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# EXAMINATION OF RAILWAY AS A SUSTAINABLE TRANSPORT OPTION IN NIGERIA

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## Abstract

*Sustainability as a global concept has generated lots of attention, especially in the aspect of human mobility. Transportation, being a pivotal element in economic growth, urban development, and societal interactions, has prompted a need for sustainable practices in developing countries, just as it is in developed economies. This research therefore synthesizes various perspectives on the challenges of sustainable transport, focusing on Nigeria as a case study. It itemizes the links between rapid urbanization, environmental degradation, and the inadequacies of transport infrastructure as imperative for sustainable transportation systems. The proliferation of motorized vehicles, coupled with outdated infrastructure and dependence on fossil fuels, usually results in environmental pollution thereby scholars globally, advocate for the adoption of sustainable modes of transportation to mitigate adverse environmental impacts and promote economic and social well-being. Specifically, the revitalization of rail transport according to existing literature emerged as a reliable solution because the rail system is an efficient, environmentally friendly, and economically beneficial alternative. Howbeit, research gaps exist, which gave an impetus for further inquiry into the likelihood of rail networks as sustainable transport options, particularly in the African context. This study, using the interpretivism research paradigm, contributes to the discourse on transport sustainability hence filling a literature gap and advocating for robust policy frameworks that will propel the adoption of rail transportation in Nigeria to satisfy her quest for sustainable transport development.*

**Keywords:** Sustainability, Developing economy, Sustainable transport, Rail transport and Standard gauge rail

## 1. Introduction

Globally, there is a growing interest in the concepts of sustainability, sustainable development, and sustainable transport. Transportation is the most dynamic activity in nearly all the developing countries of the world because of its impact on economic growth and development, spatial expansion of cities, social interaction, industrial location, flow of information, and political integration (Rodriguez et al., 2013). Oke (2016) stated that the efficient running of any society is largely dependent on the availability of an efficient transport system because transport influences the quality of life and represents an inevitable tool in societal development as well as providing vital links between spatially separated facilities and enabling social interaction. Pojani and Stead (2015) posited that most urban areas across the world in both developing and developed economies have increasingly become automobile and less sustainable; thus it is imperative for this sector to be sustainably vibrant. This agrees with the submission of Ajayi (2020) that growth in urbanization drive from the late nineteenth century has triggered a resulting increment in urban travel demand, especially across the world.

With the economic boom of the late twentieth century and the attendant proliferation of motorized transport led by the Fordism revolution automobile production, the gradual emergence of the negative externalities of environmental pollution began in most cities globally (Ajayi & Ajayi, 2013) because virtually all cities in the developing world are dealing with rapid urbanization and the need for improvement in the standard of living. This has caused increased urban travel demand, particularly with regards to personal motorized modes of travel, thus leading to deterioration in air quality and an increasing number of accidents both of which have several aggravating health impacts even as an increase in the use of fossil fuel for transport has negative implication for climate change (Mehdi-Schulz, et al., 2024). Transport services are also regarded as inadequate in quality and qualitative terms in most developing countries such as Nigeria which, relies on the importation of fairly used vehicles to meet travel demands (Adeyinka, 2013). Equally, part of the numerous challenges in Nigeria's transport sector is the prevalence of obsolete transport infrastructure (Adebayo & Odufuwa, 2020). The duo indicated that the shortage in Nigeria's transport infrastructure hinders the country's economic development through increased transportation costs and reduced market accessibility.

The environmental concern of the transport network in Nigeria is also of high concern to different scholars like Oguoma, et al. (2016) and Iseoluwa & Aderemi, (2019) who reiterated that the country's heavy reliance on fossil fuel-powered vehicles greatly contributes to environmental pollution and therefore calls for the adoption of sustainable modes of transportation to mitigate the negative impacts (Adewumi, Ganiyu & Aderemi, 2020). Dioha and Kumar (2020) examined sustainable pathways to energy in Nigeria. The result showed that improved vehicle fuel economy and a carbon tax can lower Nigeria's CO<sub>2</sub> emissions by 42.8% and 26.9% respectively by 2050. Salisu and Omotor (2023) pointed out that Nigeria's transport system is not sustainable having summated that public transport modes across the selected cities in Nigeria are operationally cracked, following a cross-sectional survey to discuss the importance and challenges faced by public transport systems in Nigeria hence recommended that sustainable transport network be employed in Nigeria.

Adeyemi and Afolabi (2017) suggested that a country like Nigeria is struggling with rapid urbanization, increasing levels of pollution, and inadequate transport infrastructure. The adoption of a sustainable transportation system would not only solve the existing environmental problem but would bring economic benefits and foster social wellness of the nations which are the tripods of sustainability. According to Andrew (2020), the rail transport system is an efficient and environmentally sound means of transportation within and across cities that can move large numbers of people quickly and cleanly over short and long distances. Rail movement is indicated to be a reliable, cost-effective, and energy-efficient alternative to road and air transport, particularly in densely populated areas or regions where road infrastructures are inadequate or underdeveloped (Rodriguez et al., 2013). Rail movement was also indicated to be of economic relevance by the World Bank (2019). Therefore, investment in rail infrastructure is required since active rail transport can provide direct and indirect economic benefits, including job creation, increased productivity, and improved access to markets. The UN-HABITAT (2013) added that rail transport has the potential to foster urban and rural development by providing connectivity and access to essential services and economic opportunities. Oluwakoya and Ogundipe (2021) stated that for Nigeria to be captured as a world-developed economy as desired by her government, the revitalization of her erstwhile moribund rail transportation was required.

Research by Adepoju (2019) on the efficiency of rail transport as a sustainable mode of transportation in Nigeria using rail mass transit in Lagos and its environs showed that not much research has been done on railway sustainability in Nigeria and there is a shortage of literature on the concept having solely relied on secondary data for the work. This has brought about the need for more studies on the appraisal of rail development as an option for the sustainable transport system in Nigeria. According to Pojani and Stead (2015), existing literature on sustainable transport focuses mainly on Asian and Latin American contexts, therefore this research is posited to be among the scholarly works that are debating transport sustainability as it relates to Africa and particularly Nigeria. Based on the identified gaps, this study was undertaken to examine rail transportation as a sustainable transport option in Nigeria using the interpretivism research

paradigm with the view of formulating policies that can optimize transportation networks and promote public transit systems.

## **2. Conceptual Development of Sustainability**

The United Nations (UN) Stockholm conference on the human environment in 1992 marked the first significant international meeting on how human activities were harming the environment and putting humans at risk. The UN Conference on the Environment and Development (UNCED) also known as the Earth Summit also held in 1992 in Rio de Janeiro, Brazil adopted Agenda 21 which calls for reorienting policy towards sustainability. This agenda was a statement of principles by more than 178 governments and a comprehensive plan of action to be adopted globally, nationally, and locally by the organization of the UN system and government in areas in which humans impact the environment. The Commission on Sustainable Development (CSD) was then established in 1992 to ensure effective follow-up of UNCED. The World Summit on Sustainable Development (WSSD) in Johannesburg, 2002, re-affirmed implementation of Agenda 21 (UNESS, 2004). There are many definitions of sustainability, sustainable development, and sustainable transport (Beatley 1995, Federal Highway Administration Agency, FHWA 2011, Rehman, Kraus, Shah, Khanin, & Mahto, 2021).

Sustainability is the capacity to endure as well as survive (Ewing & Cervero, 2002). Therefore, achieving sustainability will enable the earth to continue to support human life. According to Johnson, Everard, Santillo, and Robert, (2007), the concept of sustainability is not understood due to inconsistency and ambiguity in the definition and the fact that the meaning of the term is distorted. Hay, Duffy, and Whitfield, (2014) discussed that sustainability as a term should not be difficult to explain but the problem of its definition is because different interests are considered while explaining sustainability. The most widely accepted definition of sustainable in general originated from the 1987 Brundtland report. The report defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987). This definition suggests that humans and the environment have limited resources and hence must be discrete in its usage so as to accommodate future generations. Sustainability therefore rests on the premises of leaving behind; by prudent use of scarce resources in a way that extends their use for future generations. Sustainability is geared towards promoting balances between economic, social, and environmental goals and objectives (goals are general desired outcomes, objectives are specific, measurable ways to achieve goals), including those that involve indirect and long-term impacts.

## **3. Sustainable Transport**

The numerous definitions of sustainable transport are generally derived from the Brundtland Commission's definition of sustainable development. The definitions are aimed to reflect various objectives geared specifically to the development of transportation systems. The Organization for Economic Cooperation and Development (OECD) proceeding titled 'Towards Sustainable Transportation' at the Vancouver conference hosted by the Canadian government in 1996, defined sustainable transport planning as the efforts to allow the basic access and development needs of individuals from the public to be safely met and dependable with the human and ecosystem health that benefit the next generation. The environmental dimension of a sustainable transport system highlights the stress on the natural environment that the transport activity causes (air quality, pollution, climate change, noise pollution, landscape fragmentation, loss and disturbance of habitats and species due to provision and utilization of transport infrastructures (OECD, 2015). The social angle to sustainable transport is viewed mostly from the angles of accessibility and safety. The main reason for the transport system to exist is to provide access to resources, services, and markets.

Rodriguez et al. (2013) examined transport and sustainability in light of the contribution of transport to sustainable development. It was indicated that sustainability can be appraised in terms of social equity, economic efficiency, and environmental equity. He opined that transport

is a “core component supporting the interactions and development of socio-economic systems”. He therefore described sustainable transport as the capacity to support the mobility needs of people, freight, and information in a manner that is least damageable to the environment. Sokolov, et al. (2016) equally opined that the level of development of transport is one of the factors ensuring the economic security of the country both in terms of the complete geographical coverage of the country’s territory through communication as well as in terms of the technical and technological levels of development of certain type of transport, the harmoniousness of their interaction compliance with the development of productive force of the state. Todd (2017) indicated that a sustainable transportation system should allow individuals or society access to basic needs in a manner that is regular regarding human and environmental health and equity across generations.

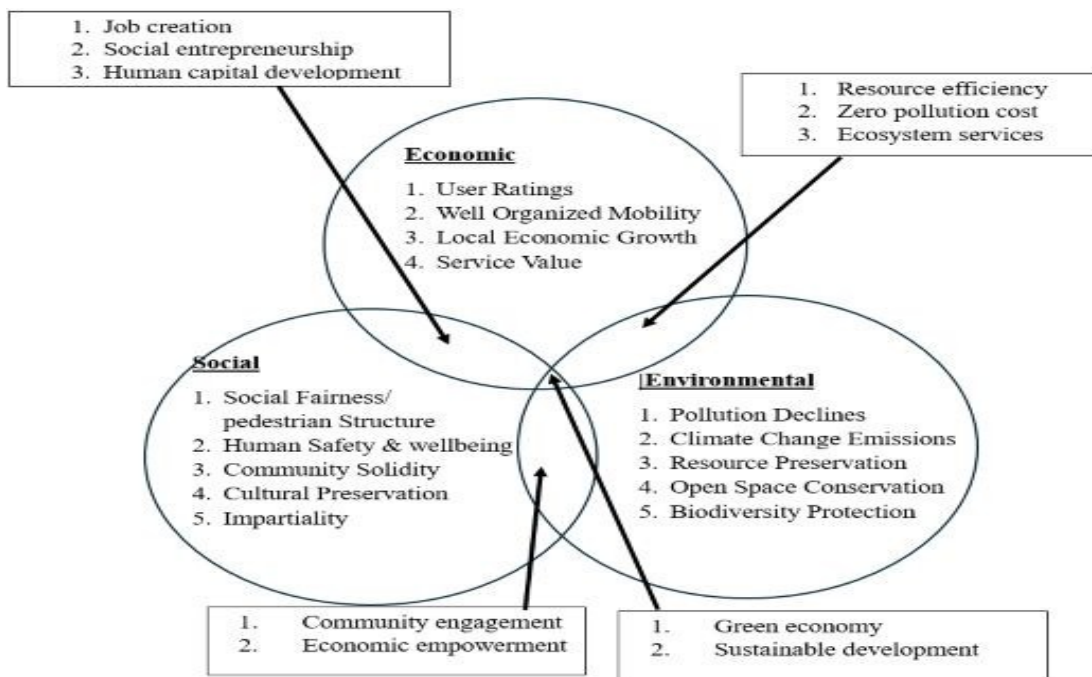


Fig 1: Conceptual Framework on the Sustainable Transport Goals  
**Source: Authors’ 2024.**

As depicted in Fig 1, a sustainable transport must therefore have a low impact on the environment, and encourage transit-oriented development, green vehicles, car sharing, and fuel efficiency. The sustainable transport system is expected to serve as an instrument for social, political, and economic unification; strengthening the operation of markets, facilitating production and resource development, and promoting relationships with the outside world. Hence, the strategic importance of a nation’s transport system to the country’s economic growth and the increasing threat that climate change poses to the world necessitates analysis of the sustainability of available transport systems in the country. Cities around the world are daily seeking to implement more sustainable transport systems for reasons of congestion, air pollution, high accident rates, and emission of greenhouse gases (Stefan et al., 2016).

#### 4. Sustainable Transport Indicators

The Organization for Economic Cooperation and Development (OECD 2001) developed the indicators of environmentally sustainable transport to include: CO<sub>2</sub> – Climate change is prevented by avoiding increased per-capita carbon-dioxide emissions, NO<sub>x</sub> – Ambient NO<sub>2</sub>, ozone levels and nitrogen deposition is greatly reduced, VOC – Damage from carcinogenic

VOCs and ozone is greatly reduced, Particulates – Harmful ambient air levels are avoided by reducing emissions of fine particulates (particularly those less than 10 microns in size), Noise – Ambient noise levels that present a health concern or serious nuisance (maximum 55-70 decibels during the day and 45 decibels at night and indoors) and Land use – Transport facility land consumption is reduced to the extent that local and regional objectives for ecosystem protection are met. Several scholars have indicated parameters otherwise called indicators upon which transport sustainability shall be appraised. Worthy of note is the work of Jain (2009) while reviewing sustainable urban transport specified that sustainable transport is concerned with ensuring safer and more efficient transport. He stated the effects of transport on the environment by mode (rail, road, air water). His work highlighted the capacity cost and emissions of various transport modes. He went further to discuss transport infrastructure and the ideal city and submitted that a sustainable and ideal city must be based on the following parameters;

- i. Maximum 8 to 10 minutes walking distance from residence/ walk place to public transport mode
- ii. No automobiles except taxis at peak hours, as all citizens move by public transport and bicycles
- iii. Homes with nearby stores, restaurants, movies, and cultural activities
- iv. Abundant parks, pedestrian streets, greenways, wide sidewalks, bicycle paths, etc.
- v. High and low-income citizens meeting as equals in public spaces
- vi. Autonomy and freedom of movement of children and the elderly, and lastly
- vii. Very low levels of noise and air pollution

Zheng, Carol, Chris, Rayan, and Norman, (2011) stated affordability, mobility, finance, and resilience as indicators upon which transport sustainability should be appraised. Todd (2021) identified the possible indicators of sustainable transport to include:

- i. User satisfaction- overall transport system user satisfaction rating.
- ii. Commute time- average door-to-door commute travel time
- iii. Land use mix- the average number of basic services (schools, shops, and government offices) within walking distance of homes.
- iv. Congestion delay- per capita traffic congestion delay.
- v. Affordability- portion of household expenditures devoted to transport, particularly by lower-income households
- vi. Facility costs- per capita expenditures on roads, parking, and traffic services.
- vii. Cost Efficiency- portion of road and parking costs borne directly by users.
- viii. Commercial transport- quality of transport services for commercial users (businesses, public agencies, tourists, convention attendees).
- ix. Land use planning- applies smart growth land use planning practices, resulting in more accessible, multi-modal communities.

The aforementioned authors individually and collectively presented varying aspects of sustainable transport indicators. Jain, (2009) presented a holistic view of functioning sustainable transport to include minimizing environmental impact, social equity, and urban design while Zheng et al. (2011) and Todd, (2011) specified sustainable transport indicators as measuring transport economics, social, and mobility-related metrics. Conclusively, the reviewed work jointly emphasized the need for a safe and efficient transport system in the city thereby justifying the essence of the study which is to optimize the transportation network and promote a public transit system.

## **5. The Nigeria Rail Transportation in Perspective**

Historically, the Nigeria Railway Corporation (NRC) came into being following the merger of the pre-existing Lagos government railways and the Baro- Kano railways on the 3<sup>rd</sup> of October, 1912, (Bureau of Public Enterprises, 2022). NRC became an autonomous corporation by the Nigerian Railway Corporation Act (1955), as amended in 1990, with the general objectives of

“carriage of passengers and goods in the manner that will offer full value and quality of service, ensure the safety of operations and maximum efficiency, meet social responsibility in a manner that will meet the requirements of rail users, trade, commerce, and the general public”. Nigeria Railway Corporation has its roots dating back to 1898. The British colonial government constructed the first railroad with the desire to reach the hinterland for the purpose of evacuating Nigeria's agricultural and mineral resources to the port for eventual transfer to Britain and the rest of Europe (Adesanya 2010, Okanlawon, 2011, Oluwakoya & Ogundipe, 2021).

The construction of 32km of a 1067mm gauge railway line from Iddo (Lagos) to Otta (Ogun State) started in 1898. This was extended to Ibadan covering a total of 193km in 1901 and continued incrementally to Ilorin and reaching Kano in 1912. The construction of the second rail line started in 1913 from Port Harcourt passing through Aba, Enugu, Jos, Kafanchan, and reaching Kaduna in 1923. The railway system in Nigeria started with the use of black, monstrous, and convulsively smoky steam engines and later changed to diesel engines in the 1970s. For 31 years, which is between 1927 and 1958, there was no railway construction in Nigeria (Nathan & Reddy, 2011). However, in 1958, the track between Kafanchan and Bauchi (238km) was constructed and this was extended to Maiduguri in 1964 (302km). This development brought the total rail route in Nigeria's railway network to 3505km and track kilometers to 4,332km. In 1986 the government embarked on the construction of a 19km (1069mm gauge) rail line from Port Harcourt seaport and a 277km (standard gauge) line from Itakpe through Ajaokuta to Warri, which was commissioned in 2020. The reduction in agricultural activities following the discovery and exploitation of crude oil in Nigeria led to low output of agricultural products therefore resulted into redundancy and abandonment of the hitherto vibrant rail transportation within the country, (Binuomote & Adeniyi, 2013).

In Nigeria, rail transportation until recent times suffered a crisis and accounted for an insignificant proportion of value added in the transportation sector, (Chukwurah, Okeke, Isimah. & Igwe, 2022). Records revealed that the operational segment of Nigeria's railway network till 2010 was only between Lagos- Kano and Abuja- Kaduna. The identified problems in the performance of Nigeria's rail transportation included but were not limited to poor management, poor maintenance culture, negligence of the sector by the government, and absence of a functional national transport policy, (Adesanya, 2010, Odeleye, 2010, Ademiluyi, & Dina, 2011). However, in the last few years, a deliberate attempt is made by the government to revitalize rail transportation for passenger and cargo movement across the country. This has resulted in an upgrade of existing tracks and the construction of new rail tracks. It is envisaged that the introduction and adoption of rail transport system in Nigeria holds the promise not only for environmental improvement but also for significant social and economic benefits. As Nigeria continues to develop, it is important that it builds a transport infrastructure that is capable of supporting its growing population and economic aspirations whilst being sustainable.

## **6. Railway Transport as Sustainable Transport Option**

Railways play a major role in the decarbonization of the economy with its environmental, social, and economic advantages as such result in the preservation of the planet. This is in tandem with the position of the International Labour Organisation (ILO, 1994) in Okanlawon (2011), where they stated that medium and high-speed rails are viable options for intercity travel against cars which is noted for increasing congestion and pollution. Railway transport has a significant impact on the functioning of enterprises in other sectors. Oni and Okanlawon (2011) stipulated that a virile rail transportation system plays a significant role in the sectorial development and overall growth of any economy. Transport is a natural and unsustainable activity because the infrastructure for transport operations which includes roads and railways uses nonrenewable resources and also because the transport process is responsible for great pollution, damages, irreplaceable resource loss, and long-term environmental changes (Fishman, 2016). Simionescu and Silviu (2016) while assessing the sustainability of railway modernization projects from Romania, indicated that the sustainability aspect of projects is mostly considered in relation to the project deliverables while less attention is always given to the sustainability of the process.

To determine the sustainability of the railway in their work, the duo used the SPM3 model, a model developed as descriptive by Silvius and Schipper (2015). The model broadly grouped sustainability indicators under three main categories; namely - economic, environmental, and social. Their finding indicated that the railway project in Romania is economically driven.

In the study by Oraegbune (2020), titled Sustainable Transport Infrastructure Projects (railway) in Nigeria. The issue of rail transportation infrastructure sustainability as involving multi-dimensional views of sustainability criteria such as economy, environment, and society was presented. To determine the extent of sustainability adoption in railway transportation, infrastructure projects, and identity infrastructure sustainability indicators, the scholar formulated a mathematical model computing the sustainability index (SI) using the Weighted Sum Model (WSM), which was constructed in three steps

The study adopted descriptive statistics to present and discuss his results. It was observed from the study that transport sustainability awareness has not been widely addressed in Nigeria but the government is making an effort for the implementation of the concept of sustainability in transport infrastructure projects. It may therefore be convenient to specify that his claim is evident in the structures of newly constructed terminals for modern rail services being built across rail corridors in Nigeria.

Further studies indicate rail transport as also a key to transport sustainability. According to Agnes, Daniel, and Anita (2020), the development process of rail transportation is based on the market pull effect which is initiated by the economy and society, and the market push effect fostered by technological development. The study emphasized that the development of rail transportation in a developing nation is low compared to the developed world; therefore, the provision of rail-supporting management tools and planned purposeful management with structured legal backing will play a significant role in the development of a sustainable rail transport system. Also supporting this claim are the findings from the study conducted by Agnes et al (2020), which stated that the major drivers prescribing the future demand for railway travel in developing countries are:

- i. Societal and cultural indicators
- ii. Economic indicator, denoted by a shift in the gross domestic product (GDP) and
- iii. Technological indicator, represented by the volume of passengers and tons of goods that are transported.

The results by Soretire, Lawal-Fagbo, Ajayi, Oluwakoya, and Fayomi, (2023,) showed that Nigeria's rail transportation is environmentally friendly and has resulted in economic benefits for the residents' of the communities housing the rail terminals. The results from the findings therefore present rail transport as a tool for sustainable transport system in a developing economy.

In a study carried out by Okland, Olsson, and Venstad (2021), on sustainability in railway investments using the triangulation method. It was revealed that there are no explicit requirements to do an overall analysis of sustainability. However, the environmental aspect of sustainability is largely dependent on the respondents' interpretation of the concept. Wang, Sekei, Ganiyu, and Makwetta, (2021) summated that developing practical organization tools for measuring and fostering sustainability would necessitate decisions or finding that would remain open for discussions therefore recommended that different organizations or individuals should develop specific or industry tools to obtain a balanced evaluation across social, economic and environmental policies. A quantitative method was adopted for this study where they obtained data from workers at the rail stations and residents alongside the project, using a simple random sampling technique. They specified that this sampling method reduces selection bias. The study used a five-point Likert-type scale and employed structural equation model (SEM) technique and correlation analysis. Their findings validated the use of the highway assessment model which was developed by the scholars in their work on the Empirical research in the indicator system and model of highway post evaluation at the Institute of Electrical and Electronics Engineers, (IEEE) conference (2010) as being efficient in railway sustainability evaluation.

Wang, et al. (2021) while introducing their work on sustainability of the standard gauge railway construction described railway transport as excellent in connecting cities, countries, and continents and capable of making the world feel smaller and more accessible. They specified that due to technological advancement and innovations, the railway means of transportation have been advancing to meet the safety, time, and cost efficiency which forms the basis of sustainability. The transport sustainability indicators according to this team of scholars are regarded as energy use, land use, waste, water use, safety, noise, and quality of life.

## 7. Conclusion and Recommendations

Given the evident transport negative externalities in Nigeria, it is concluded that the adoption of a sustainable transport system becomes imperative in Nigeria to ease the attending negative transport impacts and rail transportation has been established in literature as a sustainable means because it offers a greener alternative contrary to other means, and possess the capacity to emit significantly less greenhouse gases per passenger or ton of freight. Moreover, rail's sustainability extends beyond its environmental impacts but encompasses economic bounciness and social equity. Rail networks, with their capacity to move masses efficiently and affordably, become catalysts for economic growth, linking markets, facilitating trade, and spurring investment along rail corridors.

Equally, in a developing economy where differences in accessing transportation create an extensive socio-economic divide, the availability of an extensive rail network becomes a leveller, granting equal mobility access to all. Beyond mere connectivity, an active rail network stimulates job creation, drives tourism, and leads to industrial development along its routes thereby opening the full economic potential of a nation. In the records of developing economies, rail has played a pivotal role in propelling nations toward economic prowess as established in the literature. As Nigeria's transportation sector tilts toward rail system development, this study recommends that the government should embrace and promote rail transportation across the country, not just as a means of passenger and freight movement, but as a symbol of her commitment to more sustainable transportation development. Also, there should be the formulation and enforcement of policy that provides the framework for this reason efficient rail transportation.

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