Loacalizing Sustainabale Development Goal–11 Indicators

Ar. Shubham Chouhan

Town Planner & Architect

S.N. Architects (Architectural & Urban Planning Consultants)

Dewas (455001), India

Abstract— As the world rapidly urbanizes, with projections indicating that approximately 70% of the global population will live in urban areas by 2050, the need for sustainable and resilient cities becomes increasingly urgent. In India, this challenge is compounded by the anticipated addition of 404 million new urban residents, leading to heightened concerns about slum proliferation, unemployment, and deteriorating living conditions. Addressing these challenges is central to achieving Sustainable Development Goal 11 (SDG 11), which aims to make cities and human settlements inclusive, safe, resilient, and sustainable.

This study explores the role of urban planning in meeting SDG 11 by examining various global and national frameworks. The research integrates insights from existing literature and journal articles to develop a localized set of indicators for Indian cities. The frameworks reviewed include the Global Indicator Framework for the SDGs, India's National Indicator Framework on SDG 3.0, the SDG India Index by NITI AAYOG, and the North East Region District SDG Index.

The study identifies and compares indicators from these frameworks, focusing on key areas such as housing, transportation, land use, heritage preservation, disaster management, waste management, and open space accessibility. By localizing these indicators, the research ensures their relevance to Bhopal's unique context and data availability.

The finalized indicators include:

- Housing: Proportion of urban population in slums, coverage of affordable housing, and basic services.
- Public Transport: Convenient access for various demographics.
- Land Use: Ratio of land consumption to population growth, net density, and civil society participation in urban planning.
- Heritage and Disaster Management: Expenditure on heritage conservation and integration of disaster management in development plans.
- Waste Management: Collection, processing, and treatment of solid waste, with a focus on source segregation and impact from dumping yards.
- Open Space: Availability and accessibility of public open spaces.

Keywords—SDG 11, Sustainable Development Goals 11, Localization, Indicators, Framework.

1. INTRODUCTION

The concept of sustainable development first came to international attention during the 1972 Stockholm Conference, which laid the groundwork for integrating environmental considerations into global development practices. This idea was further developed in the 1980 World Conservation Strategy, marking the early days of the International Conservation Movement. The rapid, unchecked development following World War II inflicted considerable damage on socio-cultural integrity and the environment. In response, sustainability frameworks were established to address these challenges and guide future development towards a more balanced approach.

The United Nations Conference on Sustainable Development, held in Rio de Janeiro in 2012, was a pivotal moment in this ongoing effort. It resulted in the creation of the Sustainable Development Goals (SDGs), which replaced the earlier Millennium Development Goals (MDGs). While the MDGs focused primarily on reducing poverty and improving access to essential services, the SDGs introduced a broader and more integrated approach to global development. These goals address pressing environmental, political, and economic challenges, aiming to ensure that development is sustainable for future generations.

In 2015, the global commitment to sustainability was further reinforced by two critical frameworks: the COP21 Paris Climate Conference and the Sendai Framework for Disaster Risk Reduction, which was adopted in Japan. These agreements, together with Agenda 2030, established comprehensive global norms for creating safe, secure, and healthy living environments.

Agenda 2030 introduced 17 Sustainable Development Goals, which cover a wide range of issues, including poverty, hunger, health, education, gender equality, clean water and sanitation, affordable and clean energy, economic growth, industry and infrastructure, sustainable cities and communities, climate action, life below water, life on land, peace, justice, and global partnerships (Corbett and Mellouli, 2017). These goals are interconnected, meaning that progress in one area often supports progress in others. Collectively, they aim to balance social,

economic, and environmental sustainability, providing a global blueprint for promoting dignity, peace, and prosperity.

One of the most critical SDGs is Goal 11, which focuses on Sustainable Cities and Communities. As the world rapidly urbanizes—with an estimated 60% of the global population expected to live in urban areas by 2030—cities are becoming the epicenters of economic activity, but also of significant environmental and social challenges. Urban areas are projected to account for 70% of global carbon emissions and 60% of resource use, leading to unplanned urban sprawl, overburdened infrastructure, and the growth of slums. Goal 11 aims to address these issues by making cities inclusive, safe, resilient, and sustainable. It includes ten targets that focus on improving access to affordable housing, sustainable transportation, and green spaces, as well as reducing the environmental impact of cities and enhancing disaster resilience. Achieving these targets is crucial for improving the quality of life for urban residents and ensuring that cities can sustainably support their growing populations.

Figure 1: Sustainable Development Goals by UN Habitat

Global Scenario

For the first time since 2015, the SDG Index score has experienced a decline, primarily due to the widespread impacts of the COVID-19 pandemic. The pandemic has been a significant setback for development across all sectors, not only disrupting economies but also reversing progress in many areas. The global average SDG Index score has dropped considerably, driven by increased poverty and unemployment.
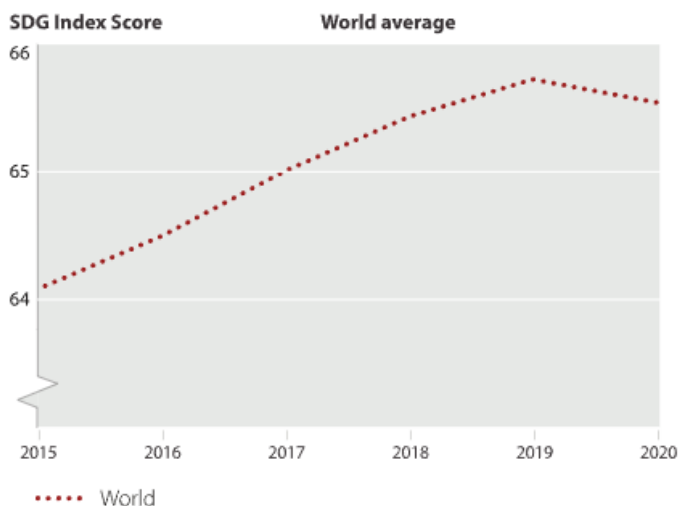

Figure 2: Average Global SDG Index Score
(Source: Sustainable Development Report 2021)

Before the pandemic, the world was making substantial progress on several Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty) and SDG 9 (Industry, Innovation, and Infrastructure). However, the pandemic has led to greater reliance on digital platforms, enhancing access to digital infrastructure worldwide. Another positive outcome has been the improvement of healthcare systems across the globe as nations responded to the health crisis.

The SDG Index is currently topped by three Nordic countries: Finland, Sweden, and Denmark. Among the top 20 countries, Croatia is unique as the only non-OECD member, while the rest are OECD countries, reflecting their strong frameworks for sustainable development. Since the SDG Index primarily measures progress in ending poverty and providing essential services, lower-income countries often show more significant improvements because they have more scope for development in these areas.
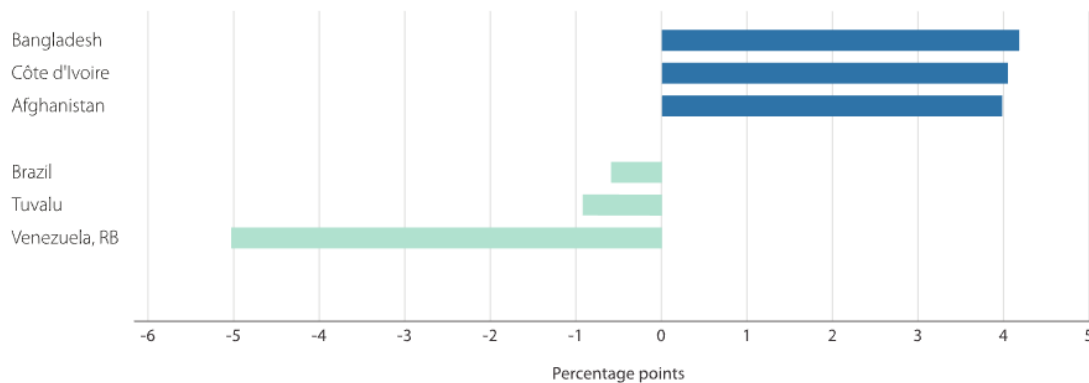

Figure 3: Countries with Greatest Increase/Decrease in SDG Index Scores
(Source: Sustainable Development Report 2021)

Countries that have made the most progress in the SDG Index include Bangladesh, Côte d'Ivoire, and Afghanistan, whereas Venezuela, Tuvalu, and Brazil have shown the least progress. Positive trends are observed in East and South Asia, while the Middle East and North Africa have shown a negative trend, particularly in SDG 11 (Sustainable Cities and Communities).

To track progress on the SDGs at the local level, various countries have developed their own indexes and frameworks, such as the City Prosperity Index (CPI) by UN-Habitat, the European Green City Index, the SDG Index for European Cities, and the SDG India Index by NITI Aayog. These frameworks, based on national data, help countries assess their progress and determine the next steps. Despite the clear understanding of the goals at the national level, many local governments and actors remain unaware of the SDGs, which hampers effective implementation

Indian Scenario

India faced significant challenges due to the COVID-19 pandemic, which led to a nationwide lockdown. This situation resulted in substantial setbacks in development, as well as increases in unemployment and poverty. The pandemic notably impacted India's progress on the Sustainable Development Goals (SDGs). In 2020, India was ranked 120th out of 165 countries evaluated, with an SDG Index score of 60.1, which is below the global average of 65.7. Most SDGs in India are either showing moderate improvement or are in decline, with only a few performing well individually.

Certain SDGs, including those related to poverty, health, energy, employment, and innovation, have shown decent performance. However, SDG 11 (Sustainable Cities and Communities) has underperformed significantly in India. One of the major challenges is the limited availability of data at the national level, which complicates accurate assessment. For SDG 11, only four indicators were used, with transportation showing positive trends while other indicators have been in decline.

The Indian government has launched several schemes and policies aligned with the SDGs. Key initiatives include the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), the Smart Cities Mission, Pradhan Mantri Awas Yojana, the National Urban Transport Policy (NUTP), and the Swachh Bharat Mission. These efforts have shown considerable success and are expected to improve India's SDG Index scores in future evaluations.

To assess progress at the state level, frameworks such as the SDG India Index by NITI Aayog, the National Indicators Framework, and the North-Eastern Regional SDG Index have been developed. According to the most recent SDG India Index report for 2020-2021, Kerala and Himachal Pradesh are leading with scores of 75, while Jharkhand and Bihar have lower scores of 56 and 54, respectively.

Figure 4: SDG Trend in India

2. THEORETICAL BACKGROUND

2.1 Need for the study

With rapid urbanization, approximately two-thirds of the global population is expected to live in cities by 2050. This trend poses significant challenges, including increased poverty, unemployment, and social disparities. In India, cities contribute 60% of the GDP but are responsible for 70% of carbon emissions, highlighting their critical role in sustainable development.

While national indices assess SDG progress, city-level evaluations are also essential. Few countries have developed frameworks for this, making it important to create systems that track urban progress toward SDGs. NITI Aayog in India is working on district-level frameworks, emphasizing the need for localized approaches.

SDG 11, focusing on sustainable cities, is chosen for this study due to its broad impact on other SDGs and its reliance on geospatial tools. The study aims to:

- Review SDG 11 and related frameworks.
- Localize international and national frameworks with a focus on spatial data.

2.2 Literature Study

Urbanization is advancing rapidly, with forecasts suggesting that by 2050, 70% of the global population will reside in urban areas. In India, this will add approximately 404 million people to cities. This growth is intensifying issues like slum development, unemployment, and deteriorating living conditions, emphasizing the need for sustainable urban solutions. SDG 11 focuses on making cities inclusive, safe, resilient, and sustainable to address these challenges.

The study involved reviewing various sources and frameworks to understand SDG 11. Key aspects include:
- Target 11.1: Ensures that by 2030, everyone has access to adequate, affordable housing and basic services, and that slums are upgraded.
- Target 11.2: Aims to provide accessible, safe, and affordable transportation for all, with special attention to vulnerable groups.
- Target 11.3: Promotes sustainable and inclusive urbanization through participatory planning and management.
- Target 11.4: Focuses on protecting the world's cultural and natural heritage.
- Target 11.5: Seeks to reduce the impact of natural disasters, focusing on minimizing deaths, economic losses, and protecting vulnerable populations.
- Target 11.6: Aims to lower the environmental footprint of cities, including improvements in air quality and waste management.
- Target 11.7: Ensures universal access to safe, inclusive green and public spaces.
- Target 11.a: Encourages development planning that strengthens connections between urban, peri-urban, and rural areas.
- Target 11.b: Supports policies for inclusion, resource efficiency, and disaster risk management.

The goal of this study is to adapt the SDG framework for local application, focusing on integrating national and international frameworks with spatial data to enhance urban planning and development.

Journals on SDG 11

1. Role of Urban Planning in Achieving SDG 11 in India

Prof. Chetan Vaidya (2020)

This paper explores the impact of urban planners on achieving SDG 11 in India, highlighting key government initiatives like AMRUT and Smart Cities Mission. It assesses how these initiatives contribute to the goals and identifies indicators for SDG 11 relevant to India.

2. Voluntary Local Review Framework for SDG 11

Taher Osman et al. (2021)

This study focuses on localizing SDG 11 indicators at the city level. It reviews frameworks like the City Prosperity Index and European Green City Index, emphasizing the need for tailored frameworks based on data availability and city-specific conditions.

3. Geospatial Technology for SDG 11

Junyoung Choi et al. (2016)

The paper examines how open geospatial technologies can aid in monitoring SDG 11, with a focus on South Korea. It finds that while some indicators can be mapped geospatially (e.g., SDG 11.1, 11.5, 11.6), others require statistical measurement.

4. Evaluating Urban Disaster Resilience and Environmental Cleanliness

Yani Wang et al. (2019)

This research develops a method for evaluating urban disaster resilience and environmental cleanliness, focusing on indicators like economic losses and waste management. It highlights the importance of data availability for accurate indicator localization.

5. Measuring Urban Sustainability in India

Shrimoyee Bhattacharya et al. (2016)

The study develops a framework to monitor SDG 11 in India, using indicators related to housing, water, sanitation, and transportation. It categorizes indicators into well-being, equity, efficiency, and foresight, finding a bias towards efficiency.

6. Accelerating SDG 11 Implementation through Local Initiatives

Ana C L Almeida et al. (2018)

This paper evaluates local initiatives in Brazilian municipalities and their impact on SDG 11. It suggests that competition among cities can motivate improvements and discusses indicators related to economic, social, and environmental dimensions.

7. Earth-Observation for Slum Indicators

Monika Kuffer et al. (2018)

The research explores using earth observation techniques to evaluate slum indicators for SDG 11. It addresses challenges in applying these methods in densely built areas like India, focusing on parameters such as roofing material and density.

8. Land Consumption and Population Growth

Ishiyaku Abdulkadir et al. (2019)

This study assesses the ratio of land consumption to population growth for SDG 11.3.1 using Landsat data and census information, providing a method for evaluating urban land use in relation to population trends.

9. Access to Public Transit

Kyle Wiebe (2018)

The paper measures convenient access to public transit for SDG 11.2 using GIS and survey data. It evaluates factors like bus frequency and travel time, proposing a practical method for assessing transit accessibility.

10. Green Space Accessibility
Aseel B. Kmail et al. (2020)
This research uses GIS to analyze green space accessibility in Dundee, Scotland. It assesses the ratio of population served by green spaces, considering factors like travel cost and service area.

11. Public Open Spaces in Urban Areas
Qiang Chen et al. (2020)
The study evaluates the distribution and accessibility of public open spaces in Deqing County using various spatial analysis models. It finds a positive relationship between urban public space development and population distribution.

3. FRAMEWORK LOCALIZATION

Global Framework 1
Global Indicator Framework for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development.

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.1	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	11.1.1 Proportion of urban population living in slums, informal settlements or inadequate housing.	Security of Tenure: • Proportion of households with formal title deeds to both land and residence. • Proportion of households with formal title deeds to either one of land or residence. • Proportion of households with Inadequate housing Proportion of households with net monthly expenditure on housing exceeding 30% of the total monthly income of the household.	Percentage of people living in Slum/Informal Settlements households (SISH): 100[Number of people in SISH/Total Population]	Security of Tenure Access to improved water resources: a. Proportion of household already having access to improved drinking water sources. b. Overlaying drinking water layout plan of AMRUT mission over development plan and calculating Proportion of household that would further be included. c. Calculating projected water requirement and comparing it with provisions in Development Plan. Access to improved sanitation facilities: a. Combining existing severage network and proposed network, then calculation the proportion of household served by it. b. Proportion of household with toilets. Slum Calculating proportion of slum (Both area and population) Calculation housing shortage due to slum and comapring it with provision in Development Plan	Water Resources a. Census data b. Development Plan c. Amrut Plan	Water Resources and Sanitation a. Municipal Report Slum: Housing Slum Population 2019 (Smart city)	Spatial

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	1. Service Area- The network analysis operation (using GIS) by constructing a zone of proximity along street networks around each public transport stop or each public transport route. 2. Population Served- The next step is to overlay the area onto other polygons, such as census tracts or zones, for which socio-demographic data is available.	A service area (denoted as i) intersects, either fully or partially, with more than one population zone j (j=1.....J). The population served by the public transport service in buffer i, Pi, is thus equal to the sum of the population of all population zones that intersect with the created service areas, Pij . Hence, Pi=ΣPij Finally, the share of the population with convenient access to public transport out of the entire city population will be computed as: %Population with convenient acces to Public Transport= 100x(Population served by service area/Total Population)	Proximity analysis of BRTS and Metro stops and population served by it.	a. Development Plan 2031 b. Census	a. BCCL BRTS Report b. Madhya Pradesh Metro Rail Corporation Ltd. Report	Spatial
11.3	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1: Ratio of land consumption rate to population growth rate	1. Deciding on the analysis period/years 2. Delimitation of the urban area or city which will act as the geographical scope for the analysis 3. Spatial analysis and computation of the land consumption rate 4. Spatial analysis and computation of the population growth rate 5. Computation of the ratio of land consumption rate to population growth rate	The ratio of land consumption rate to population growth rate= (Land consumption rate/ Population growth rate)	1. Getting Landsat data and analyzing the land consumption rate. 2. Calculating Population growth rate. 3. Computing ratio of land consumption rate to population Growth rate. 4. Calculation ratio of proposed land consumption and projected population.	a. LULC (land use land cover) data BHUVAN b. Census	a. Development Plan 2031	Spatial
		Indicator 11.3.2: Proportion of cities with a direct participation structure of civil society in urban planning and management that operates regularly and democratically	A scorecard approach to evaluate the available structures for civil society participation in urban planning and management, as evaluated by five (5) local experts from government, academia, civil society and international organizations.	As a result, if we have N cities selected for the evaluation in a given country, and n is the number of cities with scores that are higher than the mid-point, the value of the indicator will be calculated as: Value of indicator= n/N (in percentage)	Interview based approach to stakeholders indentified from Development Plan	Development Plan 2031 Survey		Statistical

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.4	Strengthen efforts to protect and safeguard the world's cultural and natural heritage	11.4.1 Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage, by source of funding (public, private), type of heritage (cultural, natural) and level of government (national, regional, and local/municipal)	Dividing total public funding in heritage from government and the total of private funding from households, other private sources such as donations, sponsorships or international sources in a given year by the number of inhabitants.	HCExp per capita = (ΣEXPpu+ΣEXPpr)/Total Population\n\nHCExp- Expenditure per inhabitant in heritage\n\nEXPpu- Sum of public expenditure by all levels of government on the preservation, protection and conservation of cultural and/or natural heritage.\n\nEXPpr- Sum of all types of private expenditure on the preservation, protection and conservation of cultural and/or natural heritage.			
11.5	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	11.5.1: Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	Adding all the person who lost their lives, missing person and who are affected directly by distaster and dividing it by total population multiplied by 100000	X= { [A1+A2+B1]/ Global Population}*1,00,000\n\nA1 Number of deaths attributed to disasters\nA2 Number of missing persons attributed to disasters\nB1 Number of directly affected people attributed to disasters	Number of person died in covid-19+ numer of people directly affected by Covid-19	a. Worldometer b. Ourworldindata	a. Nagar Nigam Database	Statistical
		11.5.2: Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters						
11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.	11.6.1: Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated by cities	Category 1 [Total MSW collected / Total MSW generated]*100\n\nCategory 2 [Total MSW managed in controlled facilities/ Total MSW generated]*100	SDG 11.6.1= [Total MSW collected and managed in controlled facilities/ Total MSW generated]*100	Category 1 [Total MSW collected / Total MSW generated]*100\n\nCategory 2 [Total MSW managed in controlled facilities/ Total MSW generated]*100	a. Swachta Survekshan Data		Statistical
		11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)	The annual urban mean concentration of PM2.5 is estimated with improved modelling using data integration from satellite remote sensing, population estimates, topography and ground measurements		Annual Mean concentration of PM2.5	a. Air Quality Index, Bhopal		Statistical

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.7	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities	1. Spatial analysis to delimit the city/urban area.\n\n2. Spatial analysis to identify open public spaces, ground verification and estimating their total area.\n\n3. Estimation of the total area allocated to streets.\na. Calculate the average land allocated to streets for all sample areas.\n\n4. Estimation of share of population with access to open public spaces within 400 meters walking distance out of the total population in the city/ urban area.\na. Create 400 meters walking distance service area from each open public along the street network.\nb. overlay the created service area with high resolution demographic data, which should be disaggregated by age, gender, and disability.	Share of land occupied by OPS= (Total area covered by OPS/Total area of city)*100\n\nThe land allocated to streets= (Sum of LAS from all sampling points/ total number of sampling points)\n\nShare of Built-up area in city that is open Space in public use%= (Total surface of OPS+ Total land allocated to street)/Total Area of city\n\nShare of population with access to open space in public spaces%= Total population within 400m service area/ total population of city	1. Proportion of open space to total development space. Comparing it with URDPFI guidelines.\n\n2. Ped Shed Analysis of Open Public spaces and calculating proportion of population it serves.	a. Development Plan 2031\nb. Census\nc. URDPFI Guidelines		Spatial
		11.7.2: Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months	This is a survey-based indicator that measures the experience of any of a set of behaviours that are collectively referred to as physical harassment and sexual harassment.\nQuestions on physical and sexual harassment are to be measured separately.\n\nPrevalence rate of sexual harrasment= (No. of people who experienced sexual harrasment/ Total no. of People surveyed)*100\n\nPrevalence rate of physical harrasment= (No. of people who experienced physical harrasment/ Total no. of People surveyed)*100	Prevalence rate of sexual and Physical harrasment= (No. of people who experienced sexual and physical harrasment/ Total no. of People surveyed)*100	Survey in every ward and determining Prevalence rate of Physical Harrasment	Primary Data (Survey)		Statistical

Figure 5: Global Framework

National Framework 1

National Indicator Framework on SDG 3.0 _India

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.1	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	11.1.1 : Percentage of Slums/Economically Weaker Sections (EWS) households covered through formal/affordable housing.			(Number of houses completed under PMAY or related schemes/ Total number of houses sanctioned)*100	PMAY Report		Statistical
		11.1.2 : Percentage of Slum Area Covered with basic Services			1. Calculating area of slum. 2. Calculating Area of slum that is proposed under AMRUT scheme to provide basic services.	1. Development Plan 2031 2. Census 3. Amrut Plans	Housing Slum Population 2019 (Smart city)	Spatial
		11.1.3 : Proportion of Urban Population Living in Slums, Informal Settlements or Inadequate Housing			1. Calculating Poulation living in Slum, Inadequate housing. 2. Calculating housing shortage and comaring it with recommendation in development plan	1. Census 2. Development Plan 2031		Statistical
11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	11.2.1 : Proportion of cities with efficient urban mobility and public transport			1. Calculating percentage of area dedicated to streets and comparing it with URDPFI guidelines. 2. Buffer analysis of Public Transport	1. Development Plan 2031 2. URDPFI Guidelines 3. Census	1. UNESCAP Bhopal Comprehensive Mobility Plan-2031	Spatial
		11.2.2: People killed/injured in road accidents	The indicator gives the total number of people killed (injured) due to road traffic accidents during reference year per population of reference year.	(People killed (injured) due to road traffic accidents during reference year / Mid-year population of reference year)* 1 ,00,000	Number of people killed or injured in road accidents/ total population of the year	1. National Crime Records Bureau Reports 2. Census		Statistical
11.3	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	11.3.1 : Proportion of cities with integrated development plans.	The indicator gives the proportion of cities with Master plan during reference year.	(Number of cities with Master plan during refrence year / Total number of cities during the reference year)*100				
		11.3.2 : Share of Mixed Land Use Area in overall city land use	Proportion of Mixed Land Used in whole land use plan	(Area Designated to Mixed Land Use/ Total Area of Development)*100	1. Caculating the percentage of area designated to mixed land use in development plan 2031 and comparing it with URDPFI Guidelines	1. Development Plan 2031		Spatial+ Statistical
		11.3.3 : Net Density	Population Density	Calculating Population Density	1. Calculating the area required to maintain the net density as per URDPFI guidelines for the projected population	1. Development Plan 2031 2. URDPFI Guidelines 3. Census		Statistical

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.4	Strengthen efforts to protect and safeguard the world's cultural and natural heritage	11.4.1: Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage	Total funding from central government in the preservation, protection and conservation of cultural and/ or natural heritage for a given year per capita.	(Expenditure for conservation, preservation and environmental development of monuments / Projected population for the reference period)				
11.5	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	11.5.1 : Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	The number of people who died, went missing or were directly affected by disasters per 100,000 population.	{(A2+A3+B1)/ Poulation}*100000 A2: Number of deaths attributed to disasters; A3: Number of missing persons attributed to disasters; and B1: Number of directly affected people attributed to disasters	Number of person died in covid-19+ numer of people directly affected by Covid-19	a. Worldometer b. Ourworldindata	a. Nagar Nigam Database	Statistical
11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 : Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities			[Total MSW collected / Total MSW generated]*100	a. Swachta Survekshan Data	a. Nagar Nigam Database	Statistical
		11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)			Annual Mean concentration of PM2.5 and PM10	a. Air Quality Index, Bhopal		Statistical
		11.6.3: Number of days the levels of fine particulate matter (PM2.5 and PM10) above mean level			1. Calculating the annual mean concentration of PM2.5 and PM10 (Same as 11.6.2) 2. Calculating the number of days that fall above the annual mean concentration	a. Air Quality Index, Bhopal		Statistical
		11.6.4: Percentage of wards with 100% door to door waste collection	Determining the wards where waste collection is done to 100%	(Number of wards with 100% door to door collection/ Total number of wards)*100	Percentage of wards with 100% door to door MSW collection in city.	a. Nagar Nigam Swachhta Department		Spatial+ Staistical
		11.6.5: Percentage of waste processed	The percentage of total waste processed out of total waste generated during reference year.	(Total waste processed during reference year/ Total waste generation during the reference year)*100	[Total MSW collected / Total MSW generated]*100	a. Swachta Survekshan Data	a. Nagar Nigam Database	Statistical

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.7	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	11.7.1: Proportion of households reporting an open space within 500 meters from premises (urban)			1. Buffer analysis of area covered under 500m of open public space in entire city. 2. Calculating proportion of population covered under buffer zone. 3. calculating proportion of household under 500m from Open Space	a. Development Plan 2031 b. Census		Spatial
11.a	Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning	11.a.1: Proportion of cities with Master plans	The indicator gives the proportion of cities with Master plan during reference year. (Same as 11.3.1)	(Number of cities with Master plan during reference year / Total number of cities during the reference year)*100				
11.b	By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	11.b.1: Whether the country has adopted and implemented national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	National and local disaster risk reduction strategies should be based on, and aligned with, the guiding principles, scope, outcomes, and strategic priorities of the Sendai Framework.					
		11.b.2: Proportion of local governments that adopt and	The indicator is defined as the percentage of districts that have adopted and	(Number of districts that have adopted and implemented local				
11.c	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials							

Figure 6: National Indicator Framework

National Framework 2

SDG India Index - NITI AAYOG

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.1	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	11.1.1 Percentage of urban households living in katcha houses			(Number of household living in katcha house/ Total number of household)*100	Census		Statistical
		11.1.2 Percentage of urban households with drainage facility	Percentage of urban households with drainage (Underground + Covered pucca + Open pucca)	(Numer of household with drainage facilities/ Total number of household)*100	Proportion of household covered by drainage system (Proposed and Existing)	Sanitation: a. Development Plan b. Amrut Plan c. Swachta Survekshan Data	a. Municpal Report	Spatial
		11.1.3 Percentage of individual household toilets constructed against target (SBM(U))	The target of 100% IHHL has been aimed by Government of India This indicator estimates the achieved target.	(Number of IHHL units constructed/ Number of IHHL units targeted to be constructed)*100	(Number of IHHL units constructed/ Number of IHHL units targeted to be constructed)*100	a. Swachta Survekshan Data		Statistical
11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	11.2.1 Deaths due to road accidents in urban areas (per 1,00,000 population)	The indicator gives the total number of people killed (injured) due to road traffic accidents during reference year per population of reference year.	(People killed (injured) due to road traffic accidents during reference year / Mid-year population of reference year)* 1,00,000	Number of people killed or injured in road accidents/ total population of the year	1. National Crime Records Bureau Reports 2. Census		Statistical
11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 Percentage of wards with 100% door to door waste collection (SBM(U))	Determining the wards where waste collection is done to 100%	(Number of wards with 100% door to door collection/ Total number of wards)*100	Percentage of wards with 100% door to door MSW collection in city.	a. Nagar Nigam Swachhta Department		Spatial+ Staistical
		11.6.2 Percentage of MSW processed to the total MSW generated (SBM(U))	The percentage of total waste processed out of total waste generated .	[Total MSW Treated (Tones/Day)/ Total MSW Generated (Tones/ Day]*100	[Total MSW collected / Total MSW generated]*100	a. Swachta Survekshan Data	a. Nagar Nigam Database	Statistical
		11.6.3 Percentage of wards with 100% source segregation (SBM(U))	Determining the wards where waste collection is done to 100%	(Number of wards with 100% source segregation / Total number of wards)*100	(Number of wards with 100% source segregation / Total number of wards)*100	a. Swachta Survekshan Data	a. Nagar Nigam Database	Spatial+ Staistical
		11.6.4 Installed sewage treatment capacity as a percentage of sewage generated in urban areas	Detremining ratio of the total sewage treated to total sewage generated	(Total Sewage Treatment Capacity/ Total sewage generated)*100	1. Calculating total sewage generation. 2. calculating total required Capacity of treatment plant 3. Comparing it with te provision in Development Plan 2031	a. Census b. Development Plan 2031 c. URDPFI Guidelines		Statistical

Figure 7: SDG Index- NITI AAYOG

National Framework 3

North East Region District SDG Index

Target No.	Target	Indicators	Measurement by document	Methodology	Measurment in Bhopal Context	Data Source	Possibility of Traingulation	Remarks
11.1	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	11.1.1 Houses completed under Pradhan Mantri Awas Yojana (PMAY) and/or other schemes as a percentage of net demand assessment (Urban)	One of the major sceme is PMAY for affordable housing aiming at Housing to all.	(Number of houses completed under PMAY or related schemes/ Total number of houses sanctioned)*100	(Number of Houses completed under PMAY/ Number of Houses Sanctioned)*100	PMAY- Housing for all (City-Wise Progress)		Statistical
		11.1.2 Percentage of individual household toilets constructed against target (SBM(U))	The target of 100% IHHL has been aimed by Government of India. This indicator estimates the achieved target.	(Number of IHHL units constructed/ Number of IHHL units targeted to be constructed)*100	(Number of IHHL units constructed/ Number of IHHL units targeted to be constructed)*100	a. Swachta Survekshan Data		Statistical
11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	11.2.1 Deaths due to road accidents in urban areas (per 1,00,000 population)	The indicator gives the total number of people killed (injured) due to road traffic accidents during reference year per population of reference year.	(People killed (injured) due to road traffic accidents during reference year / Mid-year population of reference year)* 1 ,00,000	Number of people killed or injured in road accidents/ total population of the year	1. National Crime Records Bureau Reports 2. Census		Statistical
11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	11.6.1 Percentage of wards with 100% door to door waste collection (SBM(U))	Determining the wards where waste collection is done to 100%	(Number of wards with 100% door to door collection/ Total number of wards)*100	Percentage of wards with 100% door to door MSW collection in city.	a. Nagar Nigam Swachhta Department		Spatial+ Staistical
		11.6.2 Percentage of Municipal Solid Waste (MSW) treated out of total MSW generated	The percentage of total waste processed out of total waste generated .	[Total MSW Treated (Tones/Day)/ Total MSW Generated (Tones/ Day]*100	[Total MSW collected / Total MSW generated]*100	a. Swachta Survekshan Data	a. Nagar Nigam Database	Statistical

Figure 8: North East Region District SDG Index

THE FINALIZED INDICATORS

Indicators Comparison

To determine the final Indicators, all the available indicators in the studied frameworks needs to analysed at a single place and based on which the final indicators can be extracted based on the data availability in development plan of Bhopal city. NITI AAYOG's Urban Index has been taken as the baseline and then further indicators have been selected. Table 7 shows the comparative indicators:

"Target No.	Global Indicator	National Framework Indicator	NITI AYOG National Framework Indicator	NITI AYOG Urban Index Indicator	Finalized Indicator
11.1	11.1.1 Proportion of urban population living in slums, informal settlements or inadequate housing.	11.1.1: Percentage of Slums/Economically Weaker Sections (EWS) households covered through formal/affordable housing	11.1.1 Percentage of urban households living in katcha houses	Percentage of houses completed against sanctioned under PMAY (Urban)	11.1.1 Proportion of urban population living in slums, informal settlements or inadequate housing.
		11.1.2: Percentage of urban household Covered with basic Services	11.1.2 Percentage of urban households with drainage facility		11.1.2: Percentage of Slums/Economically Weaker Sections (EWS) households covered through formal/affordable housing
		11.1.3: Proportion of Urban Area Living in Slums, informal Settlements or Inadequate Housing	11.1.3 Percentage of individual household toilets constructed against target (SBM(U))		11.1.3: Percentage of houses completed against sanctioned under PMAY (Urban)
					11.1.4: Proportion of Urban Area Living in Slums, informal Settlements or Inadequate Housing
					11.1.5: Percentage of urban household Covered with basic Services
					11.1.6: Water Supply Per Capita

11.2	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	11.2.1: Proportion of Households in urban areas having convenient access to public transport	11.2.1 Deaths due to road accidents in urban areas (per 1,00,000 population)	Death rate due to road traffic accidents per 1,00,000 population	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities
11.3	11.3.1: Ratio of land consumption rate to population growth rate	11.3.1: Proportion of cities with integrated development plans.			11.3.1: Ratio of land consumption rate to population growth rate
	11.3.2: Proportion of cities with a direct participation structure of civil society in urban planning and management that operates regularly and democratically	11.3.2: Share of Mixed Land Use Area in overall city land use			11.3.2: Net Density
		11.3.3: Net Density			11.3.3: Consideration of direct participation structure of civil society in urban planning and management that operates regularly and democratically
11.4	11.4.1 Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage, by source of funding (public, private), type of heritage (cultural, natural) and level of government (national, regional, and local/municipal)	11.4.1: Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage			11.4.1: Identification & consideration of heritage protection in Development Plan
11.5	11.5.1: Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	11.5.1: Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population			11.5.1: Consideration of disaster management in Development Plan
	11.5.2: Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters				
11.6	11.6.1: Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid	11.6.1: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid	11.6.1 Percentage of wards with 100% door to door waste collection (SBM(U))	Percentage of Municipal Solid Waste (MSW) treated against MSW generated	11.6.1: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities

	waste generated by cities	waste generated, by cities			
	11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted	11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted	11.6.2 Percentage of MSW processed to the total MSW generated (SBM(U))	Swachh Survekshan Score	11.6.2: Percentage of wards with 100% door to door waste collection
		11.6.3: Number of days the levels of fine particulate matter (PM2.5 and PM10) above mean level	11.6.3 Percentage of wards with 100% source segregation (SBM(U))		11.6.3: Percentage of waste processed
		11.6.4: Percentage of wards with 100% door to door waste collection	11.6.4 Installed sewage treatment capacity as a percentage of sewage generated in urban areas		11.6.4: Installed sewage treatment capacity as a percentage of sewage generated in urban areas
		11.6.5: Percentage of waste processed			11.6.5: Proportion of area conveniently served by Transfer Stations
					11.6.6: Proportion of population under ill-effect of dumping yards
11.7	11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities	11.7.1: Proportion of households reporting an open space within 500 meters from premises (urban)			11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities”

Table1: Indicators Comparison

Final Indicators

To finalize the indicators, localization of indicators was done and based on the data availability indicators were finalized (Figure 9).
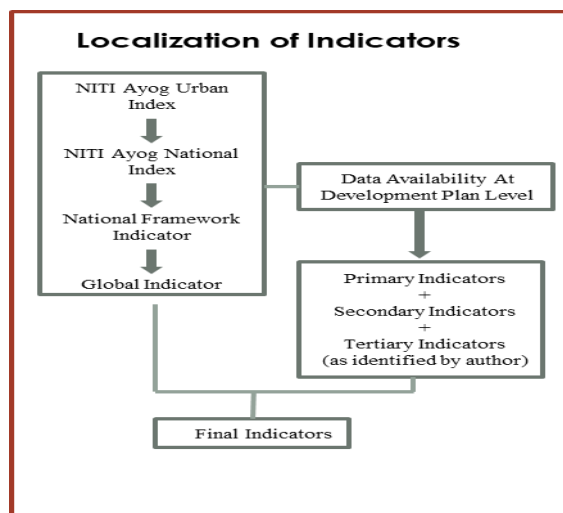

Figure 9: Methodology for Localization of Indicators

The finished indications have been classified into three groups. The primary metrics are those taken straight from the NITI AAYOG's Urban Index. Secondary indicators are those that have been adopted from the Global framework, NITI AAYOG SDG National Indicator, and National Indicator Framework, whilst tertiary indicators are those that have been established by the author for better evaluation of development plans based on data availability. Final Indicators have been shown in Table 2 below.

Target	Indicators
"11.1	11.1.1 Proportion of urban population living in slums, informal settlements or inadequate housing.
	11.1.2: Percentage of Slums/Economically Weaker Sections (EWS) households covered through formal/affordable housing
	11.1.3: Percentage of houses completed against sanctioned under PMAY (Urban)
	11.1.4: Proportion of Urban Area Living in Slums, informal Settlements or Inadequate Housing
	11.1.5: Percentage of urban household Covered with basic Services
	11.1.6: Water Supply Per Capita
11.2	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities
11.3	11.3.1: Ratio of land consumption rate to population growth rate
	11.3.2: Net Density
	11.3.3: Consideration of direct participation structure of civil society in urban planning and management that operates regularly and democratically
11.4	11.4.1: Identification & consideration of heritage protection in Development Plan
11.5	11.5.1: Consideration of disaster management in Development Plan
11.6	11.6.1: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities
11.6	11.6.2: Percentage of wards with 100% door to door waste collection
	11.6.3: Percentage of waste processed
	11.6.4: Installed sewage treatment capacity as a percentage of sewage generated in urban areas
	11.6.5: Proportion of area conveniently served by Transfer Stations
	11.6.6: Proportion of population under ill-effect of dumping yards
11.7	11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities"

Table 2: The Finalized Indicators

A total of 19 indicators have been developed of which three are primary, twelve are secondary and four are tertiary indicators.

4. CONCLUSIONS

The process of localizing the indicators for sustainable urban development has involved a comprehensive analysis of global and national frameworks. Here's a summary of the approach and findings:

1. Frameworks Reviewed:

o Global Framework: The Global Indicator Framework for the Sustainable Development Goals (SDGs) provided a broad and universal set of indicators aimed at addressing global challenges and objectives.

o National Frameworks: Various national frameworks were examined, including India's National Indicator Framework on SDG 3.0, the SDG India Index by NITI AAYOG, and the North East Region District SDG Index. Each framework presented unique metrics relevant to national and regional contexts.

2. Indicators Comparison:

o A detailed comparison was conducted among indicators from these frameworks, focusing on their relevance to urban development in Bhopal. Key areas of interest included housing conditions, access to public transport, land use, heritage preservation, disaster management, waste management, and open space availability.

3. Finalized Indicators:

o Based on this comparison and the availability of data, a set of finalized indicators was selected. The indicators were categorized into:

▪ Primary Metrics: Directly sourced from NITI AAYOG's Urban Index, providing a foundation for local assessment.

▪ Secondary Indicators: Derived from global and national frameworks, enriching the evaluation with additional perspectives.

▪ Tertiary Indicators: Developed specifically to address gaps in data and enhance the local relevance of the evaluation.

4. Key Findings:

o Housing: Emphasis on the proportion of urban population living in slums and informal settlements, as well as the coverage of affordable housing.

o Public Transport: Measurement of convenient access to public transport for various demographics.

o Land Use and Density: Consideration of land consumption rates and net density, alongside the participation of civil society in urban planning.

o Heritage and Disaster Management: Identification of heritage protection measures and integration of disaster management in development plans.

o Waste Management: Monitoring of waste collection, processing, and sewage treatment capacity, with attention to waste segregation and impact from dumping yards.

o Open Space: Assessment of the availability and accessibility of open spaces for public use.

This localized approach ensures that the indicators are not only aligned with global and national standards but are also tailored to the specific needs and data availability. By integrating these indicators into the city's development plans, a more effective and contextually relevant evaluation of urban sustainability and progress can be achieved.

REFERENCES

Ana C L Almeida, James C R Smart and Peter Davey. 2018. "Can Learned Experiences Accelerate the Implementation of Sustainable Development Goal 11? A Framework to Evaluate the Contributions of Local Sustainable Initiatives to delivery SDG 11 in Brazilian Municipalities." European Journal of Sustainable Development.

Corbett, J, and S. Mellouli. 2017. "Winning the SDG battle in cities: how an integrated information ecosystem can contribute to the achievement of the 2030 sustainable development goals." Info Systems J. doi.

Habitat, Un. 2016. "Measurement of City Prosperity." Un Habitat: Nairobi.

Hall, R.P, S Ranganathan, and R. Kumar G. C. 2017. "General Micro-Level Modeling Approach to Analyzing Interconnected SDGs: Achieving SDG 6 and More through Multiple-Use Water Services." Sustainability.

Horn, P., and J. Grugel. 2018. "The SDGs in middle-income countries: Setting or serving domestic development agendas?" World Dev.

India, Role of Urban Planning in Achieving SDG – 11 in. 2020. "Prof. Chetan Vaidya." Institute of Town Planners, India Journal.

Jacob, A. 2017. "Mind the Gap: Analyzing the Impact of Data Gap in Millennium Development Goals." World Dev.

Jun Chen, Z.L. 2018,. "Chinese pilot project tracks progress towards SDGs." Nature.

Junyoung Choi, Myunghwa Hwang, Gayeon Kim, Janghwan Seong and Jaeseong Ahn. 2016. "Supporting the measurement of the United Nations' sustainable development goal 11 through the use of national urban information systems and open geospatial technologies: a case study of south Korea." Open Geospatial Data, Software and Standards.

Majumdar, D.D., and Biswas. 2016. "A. Quantifying land surface temperature change from LISA clusters: An alternative approach to identifying urban land use transformation." Landsc. Urban Plan.

Management, UN Committee of Experts on Global Geospatial Information. 2012. "Monitoring sustainable development: Contribution of geospatial information to the Rio+20 processes."

Mbah, P.O., and T.C. Nzeadibe. 2017. "Inclusive municipal solid waste management policy in Nigeria." Local Environ.

Moallemi, E.A., S. Malekpour, M. Hadjikakou, R. Raven, K. Szetey, D. Ningrum, A. Dhiaulhaq, and B.A. Bryan. 2020. "Achieving the Sustainable Development Goals Requires Transdisciplinary Innovation at the Local Scale." One Earth.

Orzes, G., A.M. Moretto, M. Ebrahimpour, M. Sartor, M. Moro, and Rossi. 2018. "United Nations Global Compact: Literature review and theory-based research agenda." J. Clean. Prod.

Qiang Chen, Mingyi Du, Qianhao Cheng and Changfeng Jing. 2020. "Quantitative Evaluation of Spatial Differentiation for Public Open Spaces in Urban Built-Up Areas by Assessing SDG 11.7: A Case of Deqing County." MDPI International Journal of Geo-Informatics.

Sachs, J.D., G. Schmidt-Traub, M. Mazzucato, D. Messner, N. Nakicenovic, and J. Rockström. 2019. "Six transformations to achieve the sustainable development goals." Nat. Sustain.

Salvia, A.L., W. Leal Filho, L.L. Brandli, and J.S. Griebeler. 2019. "Assessing research trends related to Sustainable Development Goals: Local and global issues." J. Clean. Prod.

Scott G, Rajabifard. 2015. "A. Integrating geospatial information into the 2030 agenda for sustainable development." Jeju: Twentieth United Nations Regional Cartographic Conference for Asia and the Pacific.

Taher Osman, Emad Kenawy, Karim I. Abdrabo, David Shaw and Aref Alshamndy. 2021. "Voluntary Local Review Framework to Monitor and Evaluate the Progress towards Achieving Sustainable Development Goals at a City Level: Buraidah City, KSA and SDG11 as A Case Study." MDPI Journal of Sustainability.

Valencia, S.C., D. Simon, S. Croese, J. Nordqvist, M. Oloko, T. Sharma, N.T. Buck, and I. Versace. 2019. "Adapting the Sustainable Development Goals and the New Urban Agenda to the city level: Initial reflections from a comparative research project." Int. J. Urban Sustain. Dev.

Xia, C., G.-O.Y. Anthony, and Zhang. 2020. "Analyzing spatial relationships between urban land use intensity and urban vitality at street block level: A case study of five Chinese megacities." Landsc. Urban Plan.

Yani Wang, Mingyi Du, Lei Zhou, Guoyin Cai, Yongliang Bai. 2019. "A Novel Evaluation Approach of County-Level City Disaster Resilience and Urban Environmental Cleanliness Based on SDG11 and Deqing County's Situation." MDPI Journal Sustainability.

Zinkernagel, R., J. Evans, and L Neij. 2018. "Applying the SDGs to Cities." Sustainability.