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MINISTRY OF ENVIRONMENT

Rwanda's Climate Adaptation Monitoring, Evaluation, and Learning System in the Human Settlements and Transport Sectors:

Data and information collection and management

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Briefing Note

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Executive Summary

Background

The National Adaptation Plan Global Network supports the Rwandan Government in establishing a monitoring, evaluation, and learning system for climate adaptation, initially piloted in the agriculture sector as part of Rwanda's updated nationally determined contribution. Rwanda's nationally determined contribution demonstrates a comprehensive effort toward climate change adaptation in the human settlement and transport sectors, focusing on robust data collection and management.

The document provides a detailed review of adaptation actions in the two sectors. It outlines the seven indicators used to track the implementation of adaptation actions, along with corresponding baseline data and targets. The nationally determined contribution also assesses the data collection and management system for these sectors, proposing potential improvements and future directions.

Findings and Conclusion

Rwanda is committed to reducing greenhouse gas emissions and incorporating adaptation measures in sectors such as human settlement and transport. In this regard, key policies and strategic plans are in place to support sustainable urbanization, climate-resilient development, and environmental considerations in transport. Baseline values for adaptation indicators in Rwanda's human settlement and transport sectors were established using data from the National Institute of Statistics of Rwanda and various strategic documents, including national and sectoral plans, and annual reports from several institutions. These institutions include the Ministry of Infrastructure, Rwanda Housing Authority, Water and Sanitation Corporation, the Rwanda Water Resource Board, the Ministry in Charge of Emergency Management, the Rwanda Transport Development Agency, and the Rwanda Utilities Regulatory Agency.

Rwanda has a Water, Sanitation, and Hygiene Management Information System, which is a web-based platform designed to manage and display water, sanitation, and hygiene data from all districts. Its purpose is to provide reliable data for planning and decision making in the water and sanitation sector. Despite its development and operationalization across various districts, the system is not yet fully effective, with a lack of comprehensive data affecting investment allocation. The urban dynamic maps system for monitoring human settlements is limited to five districts and struggles with tracking informal settlements. In rural areas, only National Institute of Statistics of Rwanda data is used. A road asset management system is being developed for the transport sector.

This briefing also identifies gaps in current indicators and suggests areas for improvement, particularly regarding data quality, consistency, and the integration of socio-economic and environmental data. Challenges in data collection, management, and analysis are acknowledged, and recommendations for improvement, including, but not limited to, expanding urban dynamic maps to more districts, developing dedicated rural area monitoring systems, revising indicators to align with the language of the Sustainable Development Goals, especially for water and sanitation, continuing road asset management system development with a climate-resilience focus, among others.

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List of Abbreviations

CoK	City of Kigali
GIS	Geographic Information System
MEL	monitoring, evaluation, and learning
MIDIMAR	Ministry of Disaster Management
MINEMA	Ministry in charge of Emergency Management
MININFRA	Ministry of Infrastructure
MIS	Management Information System
MoE	Ministry of Environment
NDC	nationally determined contribution
NGO	non-governmental organization
NISR	National Institute of Statistics of Rwanda
NST	National Strategy for Transformation
RHA	Rwanda Housing Authority
RSA	Rwanda Space Agency
RTDA	Rwanda Transport Development Agency
RURA	Rwanda Utilities Regulatory Agency
RWB	Rwanda Water Resources Board
SDGs	Sustainable Development Goals
UNICEF	United Nations Children's Fund
WASAC	Water and Sanitation Corporation
WASH	water, sanitation, and hygiene

1. Introduction

Rwanda's approach to climate adaptation monitoring, evaluation, and learning (MEL) in the human settlement and transport sectors, as reflected in its nationally determined contribution (NDC), demonstrates a comprehensive and ambitious effort to tackle climate change and involves several key components, with a particular focus on data and information collection and management (Ministry of Environment [MoE], 2020).

With reference to the urbanization and transport sectors, the country has increasingly recognized the importance of data and information for climate adaptation. Data allows for the monitoring of climate change impacts over time, which is particularly important in urban areas that often face unique challenges, such as heat islands and drainage issues. Transport sectors also benefit from data in assessing the efficiency and sustainability of their systems in changing climatic conditions. With accurate data, urban planners and policymakers can make informed decisions on infrastructure development, transportation networks, and urban expansion.

This is essential to ensuring that these developments are resilient to climate change impacts like flooding, heat waves, and increased rainfall. The emphasis on data and information in Rwanda's urbanization and transport sectors is a forward-thinking approach that aligns with global trends in climate change adaptation and sustainable development.

Rwanda does not need to begin anew, as it has already laid a solid foundation with a broad range of policies and strategies, aiming to foster sustainable, well-organized, and inclusive urban communities alongside developing a resilient transport network. The National Urbanization Policy (2015) underscores Rwanda's dedication to environmentally conscious urban growth, offering guidelines for orderly and sustainable urban development, with performance indicators tracking urban progress and planning efficiency (Ministry of Infrastructure [MININFRA], 2015a). This policy was revised and is now in the approval stage. This revision focused on updating the policy to reflect current urbanization trends, challenges, and opportunities, including climate change adaptation and mitigation strategies (Ministry of Infrastructure, 2023a, p.6). This updated policy is structured around four main pillars: coordination, intensification, livability, and economic growth. With a particular focus on environmental and climate change, the 2015 Housing Policy highlights Rwanda's commitment to sustainable and climate-resilient development (MININFRA, 2015b).

These policies related to human settlement are operationalized through the Urbanization and Rural Settlement Strategic Plan 2017–2024. This 7-year plan is integral to Rwanda's goals of sustainable development, economic growth, and enhanced living standards in line with Vision 2050¹ and the National Strategy for Transformation (NST-1).² Its objectives range from promoting sustainable

¹ Rwanda Vision 2050 is a long-term development program aimed at transforming Rwanda into a prosperous, high-income country by the year 2050. This vision is built on the success of the earlier Vision 2020 and seeks to propel Rwanda to greater heights in terms of economic, social, and environmental development.

² The Rwanda National Strategy for Transformation (NST1) is a key strategic framework that outlines Rwanda's development goals and priorities from 2017 to 2024. It serves as a blueprint for the nation's transformation toward achieving the objectives set in Vision 2050. The NST1 focuses on three key pillars of economic

urbanization and enhancing rural settlements to infrastructure development, achieving environmental sustainability, and improving governance and institutional frameworks.

Regarding the transport sector, Rwanda's 2021 national transport policy and strategy emphasizes the importance of guaranteeing universal access to a safe, competitive, integrated, resilient, and high-quality transport system for both citizens and visitors of Rwanda (MININFRA, 2021). In the context of environment and climate change, the policy reflects the country's commitment to sustainable development and the mitigation of climate change impacts. This policy is part of a broader national strategy that integrates environmental considerations into various sectors, with transport being a key focus due to its significant impact on greenhouse gas emissions and environmental degradation. The Strategic Plan for the Transport Sector (2018–2024) in Rwanda mandates that all road projects undergo environmental and social impact assessments. Additionally, it requires a strategic environmental assessment of its policies by 2024.

Complementing the transport policy, the Rwanda Water Resources Board (RWB)'s Strategic Plan (2021–2030) outlines several key objectives and actions. These include efforts to prevent, reduce, and control soil erosion, as well as to enhance resilience against flooding and landslides. This is achieved through improving various mechanisms related to preparedness, prevention, adaptation, mitigation, and response, specifically targeting road-related infrastructure. All of these strategic documents are also aligned with Rwanda's Vision 2050 and NST-1, marking a pivotal step in its journey toward sustainable growth.

This briefing document comprehensively reviews adaptation actions in human settlement and transport sectors, including seven indicators for progress tracking and baseline data analysis. It details information sources for these indicators and provides suggestions for improvement. Additionally, it assesses the data collection and management system, proposing potential improvements. The conclusion outlines the actions aimed to address data needs and suggests directions for future efforts.

transformation, social transformation, and transformational governance, with a few cross-cutting areas such as climate change and environment disaster risk reduction, gender, ICT, among others.

2. Adaptation Interventions, Indicators, and Baseline Data in the Human Settlement and Transport Sectors

Rwanda's updated NDC, submitted in 2020, includes bold commitments to reducing greenhouse gas emissions by 38% and incorporates adaptation measures in priority sectors, including human settlement and transport. It includes three NDC adaptation interventions in the human settlements and transport sectors and identifies seven indicators of NDC adaptation that are used to track progress on the implementation of the interventions (see Table 1). These indicators were developed using a holistic and inclusive consultative approach involving the government, the private sector, and civil society organizations.

Table 1. NDC adaptation interventions and their corresponding indicators in the human settlement and transport sectors

NDC adaptation interventions	Indicators
1. High-density buildings and informal settlement upgrading	1. Percentage of (1) urban population living in informal settlements, (2) rural population living in clustered settlements 2. Average share of the built-up area of cities that is an open and green space for public use for all, in line with the Sustainable Development Goals (SDG) 3. Access to water and sanitation services
2. Stormwater management	4. Percentage of urban population in areas covered by master plans with stormwater considerations
3. Improved transport infrastructure and services	5. Environmental and engineering guidelines developed (for climate-resilient road infrastructure) 6. Reduction of length of roads that is vulnerable to flood and landslides 7. Number of passengers using public transport each year

Source: MoE, 2020.

While specific indicators for tracking progress in the human settlement and transport sectors were not detailed in the available data sources, Rwanda's approach includes developing quantifiable adaptation targets supported by the World Bank and other partners. These indicators likely focus on key aspects such as infrastructure resilience, and implementation of sustainable practices in urban planning and transportation.

The MoE and the World Bank led a study that compiled baseline data on these seven indicators for the three adaptation interventions (Gashugi et al., 2021). The baseline values for each adaptation indicator in the human settlement and transport sectors were developed, drawing on information from several sources. These include the National Institute of Statistics for Rwanda (NISR) range of national and sectoral strategic documents, such as NST-1, sector strategic plans, such as the Urbanization and Rural Settlement Strategic Plan (2017–2024) and the Strategic Plan for the Transport Sector (2018–2024), annual reports of institutions such as MININFRA, Rwanda Housing

Authority (RHA), Water and Sanitation Corporation (WASAC), RWB, Ministry in charge of Emergency Management (MINEMA), Rwanda Transport Development Agency (RTDA), and Rwanda Utilities Regulatory Agency, RURA (see Table 2). Table 2 provides detailed information on various indicators from Rwanda's 2020 NDC, their baseline values as of 2020, targets as per the NDC implementation framework, and the relevant stakeholders for data collection.

Table 2. Baseline values, targets for each climate change adaptation in the human settlement and transport sectors, relevant stakeholders, and sources of baseline data

Indicators (from Rwanda's 2020 NDC)	Baseline values for 2020 (information sources)	Targets (from the NDC implementation framework)	Relevant stakeholders for data collection
Percentage of (1) urban population living in informal settlements, (2) rural population living in clustered settlements	61.3% of the urban population living in informal settlements in 2016/17 (EICV5) 61.7% of rural households settled in integrated, planned, green rural settlements (EICV5)	47% of urban population living in informal settlements by 2025. 35% of urban population living in informal settlements by 2030 80% of rural households settled in integrated, planned, green rural settlements by 2025	MININFRA, RHA, NISR, the private sector, non-governmental organizations (NGOs)
Average share of the built-up area of cities that is open and green space for public use for all (In line with SDGs)	The City of Kigali (CoK) is comprised of more than 30% public space in 2018.	To have a sustained (with qualitative maintenance) area of 30% urban green and public space	MININFRA, RHA, NISR, the private sector, NGOs
Access to water and sanitation services	87.4% of households using an improved water source and 86.2% of households accessing basic sanitation facilities in 2017	100% of households using an improved water source and 100% of households accessing basic sanitation facilities by 2030	MININFRA, Water and Sanitation Corporation, NISR, the private sector, NGOs
Percentage of urban population in areas covered by master plans with storm water considerations	Less than 20% of urban population in areas covered by master plans with storm water considerations in 2016	90% of urban population in areas covered by master plans with stormwater considerations by 2025 Regular maintenance and upgrading of road and drainage infrastructure	MININFRA, Rwanda Water Resources Board, NISR, the private sector, NGOs

Indicators (from Rwanda's 2020 NDC)	Baseline values for 2020 (information sources)	Targets (from the NDC implementation framework)	Relevant stakeholders for data collection
Environmental and engineering guidelines developed (for climate-resilient road infrastructure)	Draft road design manuals are available but without consideration of climate change adaptation.	Guidelines developed by 2025 on: <ul style="list-style-type: none"> • Road material stabilization • Sealed road • Gravel roads inspection and maintenance • Emergency response to landslide & floods • Erosion control • Quarry and borrow pits management 	MININFRA, MINEMA, RTDA, RHA, Meteo Rwanda, districts, the private sector, NGOs
Reduction of length of roads vulnerable to flood and landslides	In 2015, the total length of roads vulnerable to landslides was estimated at 979 km (with 165 km for national paved roads, 210 km for national unpaved roads and 604 km for district roads) (MIDIMAR, The National Risk Atlas of Rwanda, 2015).	To be determined	MININFRA, MINEMA, RTDA, RHA, Meteo Rwanda, districts, the private sector, NGOs, MININFRA (RTD A, Rwanda Utilities Regulatory Agency, NISR, private sector)
Number of passengers using public transport each year	(i) In 2017, the total length of urban roads was estimated at 421.4 km (ii) In 2017, the total length of feeder road rehabilitated was estimated at 2,060 km.	Establishing scheduled bus routes, construction of urban roads and rural roads rehabilitated, route franchising, and operationalization of a smart ticketing system	

Source: Cook et al., 2020; Gashugi et al., 2021; Ministry of Finance and Economic Planning, 2017; Ministry of Disaster Management (MIDIMAR), 2015; MoE, 2020.

3. Systems for Data Collection and Management for the MEL of Adaptation in Human Settlement and Transport Sectors

Rwanda has been working on developing MEL systems for climate adaptation. In this regard, from April 2022 to February 2023, the National Adaptation Plan Global Network started supporting the Government of Rwanda in the implementation of its roadmap to establishing a MEL system for climate adaptation. This started with a pilot test of the MEL framework for the NDC in the agriculture sector (MoE, 2023).

Significant outcomes from the pilot test encompass the development and publication of four briefing notes now accessible on the National Adaptation Plan Global Network website, the generation of a range of technical reports, the organization and execution of various workshops, the undertaking of engagement activities, and the development of templates and spreadsheets, among other achievements.

A suggestion from the pilot test on the agriculture sector included expanding the MEL system to additional sectors such as human settlement and transport. It is essential to recognize that the seven adaptation indicators, intended to track intervention progress in human settlement and transport, are divided into three specific sectors, and not just the two mentioned in the NDC. These sectors are Urbanization and Human Settlement, Water and Sanitation, and Transport. These considerations could stem from the importance of access to water and sanitation services, a prominent issue in urban regions, leading to its inclusion in the urbanization and human settlement sector.

As noted earlier, Rwanda has established strong data management systems, particularly effective for managing adaptation data. This fact was highlighted in a series of briefing notes, one of which focused on examining the indicators used to monitor adaptation actions in the country's agriculture sector (MoE, 2023). Therefore, instead of replicating existing efforts, these systems should be incorporated into the adaptation MEL framework within the human settlement and transport sectors. This section outlines the existing data collection and management systems for MEL of adaptation in each of the three sectors.

Rwanda is known for leveraging technology and international partnerships in its development strategies. Examples include the Kigali Innovation City, the pioneering Drone Delivery Program, and the Smart Kigali Initiative, all highlighting the nation's dedication to integrating technology and international collaboration for developmental objectives. Further, the Rwanda Space Agency (RSA) is deeply engaged in technological investments, particularly in employing high-resolution satellite imagery. This imagery is instrumental in identifying areas vulnerable to climate-related incidents, such as landslides, floods, and erosion, targeting roads and other infrastructure especially. Furthermore, the agency is using satellite data to develop early warning systems and swift response mechanisms in the event of natural disasters, a critical resource for densely populated urban areas. The similar approaches are being applied in the development of MEL systems for **adaptation in the above three sectors**.

The Water, Sanitation, and Hygiene Management Information System (WASH MIS) is designed to ensure the availability of timely and reliable data, which is essential for planning and decision

making in the water and sanitation sector (MININFRA, 2021). This system has been developed and is now being operationalized across various districts in Rwanda. It is a web-based software system that facilitates the management of WASH data from all districts in Rwanda. This includes the collection, entry, validation, analysis, structuring, storage, and summary display of data through dashboards. However, it is noteworthy that as of the last update the system was not yet fully effective and operational, and the lack of comprehensive data was impacting the allocation of investments in the sector.

The WASH MIS is hosted by MININFRA and serves the information needs of various stakeholders. This includes local governments and development partners involved in the WASH sector. The development and implementation of the MIS have been supported by organizations such as the United Nations Children's Fund. The implementation of the WASH MIS is part of a broader strategy in Rwanda known as the "District-Wide Approach," adopted in 2016. This approach aims at achieving universal and sustainable access to water and sanitation services strengthening the enabling environment and concentrating efforts at the district level, which acts as the service authority.

In the human settlement sector, there are urban dynamic maps used for monitoring purposes. However, this system covers only five districts and is not effective at tracking informal settlements. In rural areas, there is no specific MIS; only data from the NISR is used. MININFRA, in collaboration with ESRI-Rwanda has also established the National Urban Planning and Infrastructure Geo-Database and Portal (MININFRA, 2023b). This project is focused on consolidating all spatial data from the Ministry and its associated agencies into a unified, scalable database accessible through a specialized data platform. This central database is intended to facilitate the utilization of spatial data for planning and decision making among government technicians, provide critical information for government officials, and make valuable data available to the private sector and the public. Further, the Urban Dynamic map serves as a monitoring system currently covering five districts and the City of Kigali, with ambitions to extend coverage to all 30 districts. Despite its reach, it falls short in accurately tracking informal settlements. In the transport sector, a road asset management system is being developed.

The systems in place appear to align with Rwanda's wider national development objectives and policies, emphasizing sustainability, environmental conservation, and resilience to climate change. Despite Rwanda's advancement, issues such as limited resources, the demand for technical expertise, and the necessity to guarantee data precision and dependability may persist. Nevertheless, Rwanda's active approach to climate change adaptation and technological advancement offers substantial prospects for establishing effective MEL systems in these sectors.

4. Assessment of Indicators

This section evaluates the seven adaptation indicators related to the human settlement and transport sectors, as outlined in the NDC. It also provides recommendations for enhancing these indicators, drawing on best practices and expert guidance. The current indicators in the NDC are quantitative, offering insights into the implementation progress of various actions and the monitoring of anticipated outputs and targets. However, there is room for the refinement of these to yield more specific and actionable measures. To further refine these indicators, the proposed improvements for each of the seven indicators are as follows:

Indicator #1. “Percentage of (1) urban population living in informal settlements, (2) rural population living in clustered settlements” serves as a critical metric in understanding the living conditions and spatial organization of populations, especially in the context of Rwanda. This indicator aligns with several Sustainable Development Goals (SDGs), particularly those related to sustainable cities and communities (SDG 11) and poverty reduction (SDG 1). It also plays a role in climate adaptation strategies by identifying the populations that are most at risk and in need of resilient infrastructure and services.

While this indicator is highly relevant and useful for understanding and addressing key development challenges in urban and rural areas, its effectiveness is dependent upon the quality, consistency, and clarity of the data collected. The indicator primarily measures the proportion of the population in these settlements, but it does not capture qualitative aspects, such as the quality of housing, access to services, or social and economic conditions. Further, there is often no universally accepted definition of what constitutes an “informal” or “clustered” settlement, leading to inconsistencies in data collection and analysis. Thus, this indicator on its own does not provide a complete picture. It needs to be analyzed in conjunction with other indicators (e.g., access to clean water, education, and health care) for a more comprehensive understanding of the living conditions and needs of these populations.

Addressing these gaps requires improved data collection methods, improved standardization in definitions and methodologies, and a more integrated approach that combines this indicator with other socio-economic and environmental data. This would enhance the overall utility and accuracy of the indicator, making it more effective for policymaking and planning.

Indicator #2. “Average share of the built-up area of cities that is open and green space for public use for all,” related to SDG 11 (Sustainable Cities and Communities), is essential for evaluating the availability of public green spaces in urban environments. Several gaps and challenges associated with this indicator were identified:

- **focus on quantity over quality:** The indicator primarily measures the percentage of green space but does not account for the quality, maintenance, or usability of these spaces.
- **lack of contextual data:** This indicator does not consider the broader urban planning and environmental context, such as the type of green space (e.g., urban parks, natural reserves) and its ecological value.
- **oversight of urban biodiversity:** The indicator may not adequately reflect the contribution of green spaces to urban biodiversity and ecosystem services.

- **socio-economic disparities:** The indicator does not directly address socio-economic disparities in the availability and quality of green spaces within cities.
- **rapid urbanization challenges:** In rapidly urbanizing cities, maintaining or increasing green space can be challenging, a factor not directly addressed by this indicator.

To address these gaps, a more nuanced approach is needed and should consider quality, accessibility, and distribution of green spaces, as well as their integration into the broader urban and environmental context. This would provide a more comprehensive understanding of the role and value of green spaces in urban areas, leading to more effective and equitable urban planning and policy decisions.

Indicator #3. "Access to water and sanitation services" is a vital measure for evaluating the level of basic services available to a population. It plays a critical role in public health, environmental sustainability, and human dignity. It also aligns with the recognition of access to water and sanitation as a human right, underscoring its importance in social and economic development. However, it has several gaps and challenges that can hinder its effectiveness in fully capturing the state of access to water and sanitation:

- **quality and reliability of services:** The indicator often measures access in terms of quantity rather than quality and often does not distinguish between different levels of service quality. For example, access to a water source does not always mean that the water is safe to drink.
- **inequalities in access:** The indicator may mask disparities in access to water and sanitation services within and between regions, rural and urban areas, and different socio-economic groups.
- **sustainability of resources:** Merely having access to water does not guarantee the sustainability of water resources, which is crucial in the context of increasing water scarcity and climate change.
- **reliability and continuity:** Access does not necessarily imply reliability. The indicator may not capture intermittent services or frequent disruptions in water supply and sanitation facilities.
- **infrastructure and its maintenance:** The quality of infrastructure and its maintenance play a crucial role in ensuring continuous and safe access and this indicator does not directly address these aspects.
- **affordability:** Access does not necessarily equate to affordability. The costs associated with water and sanitation services are not always considered, which is a critical gap, especially in low-income areas.
- **hygiene and behavioural aspects:** Sanitation services are not only about infrastructure but also about hygienic practices. The indicator does not capture the behavioural aspect of sanitation, including the proper use and maintenance of facilities.

Addressing these gaps would involve improving data collection methods, incorporating qualitative aspects of services and considering the broader context of water and sanitation in policy and planning. This would provide a more comprehensive understanding of the true state of access to water and sanitation and its impact on public health and well-being.

Indicator #4. “Percentage of urban population in areas covered by master plans with stormwater considerations.” This indicator is an important measure for urban planning and environmental management. It assesses the extent to which urban areas have integrated stormwater management into their planning processes. This indicator is crucial for understanding the extent to which cities are prepared to manage stormwater, which is increasingly becoming important due to climate change and urbanization. Effective stormwater management is also key to preventing flooding, reducing water pollution, and protecting ecosystems. The indicator is aligned with the SDGs, particularly those related to sustainable cities, water management, and climate action. However, there are several gaps and limitations that can negatively affect its effectiveness and comprehensiveness:

- **quality and depth of plans:** The indicator measures the coverage of master plans but may not reflect the quality or effectiveness of the stormwater considerations within those plans.
- **implementation gap:** There can be a significant gap between the planning stage and actual implementation or enforcement of these plans.
- **varying definitions and standards:** There may be differences in how cities define and integrate stormwater considerations, leading to inconsistencies in measurement.
- **climate change adaptation:** While the indicator focuses on planning, it may not reflect the adaptability or resilience of these plans in the face of climate change and extreme weather events.
- **infrastructure and its maintenance:** The indicator does not account for the maintenance and operational aspects of storm water infrastructure, which are crucial for long-term effectiveness.

Addressing these gaps would involve enhancing the quality and depth of stormwater considerations in urban planning, ensuring consistency in standards and definitions, and integrating the indicator into broader environmental and social objectives. This would provide a more comprehensive understanding of urban resilience and sustainability in relation to stormwater management.

Indicator #5. “Environmental and engineering guidelines developed (for climate-resilient road infrastructure).” This is an important metric for assessing the preparedness and adaptation strategies of a region or a country in the context of climate change. However, the indicator has several gaps that can hinder its effectiveness and comprehensiveness:

- **quality and depth of guidelines:** The indicator might confirm the development of guidelines but does not necessarily reflect their quality, comprehensiveness, or appropriateness for local conditions.
- **adaptation and innovation:** While the development of guidelines is a first step, they need to be continuously adapted and updated to reflect the latest scientific knowledge and technological advancements.
- **gap between development and application:** There can be a significant difference between the development of guidelines and their actual implementation or enforcement in road construction and maintenance practices.
- **narrow focus:** The indicator seems to focus solely on the environmental and engineering aspects without integrating broader considerations such as social impact, economic feasibility, and long-term sustainability.

- **resource allocation:** The effective implementation of these guidelines often requires adequate resources, training, and institutional capacity, which might not be uniformly available.
- **quantitative versus qualitative assessment:** The indicator provides a quantitative measure (i.e., whether guidelines have been developed) but lacks a qualitative assessment of the guidelines' effectiveness and suitability.

Addressing these gaps would involve ensuring the quality and region-specific relevance of the guidelines, bridging the gap between development and practical implementation, and integrating them within a comprehensive policy and regulatory framework. Continuous monitoring, evaluation, and update of the guidelines are also crucial to ensuring their effectiveness in promoting climate resilience in road infrastructure.

Indicator #6. "Reduction of length of roads vulnerable to flood and landslides" is a significant measure for assessing the resilience of transportation infrastructure to environmental hazards. It directly addresses the vulnerability of road infrastructure to natural disasters, such as floods and landslides, which is crucial for ensuring the safety and reliability of transportation networks. In the context of climate change, which increases the frequency and severity of such events, this indicator is increasingly important for planning and adaptation strategies. However, it also has several gaps and limitations:

- **measurement complexity:** Measuring the length of roads vulnerable to these hazards can be complex, given the dynamic nature of environmental risks and the varying degrees of road vulnerability.
- **data availability and accuracy:** Reliable data on road vulnerability can be difficult to obtain, especially in the regions with limited monitoring and reporting capabilities.
- **focus on physical length only:** The indicator primarily focuses on the physical length of roads at risk, potentially overlooking the strategic importance or usage intensity of these roads.
- **causes of vulnerability:** While the indicator measures the reduction in vulnerable road length, it does not necessarily address the underlying causes of this vulnerability, such as poor construction standards or environmental degradation.
- **consistency in assessment methods:** There needs to be a standardized method for assessing road vulnerability to ensure consistency and comparability of data across different regions.
- **gap between identification and action:** Identifying vulnerable roads does not automatically lead to action being taken to reduce this vulnerability.
- **resource allocation and prioritization:** The indicator does not provide guidance on how resources should be allocated to address the vulnerabilities.
- **lack of integration with wider resilience efforts:** The indicator should be considered alongside environmental management practices, such as land-use planning, environmental management, and community preparedness, watershed management, and deforestation prevention, which can significantly affect the risk of floods and landslides.
- **overlooking maintenance and quality:** The indicator does not necessarily reflect the quality of road construction or ongoing maintenance efforts, which are crucial to reducing vulnerability.

While the indicator “Reduction of length of roads vulnerable to flood and landslides” is highly relevant for infrastructure planning and climate adaptation, it presents challenges in terms of measurement, data accuracy, and the need for standardization. Addressing these gaps and challenges would involve enhancing the methods for assessing and monitoring road vulnerabilities, considering the strategic importance of roads, and integrating this indicator within a broader framework of infrastructure resilience and environmental management.

Indicator #7. “Number of passengers using public transport each year.” This indicator is a key metric for assessing the usage and, indirectly, the effectiveness of public transportation systems. This indicator is essential because high usage of public transport is generally associated with reduced traffic congestion and lower greenhouse gas emissions, making it a crucial metric for sustainable urban development. However, it presents several gaps that can limit its comprehensiveness and effectiveness:

- **data collection and accuracy:** Accurately counting the number of passengers can be challenging, especially in systems that have no electronic ticketing or where informal public transport is more prevalent.
- **absence of service quality:** The number of passengers does not necessarily indicate the quality, efficiency, or accessibility of the public transport system.
- **impact of external factors:** Usage can be influenced by external factors, such as economic conditions, fuel prices, and societal trends (e.g., telecommuting), which might not be directly related to the quality or availability of public transport.
- **environmental impact:** While high usage implies potential environmental benefits (like reduced car usage), this indicator does not directly measure the environmental impact of the public transport system.
- **population growth and urbanization:** Increases in passenger numbers might reflect population growth or urbanization trends rather than improvements in public transport services.
- **resource allocation and investment:** High or increasing usage can justify the need for further investment in public transport systems, while low or declining numbers might indicate a need for service improvements or promotional campaigns.
- **integration with other modes of transport:** The indicator should be considered alongside other transportation metrics, such as car usage rates, to provide a comprehensive picture of urban mobility.
- **accessibility and inclusiveness:** The indicator does not address whether public transport systems are accessible and equitable for all segments of the population, including people with disabilities, the elderly, and low-income groups.

While the “Number of passengers using public transport each year” is a valuable indicator for assessing public transport usage, it should be interpreted with caution and in the context of broader urban mobility and sustainability objectives. To address these gaps, it would be beneficial to complement this indicator with additional metrics that assess the quality, efficiency, accessibility, and integration of public transport services, as well as broader urban mobility patterns.

5. Needs and Gaps in Data Collection

Significant progress has been made in the operationalization of the adaptation MEL system in the human settlement and transport sectors. MoE is responsible for the adaptation MEL system, which includes data and information collection and management. Addressing the needs and gaps in data collection and management processes, particularly in the human settlement and transport sectors in Rwanda, involves several key considerations.

The needs and gaps were organized into categories such as technology, methodology, human resources, and policy, which can provide a clearer understanding of the various aspects involved in the operationalization of the adaptation MEL system in Rwanda's human settlement and transport sectors:

Technology

- **detailed geographic information:** collection of granular data covering urban and rural areas, including informal settlements and remote areas.
- **data on transport infrastructure:** information on conditions, usage, and capacity of transportation infrastructure.
- **real-time data:** data on traffic patterns, public transport usage, and road conditions.
- **advanced data collection tools:** use of Internet of Things (IoT), remote sensing, and mobile data collection methods.
- **data analytics and forecasting:** application of advanced analytics and forecasting for planning and decision making.
- **infrastructure development:** investment in infrastructure for data collection, storage, and analysis.

Methodology

- **quality and reliability of data:** accuracy and consistency in data collection, integrating various sources and areas.
- **standardized data collection methods:** uniform methods across sectors and areas for comparability and reliability.
- **regularly updated information:** updates on human settlement patterns, urban development, and infrastructure changes.
- **centralized data repository:** platform for data storage and management.
- **open data initiatives:** promotion of open data policies for transparency and broader use.

Human Resources

- **training for data collection and analysis:** building local capacity in areas like Geographic Information System (GIS) and transport modelling.

- **public awareness and engagement:** community engagement for enhanced data collection, especially in informal settlements.

Policy

- **alignment with national development plans:** data strategies aligning with Rwanda's national goals and policies.
- **adherence to global standards:** following international best practices in data management.
- **funding and resources:** securing funding for sustained data collection and management activities.

By addressing these needs and gaps, Rwanda can significantly enhance its capacity for data-driven decision making in the human settlement and transport sectors, leading to more effective planning, sustainable development, and improved quality of life for its citizens.

6. The Way Forward

The document emphasizes Rwanda's dedication to incorporating climate change adaptation strategies, particularly in the human settlements and transport sector plans. This is in line with Rwanda's NDC and its broader environmental goals.

The briefing highlights the critical role of robust data collection, management, and analysis in implementing and monitoring adaptation actions. Effective data handling is key to documenting and understanding progress and making informed decisions.

It acknowledges the existing challenges in data collection, management, and analysis, including issues related to smartness and completeness of the indicators in terms of achieving the intended outcomes. Going forward, it is recommended that the following steps be taken:

- expand the urban dynamic maps to cover more districts and include specific tracking for informal settlements.
- integrate climate resilience and ensure that stormwater considerations in master plans include climate-resilience aspects and extend these considerations to individual households, not just at the district level.
- develop dedicated monitoring systems for rural areas to better track and manage data related to rural settlements and environmental factors.
- revise most indicators to align with SDG language, especially those related to water and sanitation, to ensure global standardization and specificity.
- continue developing the road asset management system with a focus on climate resilience in road infrastructure.
- integrate data from various sources like RTDA, Rwanda Environment Management Authority, and MINEMA to manage risks associated with natural disasters such as floods and landslides.
- utilize the e-ticketing system for better monitoring of public transport usage, and revise baselines and targets to reflect current and future needs more accurately.
- allocate necessary human, financial, and technological resources for efficient data collection, management, and implementation of the systems.
- implement awareness campaigns to educate the public about these initiatives and their impact on urban and rural development.

These recommendations aim to address the challenges and opportunities identified in the discussions, with a focus on data reliability, system effectiveness, and sustainable development in both human settlement and transport sectors.

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