Sustainable Road Infrastructure Project Implementation in Developing Countries

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Sustainable Road Infrastructure Project Implementation in Developing Countries: An Integrated Model

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List of Abbreviations

Abbreviation	Definition
ACEC	American Consulting Engineers Council
ADB	African Development Bank
AER	Annual Environmental Reports
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
AU	African Union
BREEAM	Building research establishment's environmental assessment method
CBA	Cost-benefit analysis
CCR	Climate change response
CEEQUAL	Civil Engineering Environmental Quality and Assessment Scheme
CIB	Conseil International du Bâtiment
CO_2	Carbon dioxide
CSR	Corporate social responsibility
DFR	Department of Feeder Roads
DPs	Development partners
DUR	Department of Urban Roads
EA	Environmental assessment
EIA	Environmental impact assessment
EIAP	Environmental impact assessment procedures
EM	Environmental management
EMP	Environmental management plan
EMU	Environmental management unit
EnS	Environmental sustainability
EP	Engineering performance
EPA	Environmental Protection Agency
ES	Economic sustainability
ESA	Environmental and social assessment
ESMF	Environmental and social management framework

FHWA	Federal Highway Administration
FSD	Forest services division
GDP	Gross domestic product
GHA	Ghana highway authority
GHG	Greenhouse gas
GI	Green infrastructure
GRF	Ghana Road Fund
GSGDA	Ghana Shared Growth Development Agenda
HS	Health and safety
ICE	Institution of Civil Engineers
IDOT	Illinois Department of Transportation
IISD	International Institute for Sustainable Development
INVEST	Infrastructure Voluntary Assessment Sustainability Tool
IQD	Interquartile division
IQR	Interquartile range
IRI	Institute of resilient infrastructure
IRI	International roughness index
IRTBA	Illinois Road and Transportation Builders Association
IS	Institutional sustainability
ISI	Institute for sustainable infrastructure
ISRIPI	Integrated sustainable road infrastructure project implementation
KPI	Key performance indicators
KTC	Koforidua Training Centre
LCA	Life-cycle assessment
LCCA	Life-cycle cost analysis
LEED	Leadership in energy and environmental design
LID	Low-impact development
M&E	Monitoring and evaluation
MCDA	Multi-criteria decision analysis
MEPDG	Mechanistic-Empirical Pavement Design Guide
MoT	Ministry of Transport
MRH	Ministry of Roads and Highways
NEAP	National Environmental Action Plan
NGOs	Non-governmental organizations
OP	Operational policies
PaLATE	Pavement Life-Cycle Assessment Tool for Environmental and Economic Impacts
PEA	Preliminary Environmental Assesment
PM	Project management
PMI	Project Management Institute

PP	Public participation
PPP	Public–-private partnership
RID	Road infrastructure development
RMRC	The Recycled Materials Resource Centre
RPF	Resettlement Policy Framework
RUM	Resource utilisation and management
SC	Sustainable construction
SCS	Social and cultural sustainability
SD	Standard deviation
SD	Sustainable development
SDGs	Sustainable development goals
SEA	Strategic environmental assessment
SID	Sustainable infrastructure development
SLCAs	Social life-cycle assessments
SM	Stakeholder management
SMTDP	Sector medium-term development plan
SRID	Sustainable road infrastructure development
SRIPI	Sustainable road infrastructure project Implementation
SRIPs	Sustainable road infrastructure projects
STAG	Scottish Transport Appraisal Guidance
TBL	Triple bottom line
TDR	Transfer of development rights
TIF	Tax incremental financing
TNM-Look	Traffic noise model look up
UK	United Kingdom
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
WB	World Bank
WCCD	World Commission on Culture and Development
WCED	World Conference on Environment and Development
WD	Wildlife division
WRC	Water Resources Commission
WSSD	World summit on sustainable development

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Part 1

Sustainability and Road Infrastructure Development

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Chapter 1

General Introduction to Sustainable Road Infrastructure Development*

Abstract

The sustainable development goals (SDGs) are a collection of 17 goals to address the world's most pressing sustainable development (SD) concerns by 2030. Third-world countries have a lesser global environmental impact than developed countries, and account for 66% of global greenhouse gas emissions. Infrastructure development has a key role to play in establishing a green society, with approaches such as green policy, sustainable monitoring, and sustainability reports. Indirect and induced sustainable infrastructure development (SID) dominates the SDGs, with the goal of providing secure, acceptable, readily available, and efficient transportation networks by 2030. Road infrastructure development (RID) should become more sustainable considering depleting natural resources, fragile ecological circumstances, and limited financial resources. Sustainable road infrastructure projects (SRIPs) provide several advantages, such as increased economic efficiency, lower resource utilization, greater social well-being, and enhanced protection of natural services. However, incorporating SD prerequisites into highway infrastructure projects in developing countries has been difficult due to a variety of factors. Efforts to develop sustainability certification standards for infrastructure systems are recommended, and it is important to define relevant ideas and principles for SRIP implementation. However, incorporating SD prerequisites into highway infrastructure projects in developing countries has been difficult due to a variety of factors. Different people have varied ideas about sustainability. This book aims to provide a unified guideline to aid developing nations in undertak-

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ing SRIPs and to develop a SRIP implementation model. This chapter provided a background for the book; it also provided insight into its organization, foundation, and significance. It also discusses the objectives of the book and emphasized on the purpose and motivation for writing the book.

Keywords: Sustainable development; road infrastructure development; sustainable infrastructure development; sustainable development goals; environmental impact; infrastructure development

1.1. Background to the Book

Due to the increase of harmful environmental pollution and ecological destruction in recent decades, it became critical to begin a public discussion to promote an effective response mechanism to this problem. As a result, the entire world is now focusing on a SD mission known as the SDGs. Following the United Nations (UN) meeting on Sustainable Development in June 2012, nations that are members of the UN began working on the SDGs. The SDGs were developed to establish a development policy and investment plan for the next 15 years. Seventeen goals aimed to address the world's major SD issues were adopted. Seven of the seventeen newly developed SDGs are connected to SID, which is the focus of this book. Overall, developing nations have a more negligible global environmental impact. For example, Baer et al. (2007) found that carbon emissions in developing countries seem relatively low, especially compared to advanced countries like the United States of America (USA) and China, which contribute 20.2% and 19.1%, respectively. Contrarily, developing countries, where nearly half the population is estimated to be below the statutory poverty line, are battling to lessen household hardships. The UN published a study named 'Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication', which emphasized the involvement of third-world nations in these poverty-reduction initiatives. These UN reports on SD emphasize the huge obligation developed nations have to less developed nations regarding environmental preservation because they heavily burden the planet's natural resources. The World Bank (2010) stated that although advanced nations only make up 17% of the global population, they are accountable for 66% of the world's greenhouse gas (GHG) emissions. The developing countries, on the other hand, are the ones who suffer the most as a result of severe climatic events. Several global research studies have been published on the meaning and importance of sustainability, but there are countless sociocultural activities in the Western world that encourage the long-term sustainability of domestic policies (Swilling, 2006). This is also a concern because of increased pressure from global partners. As a result, the question of whether SD is practical should be replaced with the question of whether businesses and organizations are ready and equipped to integrate sustainability requirements into their daily operations. In examining the preparedness of different industries, the World

Resources Institute (2007) stated that the transportation sector produces approximately 25% of CO_2 (carbon dioxide) pollution globally, while the transportation system, which is part of this industry, produces 80%.

As a result of the efforts mentioned and the current SD plan, the infrastructure development sector, along with every aspect of society, has a crucial role to play in creating a green society, according to Jarmin (2008). It is evident that SD principles are considered at every stage of the development of infrastructure, independent of its size, scope, design, construction, operation, maintenance, and demolition. Oltean-Dumbrava et al. (2014) opined that clients and essential stakeholders would gradually establish techniques like green ordering, sustainable monitoring, and sustainability reports for the various industries to obtain infrastructure projects or successfully compete. A solid and effective infrastructure system is essential for underdeveloped countries to experience sustainable economic development, which has reduced poverty, improved well-being, and raised living standards (Montgomery et al., 2014). SID is a direct and indirect dominant feature of the SDGs. One of the SDGs is for all nations to have access to sound, acceptable, readily available, and sustainable transportation systems by 2030, including infrastructure for all and enhanced infrastructure security, mainly through the expansion of open transportation, with particular attention to the needs of those in vulnerable situations such as women, infants, and disabled people. As a result, the road infrastructure industry must be included in the sustainability agenda because it is such an essential component of infrastructure development.

Furthermore, all road infrastructure specialists suggest that, in light of the depletion of natural resources, responsive ecological conditions, and limited financial resources, RID should become increasingly sustainable (Montgomery et al., 2014). It is important to remember that SD isn't just about focusing on environmental issues; it is also about the interconnectivity of ecology, equality, economy, and other factors that should be addressed at the project level. However, Montgomery et al. (2014) posited that integrating SD standards into highway infrastructure projects in underdeveloped nations has become problematic due to several factors, such as varied dimensions of responsibility and inadequate monetary assets.

1.2. Problem Statement

Project partners within the road infrastructure sector are under intense pressure to search for financially achievable, socially feasible, and environmentally mindful project results or techniques that will realize sustainable road infrastructure development (SRID). This is exacerbated further by the fact that project partners have diverse personal stakes and SD has several views, in addition to the absence of strategic decision-making processes and data at various dimensions in RID. Moreover, in developing countries, such a system for managing the information necessary to make decisions is non-existent or has not been determined by the various specialists working in the road infrastructure industry.

As a result, the concentration on sustainable construction concepts is on only building structures (Huang & Yeh, 2008). Very little has been done on

infrastructure projects, such as transportation and utilities, whose ecological impact typically spread across vast geographical areas and could have many further implications (Dasgupta & Tam, 2005). Even though most of the existing sustainable frameworks focus on evaluating the final outcome of the project, the evaluation does not identify and consider issues affecting the gap between SD efforts and actual project deliverables throughout construction projects.

Given that previous road infrastructure models developed in the advanced world cannot be relied upon in underdeveloped nations, and the implications of what determines the sustainability of road infrastructure projects in developing countries are unknown from previous research, the absence of literature examining the overall influence and impact of SRIP is prominent and all-encompassing requires active participation.

1.3. Purpose of the Book

The purpose of this book is to present a comprehensive model to assist developing nations in implementing SRIPs. The book considered relevant sustainability requirements, critically evaluated in previous research publications, to create a SRIPI (sustainable road infrastructure project implementation) model. The book sought to determine and combine the various interpretations and fundamental needs of the stakeholders and address the key grievances that affect the difference between sustainability motivations and their known recognition at the construction phase in terms of developing an integrative framework for SRIP implementation. To achieve deliverable goals throughout the planning and implementation process of road infrastructure projects, the book's anticipated definitive outcome is intended to act as a managerial tool for encouraging more methodical and collaborative decision-making in implementing SD principles.

1.4. Motivation for the Book

The SDGs have made participation in achieving equitable sustainability mandatory across all sectors, particularly the infrastructure development sector. As a result, the SDGs' requirement for SID serves as the main driving force behind this effort. Additionally, the book filled a gap in this field because there are few studies and literature on SRIP implementation in developing nations. Subsequently, this book aims to ascertain how SRIPs might be implemented in developing nations. The connection between independent variables and how they ultimately affected the dependent variables (SRIP results) were assessed. These factors are divided into 12 categories: stakeholder management, project management, resource utilization and management, engineering performance, climate change response, social sustainability, cultural sustainability, environmental sustainability, economic sustainability, and institutional sustainability. Constructs such as stakeholder management, climate change response, and public participation were left out of earlier scientific models of SID. The book investigated and evaluated different SRIP execution components to determine their level of impact on SRIP outcomes in addition to the other factors.

1.5. Significance of the Book

Notably, the book's overall outcome will serve as a decision-making instrument for allowing a more systematic and integrated approach to implementing sustainability initiatives to achieve the desired outcomes during the execution of road infrastructure projects. This book contributed to the current body of knowledge regarding SD and RID. The information obtained serves as a resource for studying the problems of implementing SRIPs. Finally, the anticipated financial and unmeasurable long-term advantages to the project partners are highlighted due to the sustainability initiatives.

1.6. Objectives of the Book

The following specific objectives are established to keep the purpose of the book in focus and to achieve the purpose of the book:

BO1: To educate readers with recent literature and theories on SRID and to identify critical gaps.
BO2: To ascertain the factors that affect stakeholders in the road infrastructure industry in developing nations and factors that causes different views of SD.
BO3: To identify the motivations for pursuing the road infrastructure sector's sustainability initiatives among diverse stakeholders in developing nations.
BO4: To identify the critical parameters affecting the implementation of SRIPs in developing nations.
BO5: To identify the primary criteria and indicators that contribute to the effective implementation of SRIPs in developing nations.
BO6: To establish a comprehensive framework for implementing long-term road infrastructure projects in underdeveloped nations.
BO7: To show the conceptual feasibility of an integrated approach for SRIP delivery.

1.7. Summary

This chapter provided a background to the book. It also discussed the problem statement in SRID research, purpose, and significance of the book. It also pointed out how the book was presented. The next chapter examines SD's philosophical and theoretical underpinnings and its constraints.

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