather than optional add-ons. Integrating these into land pooling, zoning and infrastructure guidelines would significantly reduce disaster vulnerability while enhancing ecosystem services. Without such reforms, peri-urban areas will continue to experience disproportionate climatic and hydrological risks, undermining both long-term resilience and sustainable growth trajectories for Gujarat's expanding urban footprint.

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