

BUILDING TRANSDISCIPLINARY TEAMS FOR COMPLEX PROBLEM SOLVING IN THE MUMBAI METROPOLITAN REGION

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Abstract:

This study examines sustainability governance in the Mumbai Metropolitan Region (MMR), where institutional fragmentation and sectorial silos constrain integrated climate planning and cross-sector coordination. Using a convergent parallel mixed-methods design, thematic analysis of twelve academic and policy documents was combined with survey data from 120 stakeholders to assess climate planning integration, governance effectiveness, and collaborative capacity. The finding shows that there is uneven sustainability implementation, limited collaboration and resource misalignment. Statistical analysis indicates significant interrelationships among governance indicators, highlighting the importance of institutional coordination. The study proposes the FISA Framework to strengthen collaborative governance and metropolitan resilience.

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Introduction:

Urban metropolitan regions support economic growth and advancement's but face rising environmental damage, climate-related threats, pressure on infrastructure, geographic disparities. These interconnected challenges restrict traditional department-based planning and require governance systems that combine environmental, economic, infrastructural, and social dimensions within organized systems. The Mumbai Metropolitan Region (MMR)— including Mumbai, Thane, Navi Mumbai, Vasai-Virar, and nearby urban centers—faces rapid population growth, need for infrastructure, flooding risks, air pollution, coastal exposure to risk, and land-use disputes. However, governance remains divided among multiple agencies with shared duties, limiting, joint sustainability planning. This study analyzes climate planning integration, cross-sector sustainability alignment, and collaborative governance efficiency in MMR. Using views of stakeholder and thematic policy analysis, it assesses how governance integration affects long-term metropolitan resilience and sustainable development

Statement of the Research Problem:

In spite of policy commitments to sustainable urban development Governance in the Mumbai Metropolitan Region still remains divided. Overlapping responsibilities in MMR cause of multiple agencies, restricting cross-sector coordination across transport, infrastructure, environment, and social development. Even though

sustainability initiatives exist, they are often integrated in isolated formats rather than through integrated metropolitan-level planning.

Existing literature documents identifies coordination challenges in Mumbai metropolitan region, yet stakeholder perceptions is evaluated by limited empirical research of governance integration and trans disciplinary collaboration in MMR. The main problem identified in this study is the absence of structured mechanisms that support coordinated sustainability implementation across institutional boundaries.

This study examines the degree of sustainability integration and institutional coordination within the Mumbai Metropolitan Region by combining conceptual analysis with empirical survey-based assessment This study examines the degree of sustainability integration and institutional coordination within the Mumbai Metropolitan Region by combining quantitative stakeholder perception data with qualitative thematic analysis of academic and contemporary policy discourse. Using a convergent parallel mixed-methods design, the research evaluates climate planning integration, cross-sector sustainability alignment, and collaborative governance capacity simultaneously. The findings are integrated at the interpretative stage to assess structural coordination gaps and institutional coherence within the metropolitan governance framework. This study seeks to address the following research questions: 1) To what level are sustainability objectives implemented across major sectors such as transport, infrastructure, environment, and social development in the Mumbai Metropolitan Region? 2) What institutional and governance gaps restricts effective cross- sector coordination in agencies operating in the MMR? 3) What practical collaboration challenges do stakeholders face in implementing transdisciplinary sustainability initiatives, and how can these be addressed?

Significance of the Study:

The study analyses how working together structures long-term development cooperation which enhances the metropolitan management studies. Stakeholder views and thematic policy review together improves the understanding of governance collaboration within complicated city systems. At the regional level, MMR represent an important case for sustainable governance in developing economies. Improving institutional coordination in MMR provide lessons relevant to other metropolitan regions facing similar division related challenges. At the policy level, the research identifies coordination weaknesses and suggests strategies to improve Trans disciplinary collaboration, supporting more unified, strong and adaptable metropolitan development.

Limitations of the Study:

The study is based on survey data from 120 participants, mainly students and private sector professionals, which may not fully represent policy decision-makers or government officials. The research depends on self-reported views, possibly causing personal bias. Also, the qualitative study is limited to public documents, not including internal organizational records that may provide more detailed understanding into coordination practices.

Objectives of the Study:

1. To evaluate the degree of integration of sustainability objectives across major sectors such as transport, infrastructure, environment, and social development within the Mumbai Metropolitan Region.

2. To identify gaps in existing collaborative governance mechanisms and assess the extent of institutional coordination among metropolitan agencies in MMR.
3. To examine stakeholder perceptions regarding the effectiveness of transdisciplinary collaboration in strengthening sustainable metropolitan development within the region.

Hypothesis of the Study:

Null Hypothesis (H₀₁): There is no significant continuity across the collaborative governance indicators.

Alternative Hypothesis (H₁₁): There is significant continuity across the collaborative governance indicators.

Null Hypothesis (H₀₂): There is no significant relationship across the collaborative governance indicators.

Alternative Hypothesis (H₁₂): There is a significant relationship across the collaborative governance indicators

Review of Literature:

Existing scholarship on sustainable metropolitan governance in the Mumbai Metropolitan Region (MMR) consistently identifies substantial weaknesses in climate change planning integration and cross-sector sustainability alignment. According to Sonam Sahu MMR's regional development framework shows that there is extremely low incorporation of climate mitigation and adaptation objectives, which shows that climate considerations are not perfectly rooted across planning sectors (Sahu, 2018). Same for, Amit Chatterjee he observed that sustainability objectives within metropolitan development policies remain divided, with limited institutional mechanisms which supports coordinated inter-sectoral implementation (Chatterjee, 2020). These findings are supported by modern developments. The Metro Line 12A extension indicates the coordination problems that arise when transport expansion intersects with environmental and land-use authorities operating under overlapping decrees. same as, recent climate finance policies aimed at positioning Mumbai as a sustainability investment hub indicating attempts at aligning governance, finance, and environmental priorities, yet reveal not even integration across departments, which suggests that cross-sector sustainability integration remains selective rather than systemic.

The inter-sectoral policy structural weaknesses are highlighted by analysis institutional in integration and sectoral sustainability alignment within MMR. The identification of Ishant Sharma and his colleagues show weak coordination in environmental, transport, infrastructure, and land-use agencies, which reflects persistent policy silos (Ishant Sharma, 2023). Raghav Chawla's research shows low strategic coordination across planning and infrastructure sectors, which is underscoring misalignment in metropolitan sustainability execution (Chawla, 2025). The indication by fiscal assessments segments allocation of regional development funds, which points towards weak inter-agency funding cohesion and limited financial integration of sustainability priorities (MMRDA, n.d.). These institutional gaps are mirrored by real world cases: regulatory conflicts between environmental authorities and infrastructure agencies indicates delay in overlapping jurisdictions coordinated decision-making, while integrated transport initiatives show that structured alignment mechanisms can increase sectoral sustainability coherence when deliberately implemented. These patterns suggest that institutional fragmentation, rather than absence of sustainability intent, constrains effective governance integration.

Recent scholarship increasingly divert focus towards transdisciplinary collaboration and stakeholder-level

coordination in complex urban systems. Network analysis of infrastructure megaproject governance by Aritra halder, including the Delhi–Mumbai Industrial Corridor, finds minimal stakeholder network density and precise influence patterns, which indicates in coordination complexity and asymmetrical decision-making power within multi-actor governance structures (Halder, 2024). this perspective is complimented by Carsten Butsch in his research the team argue that megacities such as Mumbai must be understood as complex adaptive systems, where multi-actor institutional interactions shape climate and risk governance results and need integrative, adaptive approaches rather than isolated technical solutions (Carsten Butsch, n.d.). Further Contemporary research indicates that integrating quantitative complexity analysis with transdisciplinary stakeholder engagement make system’s strong understanding and supports actionable sustainability pathways. News-based evidence highlights the same that stakeholder involvement mediates the relationship between risk mitigation practices and improved social project performance, which helps in reinforcing the centrality of perceived transdisciplinary collaboration effectiveness in achieving sustainable results. in spite of these insights, existing scholarship largely depends on qualitative policy analysis and institutional case studies, with limited empirical measurement of perceived integrative governance capacity or stakeholder perceptions of collaboration effectiveness within the MMR context.

Together, the reveal of literature persistent challenges in climate change planning integration, cross-sector sustainability alignment, inter-sectoral policy coherence, and collaborative governance capacity in the Mumbai Metropolitan Region. Whereas emerging policies indicate growing awareness of integrative approaches, structural fragmentation and uneven coordination continue to constrain systemic sustainability transformation. therefore, A clear research gap exists in the empirical assessment of stakeholder perceptions related to climate planning integration, policy alignment, funding cohesion, and transdisciplinary collaboration effectiveness. By compiling academic scholarship, contemporary developments, and primary survey data, the present study found this gap and advances structured evaluation of sustainability governance changes within MMR.

Research Methodology:

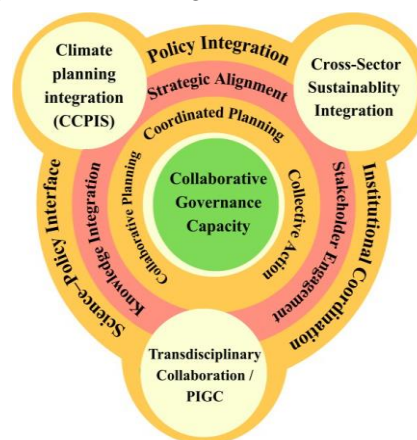
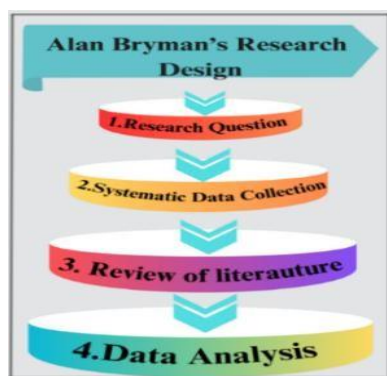


Figure 1: Alan Brymans research design model Figure 2: Collaborative governance underpinning theory
The study examines sustainability governance of Mumbai metropolitan region by looking at integrity of climate planning, cross sector coordination, and governance capacity of collaboration by a mixed method way. It is found

that sustainability objectives are highly understood by all metropolitan sectors but still their application are poorly handled because of separation of institution, mandates overlapping, and lesser coordination mechanism between multiple disciplines.

Governance effectivity, policy application and resource infrastructure expansion but rather on strong integrity of governance structures and formal collaboration methods. Structuring trans disciplinary governance should he addressed for better metropolitan resilience, policy constituency, and long-term urban development.

Data Analysis:

1. Thematic analysis based on review of literature and News articles

This table represents the regular governance challenges, institutional patterns, and coordination gaps identified through thematic analysis of academic literature and news articles relevant to sustainability integration in MMR.

Table 1: Thematic analysis governance patterns in Mumbai metropolitan regions

Category Theme /	Findings (Thematic Analysis)	Implications
Institutional Fragmentation	<ul style="list-style-type: none"> • Different agencies manage in MMR. • Overlapping compulsion exist across institutions. • coordination is limited of Inter- agency. 	Fragmented governance leads to <ul style="list-style-type: none"> • procrastination • Inefficient work • Inconsistent integration of sustainability policies.
Cross-Sector Sustainability Integration	<ul style="list-style-type: none"> • Objectives of Sustainability vary across sectors. • Sectoral silos persist. • Integration of Cross-sector remains limited. 	<ul style="list-style-type: none"> • Climate resilience weakens because of Lack of integrated planning. • Optimization of resources is affected. • The challenged is Long-term urban sustainability.
Transdisciplinary Collaboration Gaps	<ul style="list-style-type: none"> • Limitation of structured collaborations. . • Weak Cross-sector coordination • At the time of joint decision- making Stakeholders face challenges. 	<ul style="list-style-type: none"> • Formal coordination is required by Sustainable development. • Transdisciplinary collaboration is essential. • Institutional coordination is
		supported by sustainability.
Stakeholder Perception of Governance Capacity	<ul style="list-style-type: none"> • Governance effectiveness is perceived as moderate to weak. • Stakeholder trust remains limited. • Coordination challenges are evident. 	<ul style="list-style-type: none"> • Collaborative governance remains weak. • Stakeholder engagement is affected. • Policy implementation is undermined.
Resource & Policy Alignment Issues	<ul style="list-style-type: none"> • Funding initiatives remain sector-specific. • Infrastructure and economic priorities dominate. • Environmental and social concerns receive less focus. 	<ul style="list-style-type: none"> • Resource allocation remains misaligned. • Sustainability adoption is restricted. • Climate and social program impacts are reduced.

(Source: Sources: Study of variables derived from the reviewed literature, as cited in the reference list)

Findings and discussion on findings:

The thematic analysis of twelve documents (six academic papers and six contemporary news articles) shows several serious patterns in sustainability governance within MMR:

Climate Change Planning Integration – Climate objectives are often secondary to infrastructure and transport priorities. This weak integration indicates a gap between policy intent and sectoral practice. **Cross-Sector Coordination Gaps** – Multiple agencies manages in silos, creating divided decision-making. And coordination limits the ability to implement sustainability policies in a fixed manner. **Collaborative Governance & Stakeholder Engagement** –the note of lack of structured collaboration, trust deficiency, and mixed responsibilities by stakeholder, indicating the importance for trans disciplinary governance frameworks. **Policy-Implementation Misalignment** –for sustainable development policies exist, which unevenness the implementation due to divided resources and managing gaps undermines effectiveness. **Resource & Capacity** e assessment of institutional effectiveness.

2. Factor wise classification table for further analysis

To analyse the multidimensional perspectives of climate change governance and planning integration, the survey questionnaire items were grouped into particular analytical way based on conceptual relevance. Each factor shows a different dimension influencing climate planning effectiveness, coordination mechanisms, governance collaboration, implementation alignment, and institutional capacity. The following table represents the classification of factors with their corresponding questionnaire items used for analysis.

Table 2 : Factor-wise Classification of Study Variables and Questionnaire Items

Factors	Associated Questionnaire Items
Institutional Fragmentation	Q1, Q2, Q3
Cross-Sector Sustainability Integration	Q2, Q3
Transdisciplinary Collaboration Gaps	Q4, Q5, Q6
Stakeholder Perception of Governance Capacity	Q7, Q8
Resource & Policy Alignment Issues	Q9

(Source: primary data questionnaire)

The above classification shows formatted statistical analysis by grouping related questionnaire items into measurable dimensions. Q1–Q9 denotes items from the Google Forms survey questionnaire. This allowed us to calculate Descriptive Statistics of Collaborative Governance Indicators.

3. Descriptive statistics of Collaborative Governance Indicators.

To analyse the central pattern and variability of key collaborative governance indicators we have used descriptive analysis, particular for Climate Change Planning Integration Score (CCPIS), Cross-Sector Governance Strength and Effectiveness (CGSE), Policy Implementation Mechanism (PIM), and Resource Coordination Level (RCL). Overall understanding of institutional performance and consistency among the selected governance components within the study area is provided by the analysis.

Table 3: Descriptive Statistics of Collaborative Governance Indicators

CCPIS	CCPIS	CGSE	PIM	RCL
Mean	3.166666667	3.505555556	2.979166667	3.466666667
Standard Error	0.070346614	0.071876642	0.075869339	0.090077257
Median	3.166666667	3.666666667	3	4
Mode	3	4	3	4
Standard Deviation	0.770608548	0.787369165	0.83110697	0.986746912
Sample Variance	0.593837535	0.619950202	0.690738796	0.973669468
Kurtosis	0.416230158	1.110883615	0.429126524	-0.172837674
Skewness	-0.246919428	-0.785684189	-0.234256093	-0.412796609
Sum	380	420.6666667	357.5	416
Count	120	120	120	120

(Source: primary data collected through questionnaire)

Indicator’s mean value range between **2.97 and 3.50**, indicates a **moderate to good level of governance performance**. And **low standard deviation values** show confined variation in responses, which is suggesting consistency among governance components. Therefore, the results indicate **certain institutional perception**, supporting the presence of consistency across indicators

We accepted the **H₁₁ alternate hypothesis** based on the descriptive results, indicating consistency among collaborative governance indicators.

4. Correlation matrix of Collaborative Governance Indicators.

After descriptive statistical analysis, correlation analysis was calculated to evaluate the relationship and degree of relationship among the collaborative governance indicators. Pearson correlation analysis was used to decide the strength and direction of relationships among Climate Change Planning Integration Score (CCPIS), Cross-Sector Governance Strength and Effectiveness (CGSE), Policy Implementation Mechanism (PIM), and Resource Coordination Level (RCL). This analysis helps in understanding the degree of interrelationship across governance dimensions influencing collaborative metropolitan governance.

Table 4 : Correlation Matrix of Collaborative Governance Indicators

	CCPIS	CGSE	PIM	RCL
CCPIS	1			
CGSE	0.47858457	1		
PIM	0.366290667	0.395056258	1	
RCL	0.04052144	0.411250421	0.191274516	1

(Source: Primary data collected Correlation Matrix Calculated using Excel Data Analysis Tool Pack)

A moderate positive correlation exists between CCPIS and CGSE ($r = 0.478$), This indicating that improved climate planning integration is related with stronger cross-sector governance. PIM shows positive relationships with CCPIS ($r = 0.366$) and CGSE ($r = 0.395$), which is suggesting the effective policy implementation is supporting coordinated governance mechanisms. RCL demonstrates weaker but positive correlations, mainly with CGSE ($r = 0.411$), which is indicating partial linkage with governance effectiveness. Since most variables

demonstrate positive interrelationships, collaborative governance components are interconnected.

Based on the positive correlations among key indicators we rejected the **H₀₂ null Hypothesis** and accepted the **H₁₂ Alternative Hypothesis**. This is confirming the significant relationship among collaborative governance indicators.

Summary of Findings Based on Research Questions:

This study discovered sustainability governance in the Mumbai Metropolitan Region through thematic analysis and particular governance indicators. The findings disclose patterns of partial integration, determined fragmentation, and emerging collaborative potential.

RQ1: Sustainability Integration Across Sectors

Even though sustainability goals are visible across major sectors integration is still uneven. Planning efforts of course shows signs of coordination but sectoral silos influence implementation. A good relationship between planning integration and governance effectiveness implies that stronger inter agency alignment results in improvement of sustainability coherence.

RQ2: Institutional and Governance gaps.

Institutional fragmentations are the central constraints. Overlapping mandates, poor coordination mechanism, and lack of resources management results in weak cross sector collaboration. These gaps are the reasons for delays and inconsistent nature of sustainability outcomes

RQ3: Collaboration challenges and Pathways

Stakeholders noticed a gap between transdisciplinary engagement and execution of policy. However, it's found that improved coordination and institutional collaboration are directly influencing governance performance to be better, this highlights collaboration as a practical path forward

Overall interpretation

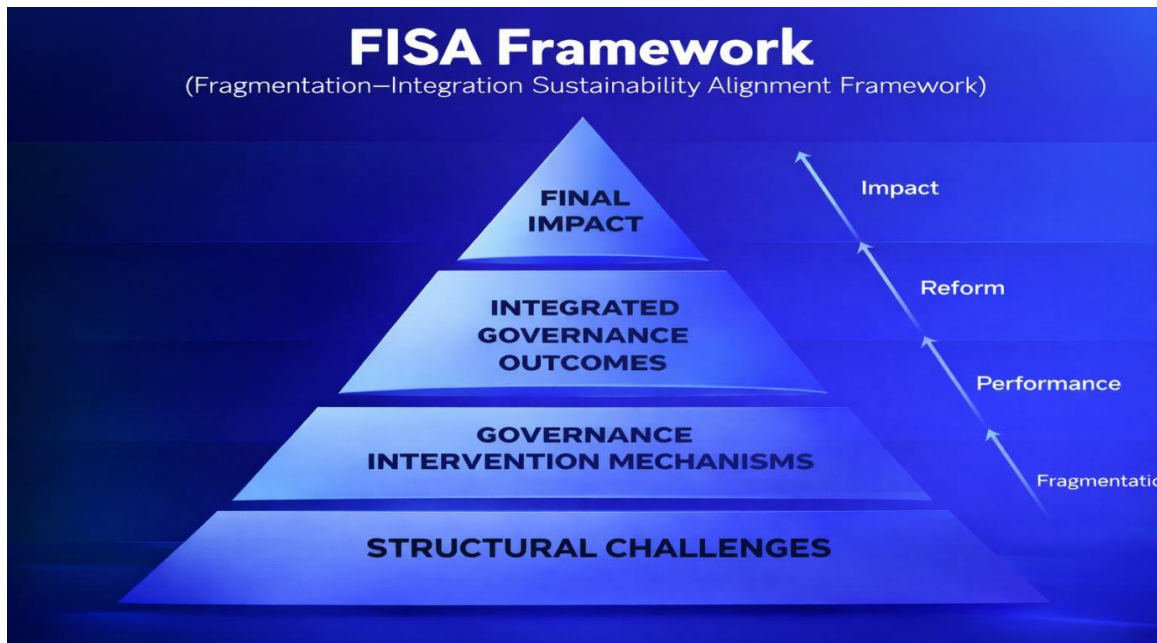
Overall, according to the evidences, Policy intent has less of an impact on sustainability challenges in MMR and is rather a problem of misalignment of various institutions.

Coordination governance mechanism strength holds more credibility in the advancing of resilient metropolitan development

Innovative suggestion for problem solving The FISA Framework:

(Fragmentation–Integration Sustainability Alignment Framework)

The **FISA Framework** is a theoretical management model developed to address institutional division and sustainability coordination challenges in the Mumbai Metropolitan Region. The model is structured into four step-by-step stages that move from identifying governance barriers to achieving sustainable metropolitan outcomes.



Model designed by team using canva

➤ **Structure of the Model (Four-Tier Architecture) Layer 1: Structural Challenges (Foundational Layer)**

These represent autonomous structural barriers derived through thematic examination:

Institutional Fragmentation, Sectoral compartmentalization, Deficient Transdisciplinary Architecture, Limited Governance Capacity Perception, Resource & Policy Mismatch

These factors obstruct institutional coordination, prolong execution processes, and Undermine sustainability consolidation.

Layer 2: Governance Intervention Mechanisms (Core Reform Layer)

These act as mediating instruments to address institutional framework:

Enhancing Metropolitan Coordinating Authority, Format Inter-Agency Sustainability committees, Integrated Budgeting Framework, Cross-Sector Information Exchange Mechanism, Participatory Governance Platforms

These mechanisms Institutionalize collaboration and enhance inter-sectoral coherence

Layer 3: Integrated Governance Outcomes (Intermediate Results)

This layer captures the immediate managerial and organizational improvements that emerge once governance reform action measures are systematically operationalized.

Better policy coordination, reduced overlapping of responsibilities, quicker decision-making, increased stakeholder trust, and better use of resources.

This stage reflects administrative efficiency enhancement in metropolitan governance.

Layer 4: Final Impact (Sustainability Outcomes)

Climate flexibility, Sustainable urban systems expansion, Social equity in Urban Planning, Long-Term Metropolitan Sustainability Represents long-term transformation through integrated governance architecture.

Conclusion:

The study examines sustainability governance of Mumbai metropolitan region by looking at integrity of climate planning, cross sector coordination, and governance capacity of collaboration by a mixed method way. It is found that sustainability objectives are highly understood by all metropolitan sectors but still their application is poorly handled because of separation of institution, mandates overlapping, and lesser coordination mechanism between multiple disciplines Governance effectivity, policy application and resource coordination are related to each other. Therefore, stronger institutional collaboration improves sustainability outcomes. Sectoral silos, improper resource alignment, and poor stakeholder participation are still major source of constraint for unified metropolitan planning. Overall, in conclusion, sustainable metropolitan development in MMR is not dependant on formation of policy or infrastructure expansion but rather on strong integrity of governance structures and formal collaboration methods. Structuring trans disciplinary governance should he addressed for better metropolitan resilience, policy constituency, and long-term urban development.

References

1. Carsten Butsch, F. K. (n.d.). *Risk governance in the megacity Mumbai/India – A Complex Adaptive System perspective*. Retrieved from ScienceDirect: <https://www.sciencedirect.com/science/article/pii/S0197397515303015>
2. Chatterjee, A. C. (2020, February 22). *Urban Development Policies in Metropolitan Regions*. In: *Satellite Towns in Neo-metropolitan Development in India*. Retrieved from Springer: https://doi.org/10.1007/978-981-15-1502-6_9
3. Chawla, R. J. (2025). *roject Management Analysis: Case of Mumbai Metro Project as an Alternate Mode of Transportation*. Retrieved from Springer: https://doi.org/10.1007/978-981-97-4988-1_21
4. Halder, A. (2024, may 18). *Social network analysis of stakeholder governance landscapes in infrastructure mega projects*. Retrieved from Springer: <https://doi.org/10.1007/s41062-024-01521-6>
5. Ishant Sharma, R. P. (2023). *Urban transport emissions under current and alternative mitigation policy scenarios for the Mumbai Metropolitan region*. Retrieved from ScienceDirect: <https://doi.org/10.1016/j.cstp.2023.101001>.
6. MMRDA. (n.d.). Retrieved from Mumbai Metropolitan Region Development Authority: <https://mmrda.maharashtra.gov.in/en/about-us/about-mmr>
7. Sahu, S. S. (2018, august 01). *Development of planning index for evaluating climate change protocols: analysis of Mumbai*. Retrieved from SpringerOpen : <https://doi.org/10.1186/s40410-018-0082-8>

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