

Full Length Research Paper

Urban Transformation in the Context of Rail Transport Development: The Case of a Warri-Itakpe Railway Line in Nigeria

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ABSTRACT: A solid rail transportation system is important for a country's economic prosperity. The way trains operate around the world has changed dramatically. Railways have undergone substantial modernization and improvement to better serve their consumers. Over the last century, rail transit in Nigeria has risen at a significantly slower rate than in the industrialized world. For some time now, operational losses have been mounting. After independence, Nigeria railway system was unable to adjust to shifting political and economic realities. Until recently, Nigeria's railway sector had lost a significant amount of clout and competitiveness. Recent government investments and regulations have highlighted the importance of Nigeria's railway system. Railroads support job creation, economic expansion, trade, and cost savings. As a result, local, regional, and national connectedness improves. The passage of a number of rail transportation-related legislation, rules, and projects in Nigeria has altered global perceptions about the country's rail transportation system. For a long time, there has been a lack of research on the growth of Nigeria's railway

infrastructure and built environment. The goal of this research is to perform a long-term review of the growth of the railway network and its impact on the built-up region between 1987 and 2021, utilizing Warri-Itakpe as a case study. The Warri-Itakpe Railway connects Nigeria's port city of Warri to an inland town. The industrial rail at Ajaokuta Steel was built in 1987. The suggested study employs both qualitative and quantitative methodologies. It will estimate binomial logit models to forecast the likelihood of new stations being built based on the amount of built-up area preceding and following the new station, as well as the likelihood that a new station would promote further growth, using a concentric buffer of one kilometer around railway stations. New stations are more likely to be built in undeveloped areas than in established built-up areas already served by existing stations as time passes.

Keywords: Urban transformation, transport, Warri-Itakpe, railway network

INTRODUCTION

Rail transportation is critical to the growth of any economy's sectors and the overall economy. Rural areas are made more accessible by fostering agricultural and small/large scale industrial development in rural areas. It

is central to residential, economic, educational, and recreational development (Nwanze, 2002; Oni, 2011). Railways assist both passenger and freight movement. The construction of railway transportation systems can

help to create sustainable urban mobility (Polom et al., 2018). Trains can compete with other means of transportation provided they have the proper infrastructure and access to train stations, but only if they are well-equipped. Consult Banister and Berechman for more details (2001). Urban growth and development research is a critical component of urban studies (Kasraian et al., 2015). From economic geographers to planners and policymakers tasked with guiding and channelling future urban development, understanding the factors that influence urban expansion and their interplay is critical information (Kasraian, 2015; Polom, 2018).

The importance of transportation infrastructure in structuring cities over time has been argued by numerous scholars (Kasraian et al., 2015; Alao 2008;).

Transportation infrastructure and urbanization (or land use) have also been found to be intertwined, as has travel behaviour. Land development generates travel demand, necessitating infrastructure improvements, while infrastructure upgrades improve accessibility, increasing the value of a property for future development (Kasraian et al., 2015).

It has been studied how transportation infrastructure development, land use, and travel behavior are interconnected. Cross-sectional studies have been conducted to investigate the impact of land use, which is the spatial manifestation of human activity, on travel behavior (Ewing and Cervero 2010). The literature also discusses the relationship between transportation infrastructure and local economic development.

Research in this area of urban economics analysed the effects of large-scale transportation infrastructure, such as motorways or high-speed rail, on regional economic developments using aggregated data and before-and-after comparisons (Ewing and Cervero, 2010; Kasraian et al., 2015). There have also been several studies on how infrastructure influences the value of land or property.

It has been revealed that there is a link between infrastructure network development and the built environment (land use). Infrastructure and land use integration is a long-term process that takes time to emerge (Ihlanfeldt, 2020; Kasraian et al., 2015). Long-term studies on this association are relatively rare due to a lack of solid data (Badoe and Miller, 2010; Kasraian et al., 2015).

According to the study's findings, they also quantified changes in accessibility as a result of infrastructure changes, as well as their implications for accessible populations or population density (Atack et al. 2010; Axhausen et al., 2011; Duranton and Turner, 2012; Kasraian et al., 2015).

Bollinger and Ihlanfeldt (1997), examined how the working and residential populations were redistributed over time. It's all about how population density is affected by changes in infrastructure. It is possible that population density change may overlook changes in land consumption, such as urban land expansion. To put it another way, population

growth does not always correspond to changes in land use. While the population of a municipality may remain stable, the amount of urban land covered may rise as fewer people live in each house.

A growing body of research attempts to explain the relationship between urban land use and infrastructure. Computerized aerial photos are commonly used in these studies. However, they are often limited to a few decades in the second part of the twentieth century and rarely spread beyond urban areas. For example, researchers in Seattle and Istanbul studied the effects of vehicle traffic on land use distribution and urban expansion. Regional land consumption and urban land consumption have not been studied by researchers in nearly a century.

Residential, commercial, and industrial real estate, as well as city infrastructure and parks, are all examples of "urban land" (Kasraian et al., 2015). This is often known as the built-up area (BUA). Given that urbanization is the process of converting undeveloped land into developed areas, the scarcity of research in this sector is astounding. Anas et al. (1998) emphasize the physical change of the landscape while discussing urban sprawl (Dieleman, Dijkstra, and Spit, 1999).

The Warri–Itakpe Railway connects the port city of Warri with the inland town of Itakpe, and is a Nigerian standard gauge railway. In 1987, the Ajaokuta Steel Mill began receiving iron ore and coal via an industrial railway. After a lengthy construction period of more than 30 years, the railway was finally inaugurated in 2020 as a mixed freight and passenger route (Okoye et al., 2016). There is currently a plan to extend the Lagos–Kano Standard Gauge Railway to Abuja (Okoye et al., 2016, 2019). As part of this study, we will look at what factors influence the accessibility of railway lines and stations, as well as how these factors interact with changes in their immediate surroundings. GIS tools, direct measurements of passenger exchange, and public opinion polls were used in the study of the rail service. In Delta, Edo, and Kogi states, the Warri–Itakpe research areas. Transportation issues are becoming increasingly problematic in these parts of southern Nigeria as a result of the rapid growth of the city. The proposed analysis is both qualitative and quantitative in nature. It will describe the proportions of built-up area in concentric buffers of one to five kilometers around railway stations, as well as estimate binomial logit models to forecast the likelihood of new stations being built based on the amount of built-up area preceding and following the new station, as well as the likelihood that a new station would spur additional growth. The data are intended to show that stations followed overall urbanization trends and that, over time, new stations are more likely to be built in undeveloped areas than in developed areas already served by existing stations. More and more studies are focusing on how infrastructure and urban land use are linked, but no study has examined the relationship between Nigeria's railway network and regional land use for more than 30 years.

The proposed models for urban and potential urban lands will typically use buffers with a 5-kilometer radius around the railway stations, as well as GIS tools, direct passenger exchange measurements, and public opinion polls among passengers taking the new line. Infrastructure, parks, and residential, commercial, and industrial properties all fall under the umbrella of urban land. It's located in the city (BUA). It's surprising that there isn't more research being done in this area in Nigeria, given that urbanization entails turning undeveloped land into populated areas. Dieleman, Dijst, and Spit (1999) cite examples of suburbanization and urban sprawl as two types of physical landscape change that need to be considered. Nigeria's Warri–Itakpe Railway, which links Warri to Itakpe in the inland region, is among the case study areas. In 1987, construction began on an industrial rail line to serve the Ajaokuta Steel Mill. This mixed freight and passenger route will open in 2020 after a 30-year construction period. The Lagos–Kano Standard Gauge Railway is being extended to Abuja. It is for these reasons that this study examines the impact of transportation infrastructure (the railway network) on urbanization at the regional level and over a long period of time (measured as built-up area).

Creating rail-based public transportation networks, such as urban railways, to bring the concept of urban sustainable mobility to life. Such systems, for example, can increase transportation efficiency in two ways. One is by adopting a mode shift, which reduces the use of private cars while simultaneously lowering congestion and its negative effects, including those harming public health and safety.

As a result of this change, we will be able to reduce our overall greenhouse gas emissions. Because cities and transportation networks consume so much energy on a daily basis, there is a lot of space to reduce emissions here. These advantages can be realized only through good spatial planning and the development of public rail-based transportation systems. As a result, rail transportation has a considerable impact on urban design and development. The main goal of this article is to answer the question of how much the Pomeranian Metropolitan Railway has contributed to changes in the geographical and functional organization of Warri Itakpe, two significant socioeconomic areas in Nigeria (Figures 1-2).

METHODOLOGY

Study areas

Itakpe, a town in Nigeria's Kogi State, is the second research area. The Itakpe Hills, which encircle Itakpe, contain very pure iron ore quantities. This is where the National Iron Ore Mining Company is located. It supplies steel to Ajaokuta and Aladja steelworks in addition to exporting ore. Warri, a South-South Nigerian oil hub, has an annexe of the Delta State Government House. It was

the former colonial capital of Warri Province. Okere, Agbassa, Uvwie, Okpe and Udu are all in Sapele but have been incorporated into Warri's greater metropolitan region. Osubi has a city airport. Warri Province was a part of the Colony and Protectorate of Southern Nigeria. Its north-eastern border was Sapele, with Forçados River in the southeast and Jameson Creek in the southwest. Effurun is the city's economic and commercial hub. The Warri–Itakpe Railway is a Nigerian standard gauge railway that connects Warri's port city to the inland town of Itakpe. Construction of an industrial railway to deliver iron ore and coal to the Ajaokuta Steel Mill began in 1987. The railway was finally inaugurated in 2020 as a mixed freight and passenger route, following a lengthy building phase of more than 30 years. An extension to Abuja is currently under construction, where it would connect to the Lagos–Kano Standard Gauge Railway.

Data collection and analysis

To achieve this research's objectives, a range of GIS tools, direct measurements of the passengers' flow assessed. The research objectives were evaluated using a hybrid method that combines qualitative and quantitative descriptions. To evaluate the first objective, descriptive graphs of the railway network's evolution were generated, including the number of stations and the length of lines at annual intervals from the network's inception to the present day, and maps showing the network's growth at decennial intervals. Qualitative explanations from the (recent) literature were added to this quantitative picture.

RESULTS AND DISCUSSION

A GIS-based database combining data from a variety of sources was created for the purpose of empirically examining changes in the railway network and the surrounding built-up area (BUA). For the Warri-Itakpe region, different demarcations are used, and this variation is reflected in the research (e.g., Laan 1998; Clark and Kuijpers-Linde 1994; van Eck and Snellen 2006). Itakpe and Warri are both included in all definitions, to our knowledge. It is the common denominator of all the data sources available to us that we choose to study (Figure 3). Other Warri-Itakpe boundaries in northern and southern Nigeria may have slight variations. Analyses of stations were conducted within this research area to ensure that changes in the surrounding environment were still taken into account.

One of the most difficult aspects of our research was collecting and constructing a consistent database of the evolution of BUA. BUA was not only measured and classified inconsistently, but the data sources and types used to collect it varied greatly. Non-overlapping ring buffers with 1-kilometre intervals were created for Warri and Itakpe existing railway stations at the nine points in

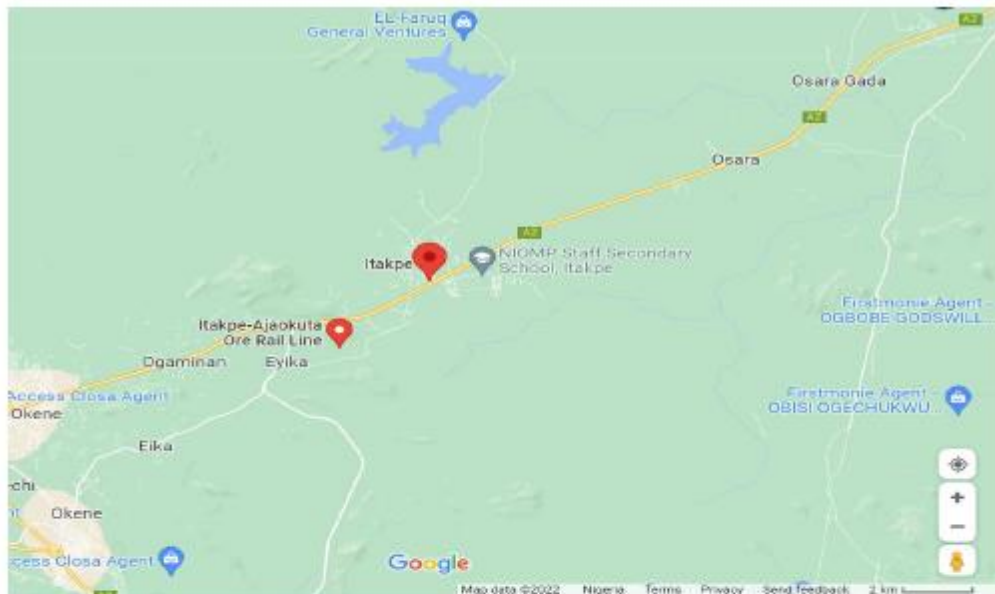


Figure 1: The Itakpe-Ajaokuta Railway line within the Okene-Itakpe boundaries.



Figure 2: Google Map showing the Warri-Itakpe-Ajaokuta Railway line within the Delta-Kogi State boundaries.

time in order to compare the amount of built-up area (BUA) and the distance to railway stations. A total percentage of BUA was calculated for the study area as a whole and for specific buffers around existing stations in the year 1850, 1910, 1940, 1960, 1970, 1980, 1990, and 2000. Following these calculations, you can see the results in (Figures 4-5). The Warri-Itakpe study area's boundaries changed during our time there. When territories are added, the study area expands by 8% from 1850 to 1991, but the borders remain the same. The Ujevnu-Itakpe Railway connects Warri, Nigeria's port city, with Itakpe, a small

town in the country's interior. The Ajaokuta Steel Mill's iron ore and coal needs were met by an industrial railway that was built in 1987. For more than 30 years, the railroad was under construction as a mixed freight and passenger line. It was finally completed in 2020. BUA's total volume increases with each time period as predicted in Figure 4. Before 1970, when urbanization slowed, BUA grew faster than it had in the previous decade. This was followed by the 1980s, which saw the lowest growth rate. There are many possible reasons for this trend, including policies to curb suburbanization prior to the 1970s and an economic



Figure 3: Railway line between Warri and Itakpe, 2022; Train stations.

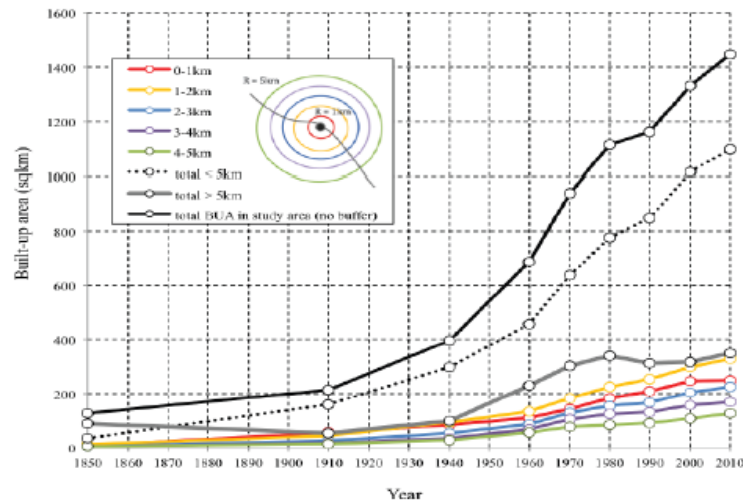


Figure 4: Development of the built-up area as a whole and within the different station buffers of Warri-Itakpe.



Figure 5: Directions and perspectives for development of different land use forms in the Warri-Itakpe area.

downturn that occurred during the 1980s. In the last two decades, the amount of BUA has increased at a faster rate than in the 1990s, but at a slower rate than in the 2000s.

Conclusion

This paper gave a long-term study of railway growth in the Wari-Itakpe area during the last 150 years, as measured by the rise in built-up area. It then looks into the effect this has had on urbanization. Because the new line had only been in operation for a short period, drawing any valid judgments about the variability of time is difficult. Railroad length and station count followed a similar pattern, with the former expanding and peaking about 1920 and the latter declining between the 1930s and 1950s before recovering to a steady state in the 1960s and continuing to increase from the 1970s to the present. Though the entire length of the railway varied, station numbers changed more frequently. Increased population and an increasing rail network had a strong association. Railways generated a distinctive pattern of urbanization early on, which later evolved and strengthened near the stations. After the emergence of the vehicle and other modes of transportation, urban growth drifted away from train stations, although it has now returned in part as of the turn of the century. Nigeria's government granted a contract to China Railway Construction Corporation for the Warri-Itakpe railway project and Warri port construction in 2019. The train and port will cost \$3.9 billion to build, with the Nigerian government contributing 15%, CRCC contributing 10%, and a Chinese bank contributing 75%. If all goes as planned, CRCC will be granted a 30-year operating concession for both the port and the railway.

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