

**PROJECT ID:**

**“ANALYSIS OF THE POTENTIAL SCALABILITY OF ELECTRIC SHARED BICYCLES IN  
KIGALI.**

**A PERSPECTIVE FROM THE COMMUTERS”**

**MASTERS THESIS**

*Submitted by*

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## **DECLARATION**

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## **ABSTRACTS**

As cities This study analyzes how electric bike-sharing could be implemented in Kigali, Rwanda, as a long-term solution for improving urban mobility. With the city facing increasing challenges from urbanization and transportation demands, shared e-bikes offer a promising solution that is cost-effective, environmentally friendly, and promotes healthy commuting. A quantitative survey was administered to 463 randomly selected participants, and the results were analyzed using descriptive statistics, exploratory factor analysis and binary logistic regression. The findings show that people generally favor shared e-bikes, particularly due to their low cost, ability to handle Kigali's hilly terrain, and environmental benefits. However, adoption rates vary depending on personal and social factors such as age, gender, income, and travel distance. Young men from low- to middle-income families were more likely to use e-bikes, whereas women showed less interest, owing to safety concerns and cultural expectations. Four major themes influenced Commuter perceptions: efficiency and sustainability, cost and convenience of use, environmental image and safety, and low maintenance with health advantages. To ensure successful adoption, the study recommends improving infrastructure, renting an affordable e-bike, and implementing gender-sensitive policies. These approaches could make e-bike sharing a more equitable and scalable transportation option in Kigali. The findings also provide useful recommendations for urban mobility planning in similar developing city contexts.

**Keywords:** Scalability, E-bike adoption, urban mobility, e-bike sharing, adoption factors.

## **CERTIFICATION**

This research proposal has been submitted with approval from the University supervisor (Main supervisor).

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## **List of Abbreviation**

CO<sub>2</sub>: Carbon Dioxide

e-bike: Electric Bicycle

EFA: Exploratory Factor Analysis

Exp(B): Exponentiation of the B Coefficient (Odds Ratio)

GIS: Geographic Information System

ICT: Information and Communication Technology

ITDP: Institute of Transport and Development Policy

KCC: Kigali City Council

NGO: Non-Governmental Organization

PTV: Public Transport Vehicle

RTDA: Rwanda Transport Development Agency

RWF: Rwandan Franc

SDG: Sustainable Development Goals

SPSS: Statistical Package for Social Sciences

TAM: Technology Acceptance Model

UN-Habitat: United Nations Human Settlements Programme

UTAUT: Unified Theory of Acceptance and Use of Technology

WHO: World Health Organization

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## **Dedication**

To God Almighty father in Heaven

To my loving mother

To my beloved husband and children

To my friends and classmates

This work is for you!!

## **CHAP I: RESEARCH BACKGROUND**

### **1.1. Introduction**

Cities all across the world promote cycling as an effective, low-emission means of transportation that promotes well-being and physical activity. This effort aims to promote sustainable urban mobility while improving people' overall quality of life (Maas & Attard, 2022a). Encouraging cycling in "starter" cities is difficult since such cities have few bicycle infrastructures, a limited cycling culture, and a low modal share for cycling overall (Félix et al., 2019). However, in Kigali, 52% of the population uses non-motorized transportation for everyday travels (Cooke et al., 2022). In a world increasingly focused on addressing climate change, almost every government is developing regulations to promote cycling as a sustainable mode of urban transportation. This is best exemplified in the Netherlands and Denmark, where cycling has transformed the narrative of how entire countries approach commuting (Handy et al., 2014). Similarly, since 1990, there has been a nearly threefold rise in bike utilization at workplaces in Washington, DC, thanks to improved cycling infrastructure and the implementation of bike sharing schemes (Buehler & Pucher, 2012). During the same period, Portland, Oregon saw a sixfold increase in cycling to work as a result of similar infrastructure upgrades (Buehler & Pucher, 2012) . When it comes to bike participation, there are clear regional differences. Cycling, for example, has a mode share of 2% in the United Kingdom but 26% in the Netherlands (Buehler & Pucher, 2012). It shows that investing in new infrastructure and guarantees the stability of bike-sharing systems can considerably enhance cycling adoption. This provides insight into Kigali's possibilities.

Many factors influence the scope of cycling, the most important of which are national and subnational policies, as these have a direct impact on infrastructure development and quality (Buehler & Pucher, 2012). Distances traveled and demographic characteristics are other important considerations (Schneider et al., 2018). Women's cycling participation varies greatly from that of men. Using the Netherlands as an example, it is somewhat balanced, however in the United States and England, men bike three times more than women (Pucher et al., 2011). Sá et al. (2018) stated, the disparity is even more obvious in cities such as Sao Paulo and Posadas, where male cyclists outnumber female cyclists 7 to 1.

The necessity of fighting climate change and achieve SDGs 10, 11, and 13 highlights the importance of transforming urban transportation into efficient, equitable, accessible, and

environmentally sustainable systems. The goal is to promote climate responsive inclusive mobility by establishing environmentally friendly mobility systems and prioritizing active transportation options. The utilization of shared micromobility systems is critical to achieving these goals since it reduces reliance on private vehicles and promotes sustainability(Zhu et al., 2023).

Bicycles, e-bikes, e-scooters, and e-cargo bikes fall under the micro-mobility category and serve a variety of transportation needs. Bicycles enhance physical health but are limited by the workload required to ride them, resulting in low inclusivity and utility. Due to their lack of physical involvement, e-scooters rank at the bottom of the active transportation succession(Félix et al., 2023). E-bikes make cycling more accessible as a mode of active transportation by utilizing electric motors and pedal-assisted technologies. The design allows Commuter to expend less effort when riding hills or traveling long distances(Schneider, 2023), making it more accessible to specific groups(Ji et al., 2014). As a result, e-bikes are a handy means to travel independently over large distances that would otherwise need the use of a car or other modes of public transportation (Hosseini et al., 2023).

Cities throughout the world are embracing E-bikes because they have a stronger influence on urban transportation in terms of usage of cost-effective alternatives. Weinert et al. (2008) states, in the China the ban on motorcycles resulted in a significant increase in the use of e-bikes. The increase of electric Bicycle shows their possible revolution in green mobility. Annual sales of two wheels vehicles (scooters and e-bikes) in China increased from 56, 000 in 1998 to above 21 millions in 2008, which shows how they can replace the other carbon intensive modes of transportation (Yang, 2010). Similar trends have been observed in Europe, with German and Netherlands witnessing the most growth, within an average of 34% annual growth in e-bikes sales from 2006 to 2016 as well as better infrastructure for e-bikes sharing(CONEBI, 2017). E-bikes accounted for 40% of all newly sold bicycles in the Netherlands by 2018, just above traditional city bikes(Mobiliteit, 2019).

The increasing interest in e-bikes globally speaks volumes of their strength to enhance mobility systems. Scholars believe that it is possible to provide better service through shared e-bikes as compared to bike sharing systems while concurrently lowering the environmental cost. E-bikes are a practical substitute for traditional bicycles as they can efficiently cover longer distances and conquer hilly terrains, with much less fatigue. Auto-pedal Commuter show a distinct

preference for e-bikes against traditional bicycles or motorized vehicles(Weinert et al., 2007). They ease the Commuter into moderate physical activity and offer health benefits at the same time (Gojanovic et al., 2011).

However, e-bikes are considerably more expensive than regular bicycles(Weinert et al., 2007). E-bikes contribute to renewable energy resource integration, promotion of public mobility, and enhanced electrical safety(Silvester et al., 2013). These make it easier to switch to non-motorized transport because of their lightweight body design which positively affects transportation pollution(Tonn et al., 2003). E-bikes offer the best energy saving efficiency, and emissions compared to other motorized forms of transportation, even buses (Cherry et al., 2009).

Miramontes et al. (2017) emphasized the relevance of sharing economic efforts that encourage less consumption and more resource sharing in reducing emissions and attaining sustainability. Bike-sharing strategies are one example of an advanced public/private transportation framework. As of 2012, there were 15 such systems in the US, allowing for automated bike sharing with 5238 bicycles in circulation and over 172,000 Commuter(Parkes et al., 2013). These systems provide an eco-friendly means of transportation for locations underserved by traditional public transportation systems.

Oduku (2021) reported in 2021, Kigali established Africa's first public bike sharing system to increase nonmotorized transportation. The initiative's purpose is to give Rwandans with a transportation option that is safe, healthy, ecologically friendly, and resourceful. However, there are operational issues, the most significant of which (Kiptum et al., 2022) identified in 2022 as bike theft and bike damage when recovered. Even though the city currently lacks an electric bike sharing system, (Sabiiti, 2022) stated that there are plans to install some to boost mobility. In addition, the city already has 18 bike stations and a bike rental system that operates via a mobile app.

The study's goal is to assess other global programs with shared e-bikes and determine how they may be scaled up efficiently for African environments, specifically in Kigali. This study looks at shared e-bike models in use around the world, highlighting challenges to incentive for their adoption. This study aims to identify approaches to scaling these systems locally by gathering Commuter' perceptions in Kigali. The ultimate goal of this project is to develop policies and

solutions to promote the acceptance and sustainability of shared e-bikes as an alternative form of transportation in Kigali.

## **1.2. PROBLEM STATEMENT**

Kigali's public transport system has major issues due to limited options and rapid urbanization, resulting in imbalances between demand for mobility and available infrastructure (Van Zyl et al., 2014). Despite the introduction of Africa's first public bike-sharing system (Oduku, 2021), Kigali's transportation remains underdeveloped in the neglected locations. While the city's newest schemes promote non-motorized transportation through redundant kinds of bike-sharing, operational concerns, particularly theft and damage, continue to limit the successful operation of these systems (Sabiiti, 2022). Furthermore, unlike other cities on the worldwide system, Kigali did not develop an electric bike system.

Kigali's moderate climate is suited to cycling, but its mountainous topography (greater than 5%) poses a challenge to properly adopt traditional biking (city, 2020). However, e-bikes, can travel greater distances and climb hills with less effort than traditional bicycles and autos, making them a plausible alternative solution (Schneider, 2023). Kigali's e-bike sharing system possibilities do not appear to have been thoroughly investigated. Such e-bike sharing systems, which have thrived in other cities around the world, could promote urban mobility by reducing traffic congestion, emissions, and reliance on privately owned motor vehicles, creating alternatives for the entire population and going further to incorporate and popularize non-motorized transit (Cherry et al., 2009; Weinert et al., 2007). However, nothing is known about how such systems could be scaled in Kigali, including Commuter perceptions, adoption obstacles, and city-specific infrastructural challenges.

Given the foregoing, it is important to evaluate the potential scalability of electric shared bicycles in Kigali. This study aims to analyze the feasibility of scaling shared e-bike systems in Kigali by examining Commuter perspectives, assessing local barriers, and developing policies and solutions to encourage shared e-bike adoption. This understanding was used to identify how best shared e-bike systems can be integrated into the Kigali transportation network for a more sustainable, inclusive, and efficient urban mobility system.

### 1.3. MAIN OBJECTIVE AND SPECIFIC OBJECTIVES

#### 1.3.1. Main Objective

The specified aims are to examine the potential for electric bike-sharing integration in Kigali's transportation network by analyzing Commuter acceptance and developing implementation frameworks.

#### 1.3.2. Specific objectives

The following are the study's objectives on perceptions, adoption, and implementation of shared e-bikes in Kigali:

1. Evaluate Commuter perceptions and views towards shared e-bikes in Kigali.
2. Assess the likelihood of adopting shared e-bike in Kigali.
3. Proposes strategies for successful Implementation of electric bike-sharing models in Kigali.

#### 1.4. Research questions

Shared e-bike systems deliver a solution that is appropriate for sustainable urban mobility. In Kigali, implementation success is determined by a review of Commuter perception, infrastructure compatibility, and global best practices. The following set of research questions is constructed with all these characteristics in mind, in accordance with the study's aims.

Table 1: Research Questions

No.	Specific Research Objectives	Research Questions
1	Evaluate commuters perceptions and views towards shared e-bikes in Kigali.	<ul style="list-style-type: none"><li>✓ How commuters perceive the many features of shared e-bikes, such as availability, dependability, cost, safety, access, and comfort?</li><li>✓ How could Commuter opinions of specific shared electric bike qualities inform attempts to establish the best possible scalability balance in Kigali?</li></ul>
2	Assess the likelihood of adopting shared	<ul style="list-style-type: none"><li>✓ What factors influence the</li></ul>

	bikes in Kigali.	likelihood of Commuter adopting shared e-bikes in Kigali? ✓ What are the potential for scalability of shared e-bikes into Kigali's Transportation Network?
3	Proposes strategies for successful Implementation electric bike-sharing models in Kigali.	✓ What actions can promote the effective implementation of shared electric bicycle systems in Kigali? ✓ How do Commuter' preferences and suggestions influence the design and operation of an effective e-bike sharing model in Kigali?

### 1.5. Research Matrix

This matrix depicts the interrelationship between objectives, techniques, data, and analysis, which are aided in the assessment of e-bike scalability in Kigali. It outlines how Commuter perceptions, infrastructure needs, and worldwide best practices were used to inform the implementation approach. This framework directs the research process and outlines a clear path from data gathering to suggestions.

Table 2: Research Matrix

Research Questions	Specific Objectives	Research Methods	Data sources
How do Commuter perceive the many features of shared e-bikes, such as availability,	Evaluate Commuter perceptions and views towards shared e-bikes in Kigali.	✓ Surveys and interviews to gather perception and demographic	✓ Interview surveys.

dependability, cost, safety, access, and comfort?		information	
How could Commuter opinions of specific shared electric bike qualities inform attempts to establish the best possible scalability balance in Kigali?	Evaluate Commuter perceptions and views towards shared e-bikes in Kigali.	✓ Binary logistic regression analysis	✓ Data corrected (Commuter opinion such as safety, comfort, etc.) from Commuter survey
What factors influence the likelihood of Commuter adopting shared e-bikes in Kigali?	Assess the likelihood of shifting to shared e-bikes in kigali	✓ Binary logistic regression analysis Survey with Likert scales	✓ Data from Interview survey
What are the potential for scalability of shared e-bikes into Kigali's transportation network?	Assess the likelihood of shifting to shared e-bikes in kigali		
How do Commuter' preferences and suggestions influence the design and operation of an effective e-bike sharing model in Kigali?	Proposes strategies for successful Implementation electric bike-sharing models in Kigali	✓ Descriptive statistics	✓ Data from the Commuter Interviews.

<p>What actions can promote the effective implementation of shared electric bicycle systems in Kigali?</p>	<p>Proposes strategies for successful Implementation of electric bike-sharing models in Kigali.</p>	<p>✓ Literature review</p>	<p>✓ Research Papers</p>
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## **CHAP II: LITERATURE REVIEW**

The success of e-bike sharing in cities largely depends on how people perceive the service, especially when it comes to cost, safety, environmental impact, and how easy it is to use. These are the same key aspects this study focuses on. (Eccarius & Lu) stated that the primary factors that influence acceptance are: Environmental concerns, performance expectancy, social influence, and effort expectancy. Their analysis shows that the performance expectancy continues as the strongest predictor of adoption in various urban regions. However, these results reinforce our study's emphasis on how demographic factors particularly gender and level of education play a role in shaping people's likelihood of adopting shared e-bikes in Kigali. Women's involvement in cycling shows a big changes, ranging from near party in developed countries to significant underrepresentation in the developing counties where male cyclists outnumber females by ratios of 7:1 (Sukmayasa et al., 2025). This gender gap plays a lot of roles for system scalability and needs targeted interventions addressing safety concerns and culture barriers to a specific context.

Sub-Saharan African cities face specific mobility difficulties that present both difficulties and opportunity for various transportation systems. Acellam (2024) These obstacles are classified as a lack of public resources, increased urbanization, informal settlements, and rapid urbanization.. Lucas (2012) the phrase "transport poverty" refers to periods when a person is unable to pay or access transportation options required for social and economic activities. In this context, shared mobility choices, such as shared e-bikes, play an important role in bridging accessibility gaps, especially if they are implemented in practical ways with suitable pricing and tactics that consider local economic trends.

As cities expand rapidly, traffic congestion and air pollution are certain to get worse. It is acknowledged that in East Africa, there is a negative effect of traffic congestion on the cities, which impacts productivity, competitiveness, and sustainability (Rastogi, 2021). As noted by Pochet and Cusset (1999), cycling is a mode of transport that is cheaper, easy to maintain. It has zero gas emissions and requires a small road space, making it one of the best practices in urban regions (Mendiate, 2016). Cycling development can help to relieve congestion and promote

healthier communities by encouraging physical exercise (Kumar & Barrett, 2008). Cycling might be difficult due to a region's topography, longer trips and excessive heat (Heinen, Wee, et al., 2010); so, boosting the alternative mode of transportation will not only help the well-being of locals but will also reduce pollution and traffic congestion. E-bikes in bike-share cities have experienced balancing the issues associated with the topography, where it is typical for Commuter to ride downhill and refuse to return the bicycle at the stations located on hills (Jurdak, 2013). Therefore, e-bikes share reduces this non-balancing flow (Fishman, 2016). Additionally, it can contribute to the tourism industry by attracting tourists (Le-Klähn & Hall, 2015). Shared transport solution, such as e-bike sharing, are among the best practices to adopt to avoid traffic-related costs and enhance accessibility and mobility (Maas & Attard, 2022b).

The Technology Acceptance Model (TAM) and its extensions give theoretical core for understanding e-bike sharing adoption. Davis (1989) have developed TAM to predict technological adoption depends on the perceived usefulness and ease of use, while (Venkatesh et al., 2003) developed this theory through the Unified Theory of Acceptance and Use of Technology (UTAUT), where also (He et al., 2016) used these directly for bike-sharing contexts, providing key predictors including environmental factor, and system reliability. Their finding requests that old technology regard modification when applied to shared mobility services, especially it involves the spatial and infrastructural factors that facilitate accessibility and usability in urban zones.

The physical infrastructure is related to the e-bike adoption in its scalability in the city. The city that has well-connected infrastructures, such as connected cycling infrastructures and a well-protected bike lane, has a high adoption rate rather than the one with a very scattered infrastructure (Marshall & Garrick, 2011). The Kigali shared e-bike system runs very smoothly; it requires the presence of secure parking infrastructure, dedicated bike lanes, and charging infrastructure. As Yin et al. (2024) have figured out, the electric bikes take care of the problems of the high slopes 60% of the time, where those hilly places are accessible due to the presence of e-bikes. Their analysis requests that the slope greater than 5% creates barriers for traditional cycling, but it remains practical work with the assistance of electric bikes; that's why it's important to use e-bikes in the mountainous areas.

Moreover, pricing is the key barrier for low-income Commuter, Haustein and Møller (2016) pricing have been the primary obstacles to the people mostly the low income use to e-bike sharing adoption while noting that the initial price sensitivity decreases as the Commuter experiences system increases. As Pojani and Stead (2015) states that the total cost of ownership between other transportation modes and e-bike sharing variety differently due to the context where with developing towns requires competitive positioning against often-subsidized public transport alternatives. As the e-bikes sharing is to serve the people from the diverse economies must balance the cost factor with accessibility objectives to ensure a more sustainable system.

In many African cities, cycling is still a necessity-based mode of travel, not a lifestyle choice. Sambu et al. (2023) indicates that walking and cycling rates range from 60 to 80% in many sub-Saharan African towns, indicating the potential need for improved cycling infrastructure and services. However, the cycling that exists serves as a necessity rather than choice; it often happens on inadequate infrastructure under dangerous conditions. The transition from necessity-based to choice-based cycling includes infrastructure, safety concerns, and a social view of cycling as a valid means of transportation (Pojani & Stead, 2015).

The adoption of e-bikes is increasing every day, whereas (CONEBI, 2017) demonstrated that between 2006 and 2016, European EPAC (electrically power-assisted cycle) sales increased, and in developed countries where cycling is more favorable, such as Germany and the Netherlands, annual sales increased by 36% and 16%. In the Netherlands in 2018, electric bicycles were 40% of all bicycles sold; that shows the success of market penetration put in place in riding regions. Chinese sales of two-wheelers rose from 56,000 in 1998 to over 21 million in 2008, depicting the best example of emerging cities (Yang, 2010). This high adoption shows that e-bikes can be very effective in replacing motorized transportation when supported by the best policy interventions.

Cities like Medellin, Colombia, have used shared e-bikes to transport on hilly terrain and serve diverse socioeconomic populations(Álvarez et al., 2023). Their innovative approaches, which began with flat areas and expanded to hilly areas as Commuter engagement increased, provide similar ideas for communities facing similar geographic issues. Midgley (2011)The system offers insights into handling steep terrain through strategic station placement and electric aid integration. Borgnat et al. (2011)shows how electric assistance allows system growth into previously ignored areas. The partnership model employed in Paris shows how the public

inputs combined with private operation can achieve both financial sustainability and social accessibility(Sims et al., 2019). Share mobility initiative receive financial supports from the international development finances institutions such as World banks which support the in developing cities such as Latin American cities by providing the precedents for similar interventions in African Context (Bank, 2019).

To increase the use of e-bikes on a large scale, the e-bike sharing system requires creating a system where its Commuter have access to better services, as the better services attract more Commuter. As a system gets bigger, it becomes more valuable, and this positive cycle is known as the "network effect". However, to achieve this success, the system needs a certain number of Commuter first (Van Alstyne et al., 2016). For electric bicycles, this number is always lower than that of regular bicycles because they require electricity to operate fully and cover a large area. Abramson et al. (2001),states that to keep the system working efficiently as it escalates on a large scale, the operators must manage the fleet, handle repairs, and ensure batteries are charged and swapped effectively and efficiently by increasing the skills of labor at swap stations. As Li et al. (2020) states, one of the biggest challenges is replacing the drained battery so fast, ideally within 4 hours, in order to make the system very reliable.

In order to make the E-bike system last for a long time, they need to make money in order to make a system run smoothly by keeping the service more affordable and easier to access. Ricci (2015) looked at various ways to charge Commuter and found that it will be appropriate if the mixed system is being employed, for example, earning money from ads and advertisements on the bikes, charging Commuter fees, and receiving government subsidies. Another way to increase income and also to make things easier for the Commuter is by connecting a shared e-bike system to a bigger transportation system where people can pay for only one ticket for the integrated transportation (multiple travel options). Jittrapirom et al. (2017) shows that these all-in-one systems can use profits from the most popular services to support the ones that don't make as much money.

However, e-bike sharing has been studied worldwide, and there are still important gaps, mostly when it comes to the African context. There has not been much real-world research on how shared e-bikes could work in places like sub-Saharan Africa. Most studies that exist focus on the developed countries. In cities like Kigali, where the roads are very steep and the cycling infrastructure is being built and cycling culture is growing as the Rwanda cycling stage race

"Tour du Rwanda" is becoming popular, the problem is biking is not being engaged by more local people as the Commuter experience and opinions have not been explored much. Also, many of the strategies developed for cities with well-established cycling systems don't fit these settings. That is the reason why it is important to investigate how bike sharing and local attitudes towards cycling all influence each other in growing cities like Kigali.

The literature review points to several factors that impact the success of e-bike sharing programs like how Commuter perceive cost, safety, and environmental impact, along with the state of infrastructure and demographic traits. These insights helped shape the survey and statistical models used in this study to explore how these elements influence the chances of people in Kigali choosing to adopt shared e-bikes.

## CHAP III: RESEARCH METHODOLOGY

### 3.1 Introduction

This chapter details the processes followed during the study that address the scalability related to electric shared bikes in Kigali. It includes study area, sample size of the population, methods of data collection, methods of analysis, and ethical considerations underlying this research.

### 3.2 Study area description.

Kigali is Rwanda's capital city, with over 45% of the country's population living in cities. It is located approximately at 1° 57' South and 30° 04' East, near the country centre. Rwanda's city of Kigali has recently experienced relative expansion and development. Today, this city is home to around 1.7 million people distributed across 730 square kilometers, prospering and evolving into a metropolis of modernity that fills every Rwandan heart with pride. Kigali is made up of Three districts, Gasabo, Kicukiro, and Nyarugenge. The Current road network in Kigali City consist of 732 Km of roads, of which only 14% is paved(city, 2020).

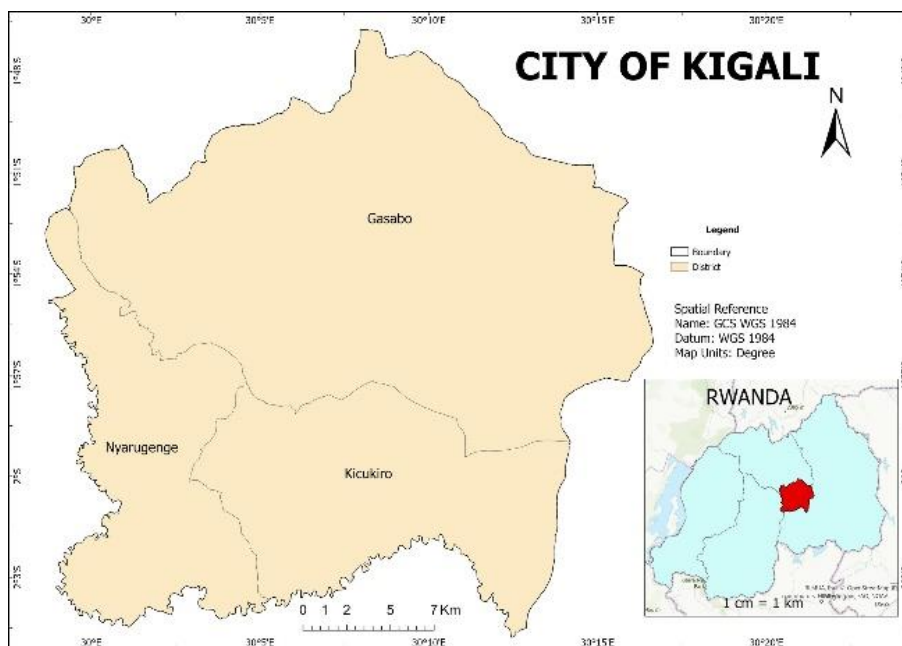


Figure 1: Kigali city Case study

### 3.2.1 Demographic characteristics

50% of Rwanda's population is under 20 years old, making it a young country. On the other hand, only 3% of the population is 65 years of age or older. This has repercussions because, on a national scale, the age dependency ratio which counts the number of potential dependents for every 100 people of working age is 93. In Rwanda, 93 people of inactive age are expected to be supported by every 100 people of working age, according to theory. Due to the higher proportion of young adults in urban than rural areas, the dependency ratio in urban areas is only 67 as opposed to 100 in rural ones. The average age of the Rwandan population is 22.7 years old. Females are older on average than men are (23.5 vs. 21.9). This is a result of both the fact that women typically live longer than men do, as well as the effects of the genocide, in which more men than women perished. The Southern Province and Northern Province have the highest mean ages at the provincial level (RWANDA-NATIONAL-INSTITUTE-OF-STATISTICS, 2022)

### 3.2.2 Modal split

The modal split refers to the percentage of trips made by different modes of transportation. For instance, these data about modal split are critical for understanding the city's transportation system and identifying areas for improvement.

The modal in Kigali is public bus taxi, private car transport, motor taxi, walking, and cycling. In Kigali, the bulk of trips are made on foot or by bicycle (52%), with low levels of motorization (around 15 cars per 1,000 people) and assisted by public transportation (PT), mostly bus services (16%) and motorbike taxi (12%) (Cooke et al., 2021).

## 3.3 Data collection

### 3.3.1 Sampling strategy

Zikmund et al. (2013) defines sample size as the number of objects in the sample. A sample is any individual or set of cases selected to take part in a study. Sampling is the process of choosing a small group of respondents to represent the population being surveyed. Since the study is being assessing Kigali city, the population of Kigali city of 1.7 million was used. To find the sample needed for this study, (TARO, 1967) formula with 0.05 significance level was used to find the sample size.

$$n = \frac{N}{(1+Ne^2)}$$

where:

$n$  is the sample size,  $N$  is population, and  $e$  is the margin error or sampling error  
it could be 0.1, 0.05, and 0.01.

for our study we used  $e = 0.05$

$$n = \frac{1.7 \times 10^6}{(1 + 1.7 \times 10^6 \times 0.05^2)} = 399.9 \approx 400$$

### 3.3.2. Sampling Techniques

#### 3.3.2.1. Probability Sampling (Simple random Sampling)

Probability sampling is any sampling scheme in which the probability of choosing everyone is the same (or at least known, so it can be readjusted mathematically). One of the best things about simple random sampling is the ease of assembling the sample. It is also considered as a fair way of selecting a sample from a given population since every member is given equal opportunities of being selected (Sharma, 2017). An unbiased random selection and a representative sample are important in drawing conclusions from the results of our study. By focusing on the objective and goals of research is to be able to make conclusions pertaining to the population from the results obtained from a sample. Due to the representativeness of a sample obtained by simple random sampling, it is reasonable to generalize from the results of the sample back to the population.

### 3.4 Questionnaire Design

The questionnaire was designed for shared e-bike riders in Kigali and targets a variety of sites, including significant hubs near the city center. Questionnaire is composed by 3 parts: social demographic, un-user experience and preferences and Importance of services, also is composed by 12 questions To assess Commuter opinions of shared e-bikes, demographic and socioeconomic data was gathered. The poll was based on essential criteria such as availability, comfort, price, and accessibility. Respondents scored on their happiness and importance of the above characteristics on a 5-point Likert scale.

Table 3: Likert Scale labeling

1	Not at all satisfied/important
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2	Slightly satisfied/important
3	Moderately satisfied/important
4	Very satisfied/important
5	Extremely satisfied/important

### 3.5 Data collection procedure

During the survey, on 18, 20 and 21 of June 2025 a 463 commuters from three different districts of Kigali such as Nyarugenge, Kicukiro and Gasabo were selected in the bus station where in Kicukiro the commuters were selected in Kicukiro car park, in Gasabo commuters were selected in Kimironko car park and in Nyarugenge commuters were selected in Nyabugogo car-park. to complete questionnaires. To ensure a sufficient sample representative of the total population, surveys was delivered at strategic sites in areas where potential e-bike riders are likely to travel. Each respondent went through some initial screening, including a brief discussion, to ensure that they match the study's requirements, which include demographic and socioeconomic factors, self-reported domicile in Kigali, and familiarity with shared e-bike services. The survey was completed only by those who match the criteria.

This survey assumes a 100% response rate, however a number greater than 75% would be acceptable(Mchopa, 2021).

The intended activities during data collecting are as follows:

- ✓ Getting authorization from the university.
- ✓ Obtaining approval from the Kigali City officials.
- ✓ Engaging with the many institutions involved in e-bike operations.
- ✓ Preparation and printing of survey materials.
- ✓ Set up Google Forms for digital data collection.
- ✓ Conducting pilot surveys.
- ✓ Recording Commuter satisfaction and significance evaluations.
- ✓ Entering and processing obtained data.

Engaging important institutions, such as UR-CST, Kigali City authorities, and shared e-bike operators, facilitated data collection and provided a full picture of the context in which shared e-bikes operate in Kigali.

### **3.6 Data analysis**

The remaining phase of this post-survey stage is entirely desk research. For conclusions to be drawn, the field data must be prepared and made ready for analysis.

The data were collected using Google Forms surveys, and the compilation was completely automated. After extracting the data, I was cleaned using Microsoft Excel and after the data from the questionnaire were collected reliability and validity was performed through the application of Statistical Packages for Social Sciences 27<sup>th</sup> edition (SPSS 27). Through the use of SPSS and the Microsoft excel, the following analysis was carried out:

#### **3.6.1. Descriptive statistics**

This analysis helps to summarize and describe the main features of a dataset. Instead of drawing conclusions or making inferences about a population based on a sample, it focuses on organizing, simplifying, and presenting data in a meaningful and understandable way. Based on our data, this analysis facilitates us to see how different groups perceive the built environment factors regarding their demographics(Wang & Tassinary, 2023).

### **3.7 Exploratory Factor Analysis (EFA)**

EFA is a widely used and broadly applied statistical techniques in the social science, as Majors and Sedlacek (2001) indicates, EFA was used for example assessing the motive of Puerto Rican high School principals and stating what kind of services should be offered to college students. Costello and Osborne (2005) encourages factor analysis above main components analysis since components analysis is only a reduction method. During the analysis to understand the structure of the factors between 18 perception factors in the questionnaire, the principal component factor and also rotation method with varimax with Kaiser Normalization analysis was used. All small coefficients less than 0.5 were removed to enable having a robust result. The robustness of the results was obtained by using Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity. The obtained factors were used as inputs for binary logistic model as the table 4 depicts. Four factors were retrieved using the eigenvalue >1 criteria. To use these latent elements in further quantitative analyses, factor scores were computed using the regression approach and saved as new variables. These scores gave a clear yet important illustration of individual respondents' perceptions, which were then used for regression analysis and demographic comparisons.

### **3.8 Analyzing the potential scalability of electric shared bikes in Kigali using Binary Logistic Model.**

The data examined using binary regression analysis, which is a method for predicting categorical outcomes based on independent variables (Peng et al., 2002). Binary regression allows thorough assessment of the relationship between multiple factors and the likelihood of a specific outcome. By defining the key predictors of shared e-bikes services efficient, Logistic regression determines which variables have the most significant impact and which ones can be optimized to improve overall system performance. Here there were a broad range of 6 economic variables and four factors from FA were added in SPSS where socio-economic factors were categorical variables as well as independent variables. So, with the question regarding the likelihood of shifting from current modes of transportation to shared e-bikes as the dependent variables. Only three social economic factors such as gender, education level and age influenced adoption as its significant values were less than 0.05. For the overall model fits statistics, the chi-square likelihood ratio test (of the fits on the model relative to the null, Pseudo R square value (Nagelkerte Square) was assessed and represented as the table 7-11 depicts

## CHAP IV. RESULTS AND DISCUSSION

### 4.1 Results Analysis

#### 4.1.1 Social Economic Background of the Respondents.

The results displayed in **Table 1** indicate that the large number of correspondents were male than female where males were 64.6 % and female 35.4%. Most of the respondents were young adults, with almost half (47.9%) between the ages of 18 and 30. Another significant portion, about 32%, were aged 30 to 45. In contrast, fewer participants were found in the other age groups—6% were under 18, 9.5% were between 46 and 55, and only 3.7% fell within the 55 to 65 age range. Overall, the data shows that participation tends to decrease with age. A little over half (51.2%) graduated from secondary school, followed by 29.0% who had primary level education, and 11.0% of respondents from university. In terms of working status, 59.4% worked full-time, while part-time workers, students, unemployed, and retired the lower proportion. Similarly, income levels were of a relatively similar distribution with approximately 79% indicated an income of less than 200k rwf each month. The attendees had the greatest responses, consulting with parents (19.7%) and/or alone (14.5%). Perhaps the most significant finding of the note was 72.15%, reporting they owned no private vehicle, which suggests a large potential Commuter base for shared e-bike services.

Table 4: Social Demographic Characteristics of the commuter

Demographic information		Frequency	Percentage (%)
Sex	Male	299	64.6%
	Female	164	35.4%
Age	<18	28	6.0%
	18-30	222	47.9%
	30-45	148	32.0%
	46-55	44	9.5%
	55-65	17	3.7%
Education Level	Primary Level	136	29.4%
	Secondary Level	237	51.2%
	University graduate	51	11.0%

	None	39	8.4%
Employment	Full time	275	59.4%
	Part-time employed	100	21.6%
	Unemployed	33	7.1%
	Student	42	9.1%
	Retired	13	2.8%
Monthly Income	<50,000	124	26.8%
	50000-100000	121	26.1%
	100000-200000	120	25.9%
	200000-400000	67	14.5%
	>400000	31	6.7%
Household Characteristics	Living alone	67	14.5%
	Living with partner	37	8.0%
	Living with Parents	91	19.7%
	Living with Children	33	7.1%
	Living with Siblings	40	8.6%
	Living with Friends	51	11.0%
	Living with Partner and Children	126	27.2%
	Living with Partner and relatives	6	1.3%
	Living with partner, relatives and Children.	12	2.6%
Vehicle Ownership	Private car	30	6.5%
	Motorcycle	55	11.9%
	Bicycle	42	9.1%
	Electric bicycle	2	0.4%
	None of above	334	72.1%

#### 4.1.2 Modal Split based on travel purpose.

Figure 2 shows that walking is the most widely used mode of transport in Kigali, with over 200 commuters especially for errands, sports, and socializing. Bus transport follows, mainly used for commuting to work and school. Motor taxis also see significant use, offering a flexible

option for daily travel. Bicycles and private motorcycles are moderately used, mostly for informal trips like sports and errands, while private cars are less common, likely due to affordability and access issues. Notably, no respondents reported using electric bicycles, suggesting limited availability or adoption. Overall, the data reflects a strong reliance on walking and affordable public transport, highlighting the need to improve infrastructure that supports these accessible travel options.

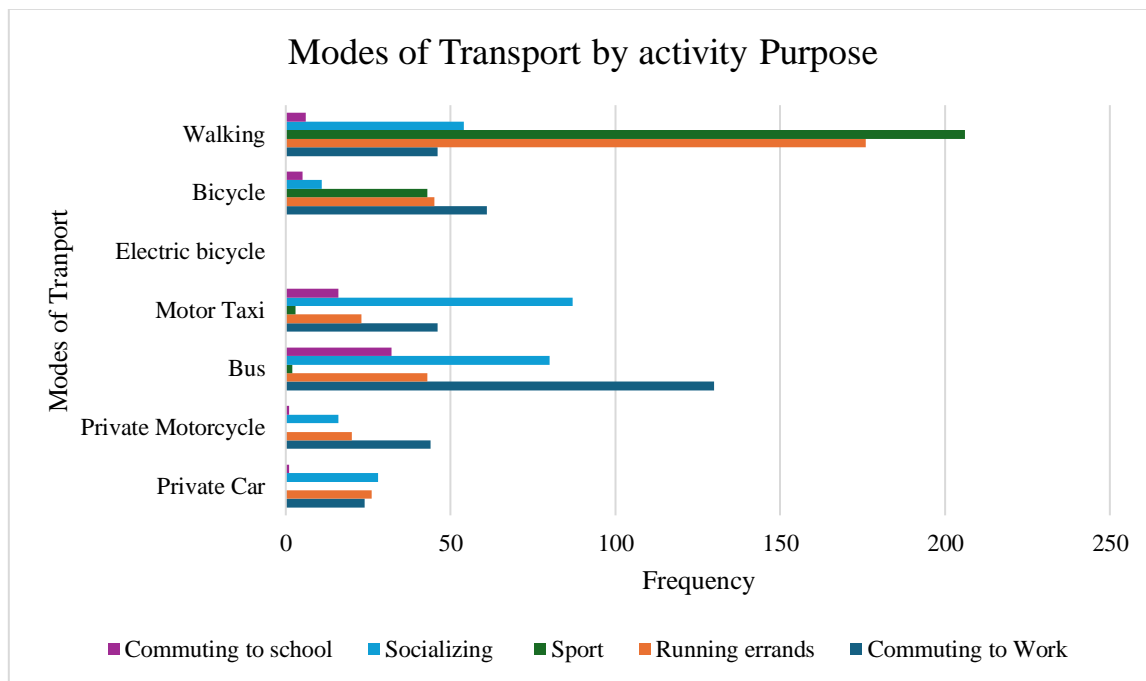


Figure 2: Modes of Transport by activity Purpose

As the **figure 4** The distribution of departure times for various travel purposes shows a high concentration of activity in the morning hours, particularly between 6:00 AM and 9:00 AM. Commuting to work has the highest frequency, rising dramatically at 7:00 AM (81 respondents) and 8:00 AM (74 respondents), followed by running errands and socializing, both of which exhibit significant peaks within the same period. Commuting to school and sports-related trips are also concentrated during these hours, though in smaller numbers. This trend implies that the early morning period is crucial for travel in Kigali, where people strongly prioritize efficiency and ease.

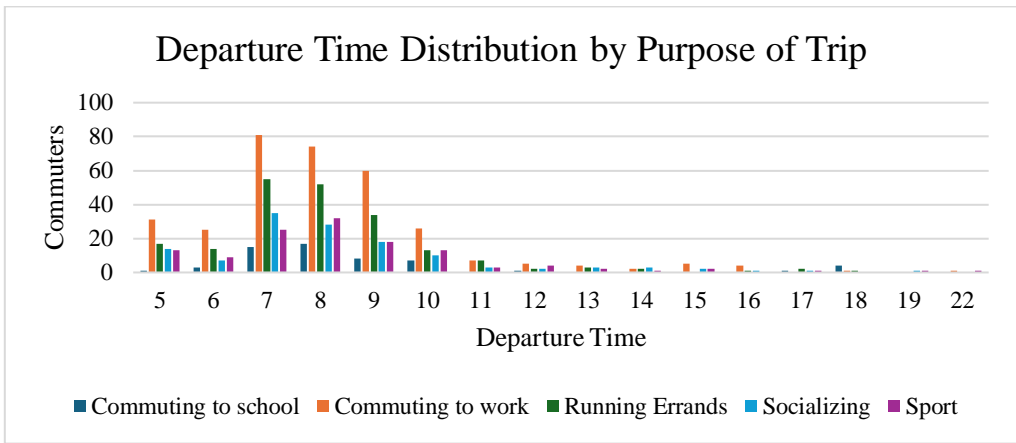


Figure 3: Departure Time Distribution by Purpose of Trip

The research on travel time across different departure hours suggests that the bulk of trips take place in the early morning (6:00 AM to 9:00 AM), lasting between 15 and 45 minutes. Specifically, 15–30-minute trips peak at 7:00 and 8:00 a.m. (53 and 40 respondents, respectively), whereas 30–45-minute journeys are equally concentrated in the same period, demonstrating a preference for mid-range travel durations during normal commuter hours as **figure 5** shows. Notably, a significant proportion of lengthier journeys (more than an hour) depart around 8:00 a.m., representing morning rush hour. These data indicate that current transport demand prefers modes that are efficient for short to medium distances, which is consistent with the functional range of electric bicycles.

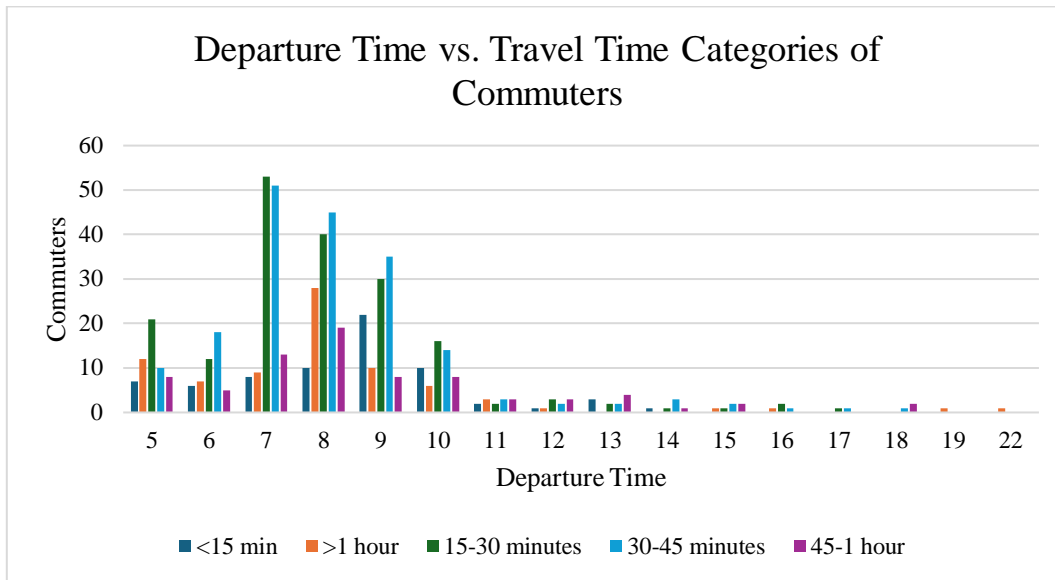


Figure 4: Departure Time vs. Travel Time Categories of Commuters

#### 4.1.3 Evaluation of commuter perceptions and views towards shared e-bikes in Kigali.

In this research the term “Commuter” refer to the respondent who participated in the survey and represent the potential or current Commuter of shared e-bikes in Kigali. It composed by the students, commuters, delivery riders and the people using e-bikes for leisure or errands

Table 2. presents respondents’ satisfaction levels regarding various e-bike attributes, ranked by the mean Importance score (I). The findings indicate that cost-effectiveness (I = 4.53) and eco-friendliness (I = 4.47) are perceived as the most important benefits of e-bikes. These are closely followed by support for physical activity (I = 4.41) and the ease of learning to ride an e-bike compared to a car (I = 4.35). Health benefits and ease of parking also rank relatively high (I = 4.34 and 4.20 respectively), suggesting practical and well-being factors are key motivators. On the other hand, e-bikes being useful for older adults (I = 2.79), reducing physical effort (I = 3.23), and supporting sustainable transport goals (I = 3.35) are rated less important, despite their policy relevance. This implies that personal convenience and direct utility may outweigh long-term or societal benefits in Commuter' perception. Overall, the results suggest that while Commuter appreciate environmental and fitness aspects, immediate practical advantages like cost, learning ease, and parking dominate their satisfaction priorities

Table 5: Respondent Satisfaction Levels on E-Bike Features.

Attitudinal Variables	Number of respondents by level of
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	satisfaction				
	1	2	3	4	5
Using an e-bike may be more cost-effective than a car	4	7	47	87	318
E-bikes are considered eco-friendly.	12	10	49	71	321
Riding an e-bike can support physical activity.	7	12	51	109	284
Learning to ride an e-bike is often easier than learning to drive a car.	8	10	62	113	270
Regular use of e-bikes may have health benefits.	24	16	47	66	310
Parking an e-bike is generally easier than a car.	11	18	91	89	254
E-bikes produce less noise compared to motorcycles.	39	51	42	36	295
Some e-bikes can be operated without a license.	41	48	41	66	267
E-bikes are often suitable for short-distance travel.	14	24	96	141	188
E-bikes can help bypass traffic congestion.	17	27	109	119	191
Riding an e-bike can help save time on commutes.	15	32	111	146	159
E-bikes may contribute to reducing traffic in urban areas.	24	52	120	111	156
Many Commuter report feeling safe on an e-bike.	24	52	129	129	129
E-bikes typically require less maintenance than cars	39	49	123	122	130
E-bikes provide assistance when riding uphill.	61	49	146	75	132
E-bikes can support goals for sustainable transport.	63	45	126	123	106
E-bikes reduce the amount of physical effort needed for travel.	106	47	80	94	136
Older adults may find e-bikes accessible and useful.	115	80	117	88	63

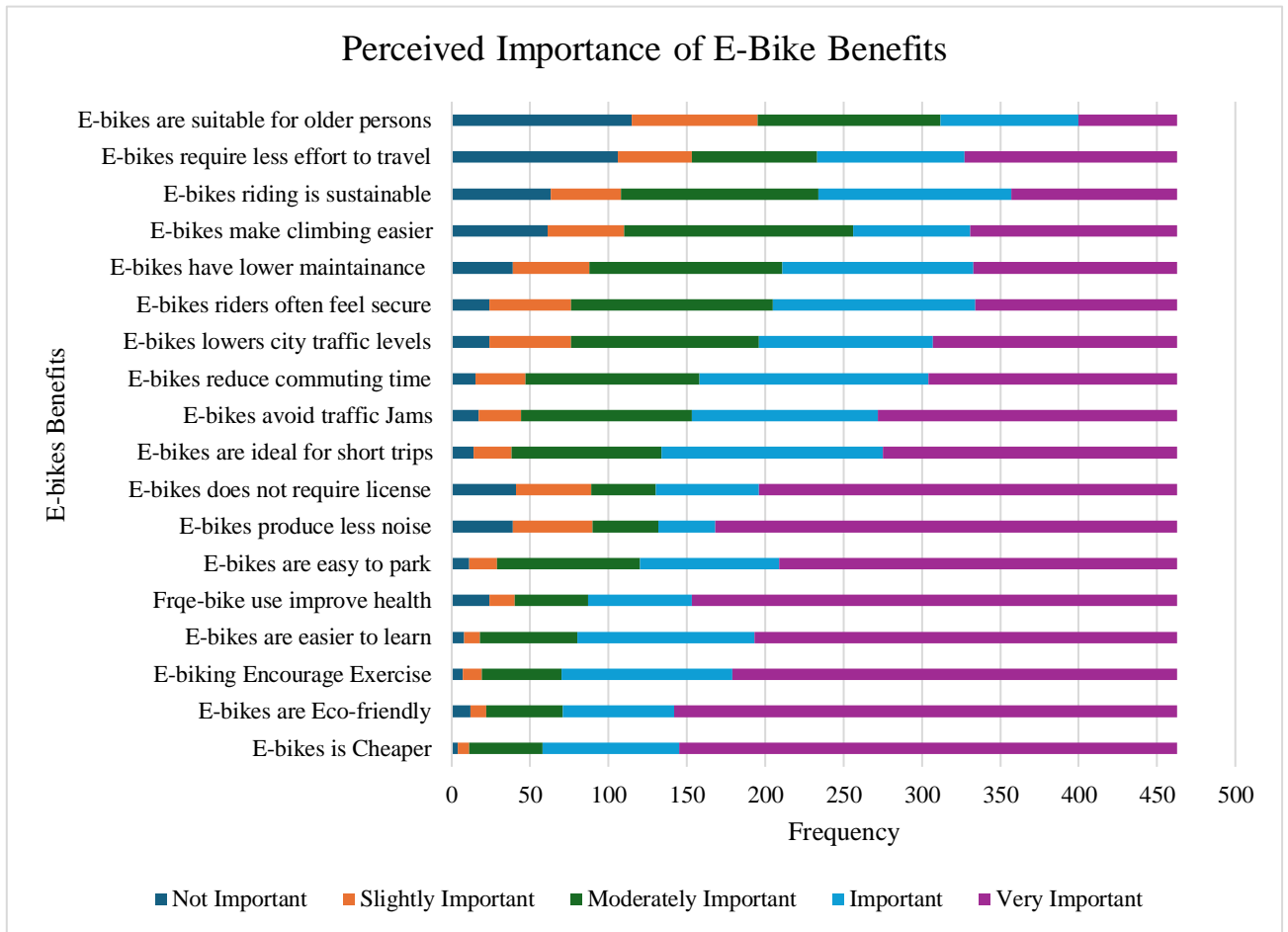


Figure 5: Perceived Importance of E-Bike Benefits (Notes E-bike=shared e-bikes)

The Exploratory Factor analysis (EFA) using Principal Component analysis with varimax rotation was carried out on 18 items regarding the perception of shared e-bikes. Table 4 shows the factors loading according to the perception of shared e-bikes in Kigali. Four factor groups were obtained, with the Keiser-Meyer-Olkin measure of sampling adequacy of 0.89, with a goodness fit (Barlett’s test of sphericity) approximate Chi-Square 3745.405; df:153; Sig=0.00 as table 3 shows. Of the 18 items loaded, only 16 were considered for the study for presenting an Eigenvalue greater than 1. The excluded perception item is that e-bikes are better for shooter trips and a rider feels safe on riding shared e-bike. The Analysis extracted the 4 factors as the Figure 7 depicts having eigen values greater than 1. Explaining the significance portion of the variance. These factors are F1, F2, F3 and F4.

Table 6:KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.891
Bartlett's Test of Sphericity	Approx. Chi-Square	3745.405
	df	153
	Sig.	0.000

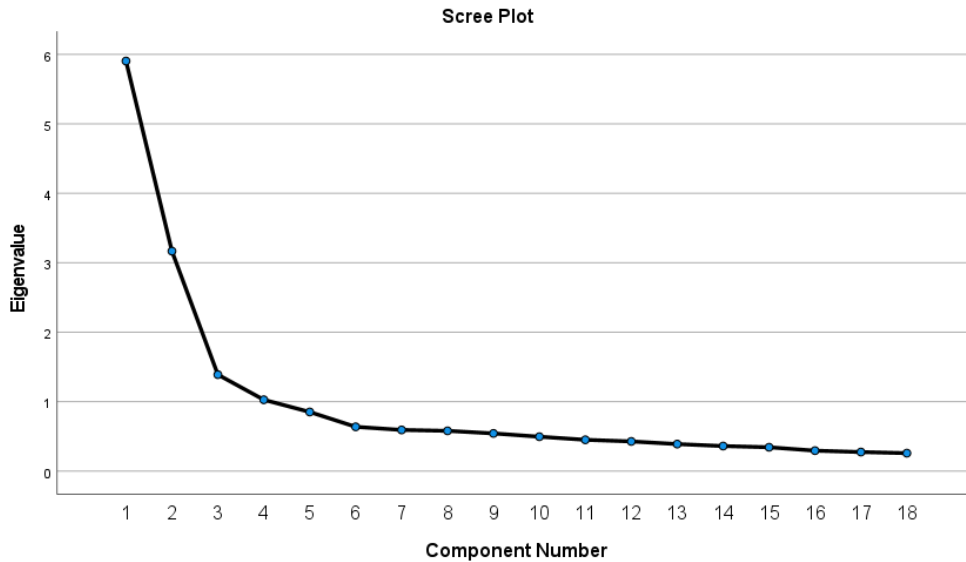


Figure 6: Screen Plot for Exploratory Factor Analysis

Using the common thresholds of 0.5 and above to state the strong loading, and as Table 4 depicts, only seven factors such as: shared e-bikes helps in skipping traffic, it helps on hilly terrain, it is goods for older people, shared e-bikes reduce traffic in cities, it supports green transport, shared e-bikes save you time, and it reduces physical efforts are in F1; Only five perceptual elements, such as shared e-bikes being less expensive than vehicles, being easier to park, being quieter than cars, riding e-bikes without a license, and learning to drive shared e-bikes being easier than automobiles, are classified under F2.

The F3 perception factor includes shared e-bikes, which are environmentally friendly and provide physical support. Finally, F4 perception elements include health benefits and the need for reduced maintenance.

Table 7: Factor Analysis

Perception Variable due to Shared e-bikes	Factors			
	F1	F2	F3	F4
Shared e-bikes help in skipping traffic	0.68			
Shared e-bikes help on hilly terrain	0.77			
Shared e-bikes are good for older people	0.62			
Shared e-bikes reduce traffic in cities	0.81			
Shared e-bikes support green transport	0.75			
Shared e-bikes save you time.	0.56			
Shared e-bikes reduce physical effort	0.84			
Shared e-bikes are cheaper than a car.		0.63		
Shared e-bikes are easy to park.		0.64		
Shared e-bikes are quieter than Cars		0.76		
Riding shared e-bikes is easier without a license.		0.83		
Shared e-bikes are easier to learn than a car.		0.65		
Shared e-bikes are eco-friendly			0.80	
Shared e bikes support Physical activity			0.78	
Shared e-bikes require less maintenance				0.74
Shared e-bikes benefits health				0.73
Initial Eigen Values Variance	5.91	3.17	1.39	1.03
% of Initial Eigenvalues cumulative (n=63.83)	32.81	17.60	7.72	5.71

According to the requirements listed in each factor, F1 is referred to as "Efficiency and Sustainability Enhancer" because of the variables related to traffic reduction, terrain adaptability, time savings, and environmental contribution. F2 is referred to as "Affordability and Ease of Use" since the factors it includes are cost-effective, easy to park, silent operation, and low entry barriers. "Green and Active Mobility" is F3 because this cluster promotes environmental awareness and personal benefits. F4 is titled "Low Maintenance and Health Support" because it discusses lesser maintenance requirements and the favorable influence on health.

#### 4.1.4 Assessment of the Likelihood of adoption shared e-bikes in Kigali.

Questionnaire Survey was conducted to gather insight from the Commuter in different districts of Kigali. Consequently, the collected data provided a comprehensive understanding of travel behavior, preferences, and the perceived benefits and barriers related to the adoption of shared e-bikes. The respondents were asked how likely are willing to switch from their current modes of transportation to using shared e-bikes. By using descriptives statistics among the 463 respondents 83% agreed that they switch from their current modes to shared e-bikes.

The Binary logistic regression model was used to determine the people who are willingly to shift from their current mode of transportation to shared e-bikes, the variables which are statistically significant were selected ( $p < 0.05$ ). The results (table 7) show male increase more than other socio-economic variables the likelihood of shifting to shared e-bikes as it increases.

Among seven factors After binary regression analysis, the factors with significant values ( $p$ -values  $> 0.05$ ) were excluded, and the remaining factors were shared. E-bikes assist riders on mountainous terrain and save commuter time. Among the significant variables, shared e-bikes enhance the likelihood of switching from current modes by 1.87 (table 10) times.

Table 8: Omnibus Tests of Efficiency and sustainability Enhancer (F1) Model Coefficient

	<b>Chi-square (Model X<sup>2</sup>)</b>	<b>Sig.</b>
<b>Step</b>	50.738	0.000
<b>Block</b>	50.738	0.000
<b>Model</b>	50.738	0.000

Table 9: Efficiency and sustainability Enhancer (F1) Model Summary

<b>Model Summary</b>		
-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
362.705 <sup>a</sup>	0.104	0.176

Table 10: Binary logistic regression model of the determinates for the Likelihood of Efficiency and sustainability Enhancer to Switch to Shared E-Bikes from their current modes of transportation

<b>Perception Factors for Efficiency and sustainability Enhancer (F1)</b>	<b>B</b>	<b>S.E</b>	<b>Sig.</b>	<b>Exp(B)</b>
Shared e-bikes help in skipping traffic	0.28	0.15	0.07	1.32
Shared e-bikes help on hilly terrain	-0.40	0.15	* 0.01	0.67
Shared e-bikes are good for older people	0.01	0.13	0.91	1.02
Shared e-bikes reduce traffic in cities	0.12	0.16	0.47	1.13
Shared e-bikes support green transport	0.18	0.14	0.19	1.20
Shared e-bikes save you time.	0.63	0.14	* 0.00	1.87
Shared e-bikes reduce physical effort	0.06	0.14	0.65	1.06

\*Sig<0.05

Among the five criteria. Following binary regression analysis, the components with significant values (p-values>0.05) were eliminated, leaving the remaining factors: shared e-bikes are easy to park and learn. The models imply that e-bikes that are easier to park may enhance the likelihood of adoption of shared e-bikes by 1.698 as table 11 depicts.

Table 11: Omnibus Tests of Affordability and Ease of Use (F2) Model Coefficient

	<b>Chi-square</b>	<b>Sig.</b>
Step	45.6899	
Block	45.6899	1.0503E-08
Model	45.6899	1.0503E-08

Table 12: Affordability and Ease of Use (F2) Model Summary

<b>-2 Log likelihood</b>	<b>Cox &amp; Snell R Square</b>	<b>Nagelkerke R Square</b>
367.753a	0.093969	0.159119

Table 13: Binary logistic regression model of the determinates for the Likelihood of F2 to Switch to Shared E-Bikes from their current modes of transportation

<b>Perception Factor for Affordability and Ease of Use (F2)</b>	<b>B</b>	<b>S.E.</b>	<b>Sig.</b>	<b>Exp(B)</b>
Shared e-bikes is cheaper than a car.	-0.14	0.21	0.49	0.87
Shared e-bikes is easy to park.	0.53	0.15	0.00*	1.70
Shared e-bikes are quieter than Cars	0.08	0.12	0.52	1.08
Riding shared e-bikes is easier without a license.	-0.04	0.13	0.73	0.96
Shared e-bikes are easier to learn than a car.	0.48	0.17	0.00*	1.62

\*Sig<0.05

Out of the two perception factors, the binary regression analysis led to the exclusion of components with non-significant p-values (greater than 0.05). As a result, only the perception of shared e-bikes as eco-friendly remained. The model suggests that this factor could increase the likelihood of adopting shared e-bikes by a factor of 1.74(Table 14)

Table 14: Omnibus Tests of F3 Model Coefficient

	<b>Chi-square</b>	<b>Sig.</b>
Step	27.86972	<0.001
Block	27.86972	<0.001
Model	27.86972	<0.001

Table 15: F3 Model Summary

<b>-2 Log likelihood</b>	<b>Cox &amp; Snell R Square</b>	<b>Nagelkerke R Square</b>
385.573a	0.058418	0.09892

Table 16: Binary logistic regression model of the determinates for the Likelihood of F3 to Switch to Shared E-Bikes from their current modes of transportation

<b>Perception Factors for Green and active mobility (F3)</b>	<b>B</b>	<b>S.E.</b>	<b>Sig.</b>	<b>Exp(B)</b>
Shared e-bikes are eco-friendly	0.55	0.13	0.00*	1.74
Shared e bikes support Physical activity	0.11	0.15	0.48	1.11

\*Sig<0.05

After performing binary regression analysis, all F4 factors were found to be significant. And the models imply that the way e-bikes benefits health than cars may enhance the likelihood of adoption of shared e-bikes by 1.94(table 17).

Table 17: Omnibus Tests of F4 Model Coefficient

	<b>Chi-square</b>	<b>Sig.</b>
Step	63.02518	<0.001
Block	63.02518	<0.001
Model	63.02518	<0.001

Table 18: F4 Model Summary

<b>-2 Log likelihood</b>	<b>Cox &amp; Snell R Square</b>	<b>Nagelkerke R Square</b>
350.418a	0.127265	0.215499

Table 19: Binary logistic regression model determines the Likelihood of F4 to Switch to Shared E-Bikes from their current modes of transportation

<b>Perception Factors for Low maintenance and health support. (F4)</b>	<b>B</b>	<b>S.E</b>	<b>Sig.</b>	<b>Exp(B)</b>
Shared e-bikes benefits health	0.66	0.11	0.00*	1.94
Shared e-bikes require less maintenance	0.23	0.12	0.04*	1.26

\*Sig<0.05

#### **4.1.5 Strategies for successful implementation of electric bike sharing models in Kigali.**

This study has tested the influence of socio-economic, efficiency and sustainability enhancers, affordability and ease of use, green and active mobility, and low maintenance and health support variables on the adoption of shared e-bikes in Kigali. Effective implementation of shared e-bike systems in Kigali requires an institutional collaboration that addresses infrastructure, policy, technology, and end-Commuter engagement. by using the results from the research and by analyzing the findings from the literature review. The following are proposed strategies on each factor from FA to achieve successful implementation of shared e-bikes in Kigali.

##### **4.1.5.1 Policies for Efficiency and Sustainability Enhancer to E-Bike Shared.**

Walking is one of the more popular modes of transport, as shown by the results, where among the 463 respondents, 39.3 percent travel by walking, and it is followed by bus commuters, who account for 22.5 percent. Also in this research, a few people are encountered using shared e-bikes. (Marshall & Garrick, 2011; Yin et al., 2024) points out that the presence of well-connected bike lanes, charging infrastructure, and secured parking infrastructure influences people to shift from their current modes of transportation to e-bikes. Also, as the terrain of Kigali is mountainous, it challenges people to change from their current modes to sustainable modes of transport, such as cycling.

The results from the model (Table 10) show that the people who see the shared e-bikes as the mode of transportation that will assist in the reduction of travel time and assist in climbing the hills are more likely to use shared e-bikes. As shown in table 10, the people agreed that e-bikes will assist with climbing hills, increasing by 1.67. This supports the finding by Yin et al. (2024), who stated that electric bikes make riding uphill easier, especially on slopes steeper than 5%, which are common in Kigali. Similarly, Jurdak (2013) cite that e-bikes aid in balancing trip patterns in hilly areas by making uphill riding more practical. A similar trend was seen in Medellin, where Álvarez et al. (2023) revealed that e-bike systems escalate successfully in steep neighborhoods as more people adopt them quickly. Overall, the research confirms that when Commuter believe that e-bikes are efficient in hilly terrain and save you time, as they are easier to navigate in heavy traffic, the results show that the people who believe that shared e-bikes help in skipping traffic will increase adoption by 1.87 times; they are more likely to adopt

them. To support this in Kigali, better infrastructure and smarter route planning could improve how useful and sustainable the system feels and encourage more people to join.

#### **4.1.5.2 Policies for affordability and ease of using shared e-bikes.**

Among the respondents, the majority has a monthly income of less than 200k Rwandan Francs, which is represented by 79%, and this shows that the affordability needs much attention for the successful implementation of shared e-bikes in Kigali. The data reveal that people are more likely to use shared e-bikes when they see the service is Commuter-friendly, where the models (Table 13) show that people are likely to increase by 1.70 and 1.62 in adopting the system when they see the shared e-bikes are easier to park and to learn than cars. Also, by referring to table 2, the statement "cheaper than using a motorcycle and car" stood out as a key factor. This agrees with the findings of (Haustein & Møller, 2016), who highlighted that cost is a major factor for low-income Commuter, mostly the ones who are trying out the new services for the first time. Pojani and Stead (2015) also stated that in developing cities it becomes more important because more people rely on subsidized public transport and have a limited extra income. Commuter also clarify that having clear instructions and mobile-friendly apps made the system easier to use. Ricci (2015) supports this by stating that services with fair pricing and simple interfaces are more likely to escalate. To achieve this success, the exploration of the successful pricing options, government subsidies, the building of strong partnerships and funding models plays a key role.

As (Midgley, 2011; Sims et al., 2019) confirm that in Paris, they have relied on partnerships between public agencies and private companies to make sure that both financial and social accessibility are maintained. Kigali should adopt that methodology by involving the private sector and the development banks. This will help in keeping costs manageable for low-income Commuter. As Haustein and Møller (2016) in their findings reflects that cost is one of the major obstacles that people face in adopting shared e-bikes in developing countries such as Rwanda, so the above approaches will help to balance affordability with the requirements to keep the system financially viable. Overall, the results suggest that to increase the adoption of shared e-bikes in Kigali, the system should focus on being easy to access, Commuter-friendly, and budget-friendly.

#### **4.1.5.3 Policies for green and active mobility in Kigali.**

The results from the models (Table 16) suggest that the people who link the shared e-bikes to environmental benefits are likely to shift from their current mode of transportation to shared e-bikes by 1.74. This finding echoes the work of Kumar and Barrett (2008) , who noted that cycling helps in reducing air pollution and promoting a healthy lifestyle, making it a key part of sustainable urban living. Eccarius and Lu (2020)also revealed that the Commuter who care about the environment and their health are more open to using shared e-bikes in the cities. Overall, the results suggest that promoting the health and environmental benefits of e-bikes, especially through targeted messaging, could boost adoption in Kigali, particularly among the young professionals and others who value sustainability.

#### **4.1.5.4 Policies for low maintenance and health benefit of using shared e-bikes.**

The analysis (Table 19) also showed that the people are likely to adopt shared bikes when they see them as benefiting health and requiring less maintenance, which increases the adoption by 1.94 and 1.26. These insights are in line with Heinen, Van Wee, et al. (2010), who pointed out that e-bikes reduce the physical strain of traditional cycling, making them more accessible to a broader range of Commuter, including older individuals who are not very physically active. Yin et al. (2024)also states how electric assistance also helps in reducing tiredness, especially in hilly areas, which encourages people who might otherwise avoid cycling. Similarly, Li et al. (2020) stated that when Commuter feel shared e-bikes are low maintenance and comfortable to ride, their overall satisfaction with the service improves.

Li et al. (2020)showing that the management of fleets, repairs, and battery maintenance is very important to keep the system operating smoothly. This complies with the results from this research, which finds that easy maintenance is one of the main factors encouraging people to adopt e-bikes. Some of the approaches, such as constructing the local repair centers, battery swapping stations, and real-time monitoring, will assist in maintaining the high quality of services, and the Commuter will be happier than before the shift, which is essential for the long-term success of shared e-bikes in Kigali. Together these findings suggest that shared e-bikes should not only be promoted as modern and eco-friendly but also as practical and inclusive transport options, suitable for people of varying physical abilities and needs.

## **4.2 DISCUSSION**

This part of the study explains the findings of the study by also comparing it with the previous research and existing literature. By focusing on three objectives, the first objective is focusing on understanding Commuter perceptions, the second one is focusing on assessing the likelihood of people adopting shared e-bikes, and the last one helps to identify the key strategies for implementing a shared e-bike system in Kigali. Even though the results align with many earlier studies, they also provide a fresh, specific context that provides the insight that is relevant to the unique mobility challenge of Kigali as a sub-Saharan African city.

### **4.2.1 Perceptions towards shared e-bikes**

The perception of shared e-bikes in Kigali mostly reflects practical gains. After Exploratory Factor Analysis, as explained in section 4.1.3, table 4, the FA grouped the perception of shared e-bikes into four key main factors, such as F1, efficiency and sustainability enhancer, which includes features like traffic avoidance, hill climbing, time saving, and environmental friendliness, which comply with, who states that its adaptability in very challenging terrain. The second main factor, which is affordability and ease of use, shows the priorities, such as easy parking, low cost, and minimal entry barriers. For example, a Commuter in order to ride a shared e-bike does not need a driving license, which supports Buck et al. (2013), who claimed that intuitive systems affect the Commuter's interest. The third main factor is green and active mobility, which emphasizes the eco-friendliness of shared e-bikes and their physical benefits. This supports the research by MacArthur et al. (2014), who cited that environmental and health benefits can boost public support. The last one, which is factor 4, is low maintenance and health support, revolving around simple upkeep and wellness benefits.

### **4.2.2 Adoption Likelihood of Shared E-bikes.**

The data analysis from a research project involving 463 correspondents shows that 83% of the people surveyed expressed a willingness to shift from their current modes of transportation towards shared e-bikes; this shows a strong potential for e-bike adoption in Kigali. These positive results support the earlier research of Shaheen et al. (2017), who stated that the successful shared e-bike implementations are often easy to use, affordable, and then sustainable.

As identified by Binary regression model of socio-economic variables, section 4.1.4 table 7 revealed the important socio-demographic pattern where gender played a role, with mostly men

being much more likely to adopt, with the odds ratio of OR: 0.247, a pattern consistent with Goodman and Cheshire (2014), who said that the reason why females do not adopt cycling is linked to cultural norms. Here also the education mattered as well, where the binary regression analysis showed that university students are more likely to shift into shared e-bikes (OR = 0.141), supporting the (Pojani & Stead, 2015) observations, where he stated that higher education correlates with stronger awareness of sustainability issues. When looking at current modes of transport from Figure 9 after cross-tabulation analysis, people who already walk, cycle, or use public transport showed the most interest in switching to e-bikes. This aligns with MacArthur et al. (2014), who found active commuters often see e-bikes as a natural upgrade. Meanwhile, the Commuter of a private car and motorcycle shows less intention in adopting shared e-bikes; this complies with Porter et al. (2020), who stated that in African cities the owner of private vehicles does not like to switch unless there are policy interventions and financial incentives. by also the binary regression analysis on the four main factors from the factor analysis on factors that influence adoption. Within F2 as table 13 describes, which is the affordability and ease-of-use category, two factors stood out as strong predictors of adoption: the flexibility of shared e-bikes in parking (Exp(B)=1.7) and how easy the bike is to learn to ride (Exp(B)=1.62). These results align with those Buck et al. (2013), who depicted that simple and Commuter-friendly systems like intuitive docking stations and very clear instructions mostly attract the new and more Commuter to shared e-bike programs.

In the environmental context, as table 16 explains, the belief that e-bikes are eco-friendly (exp(B)=1.74) also has a statistically significant impact by increasing adoption by 1.74 times. This also supports the finding by Gössling et al. (2021), who clarified that mostly young people in developing cities are very interested in the transportation options that support environmental benefits. However, from binary regression analysis of factor 4 a stable 19 shows the most influential factor overall was the perceived health benefits and minimal maintenance required by shared e-bikes compared to other vehicles. The correspondence who saw the health advantages (Exp(B)=1.94) from analysis and the people who appreciated its low maintenance (Exp(B)=1.26) were more likely to shift to shared e-bikes. These insights echo work by MacArthur et al. (2014), who emphasized mostly the appeal of health benefits, and the Pucher, Buehler, et al. (2010) who cites that easy-to-maintain and low-cost transport options are especially attractive in low-income areas.

### **4.2.3 Strategies for Successful Implementation of E-bike Sharing in Kigali**

As this study highlights, four main themes shape the success of Kigali's e-bike sharing program as discussed in section 4.1.3: efficiency and sustainability, affordability and ease of use, green and active transport, and low maintenance and health support. These reflect both proven international practices and Commuter priorities. In cities like Berlin and Shenzhen, integrating shared bikes with public transport and dedicated lanes has increased the speed and also cut emissions (Pucher, Buehler, et al., 2010), a model Kigali city can follow. Also, to improve access, flexibility, pricing, and mobile-friendly systems are very necessary, where ITDP (2019) suggest mobile platforms and targeted subsidies to help ensure that even lower-income Commuter or Commuter who do not have enough digital experience can participate. This is especially relevant in Kigali's diverse urban population. When it comes to green and active mobility, a lot of people are encouraged by personal safety and environmental awareness. Jennings et al. (2017) states how Cape Town has made good progress by investing in promoting helmet use, dedicated bike lanes, and public awareness through campaigns. Applying these similar strategies in Kigali can encourage more riders. Lastly, low maintenance and health support speak to the desire for transport that's both easy to use and beneficial for physical well-being. (Pucher, Dill, et al., 2010) shows that cities like Lyon and Medellín have seen sustained e-bike use thanks to reliable equipment and a focus on the health benefits of active travel. Kigali could replicate this by setting up local maintenance centers and promoting the health advantages of e-biking.

## **CHAP V. CONCLUSION AND RECOMMENDATIONS**

### **5.2 Conclusion**

This research revealed that many people in Kigali take shared e-bikes as a smart and eco-friendly mode of transportation to move around the cities. The four main key factors that shaped these perceptions are efficiency and sustainability enhancement, affordability and ease of use, green and active mobility, and the appeal of low maintenance with added health benefits.

After the data analysis, the results show that 83% of 463 respondents are willing to switch from their current mode of transportation to use shared e-bikes; health benefits and low upkeep influence them more to take that decision. Also, adoption varies based on gender and education, emphasize more on the need for more inclusive strategies.

The results, together with the literature review, suggest four main strategies: expand cycling infrastructure, keep pricing flexible and systems easy to use, offer local maintenance and battery swap stations, and highlight the environmental and health gains.

To understand well the real-world adoption of shared e-bikes, future research line should include pilot programs, Commuter interviews and cost analysis, and a review of Kigali's regulatory environment. This could help in shaping the scalable models for other growing cities too.

### **5.2 Recommendation**

#### **1. Improve cycling infrastructure in hilly areas**

The adaptation of shared e-bikes to hilly terrain is one of the most important factors shaping how people view e-bikes as "Efficiency and Sustainability Enhancers." This complies with (Cherry et al., 2009; Weinert et al., 2007), who highlights the importance of a well-designed infrastructure in an area with a steep slope. Kigali should focus on constructing the dedicated bike lanes in a hilly neighborhood, using gradient adjustments where needed. This will increase the use of e-bikes, as the riding would be safer, smoother, and more appealing.

#### **2. Offer flexible and affordable pricing**

Under Factor 2, which is "Affordability & Ease of Use," affordability proved to be the key factor that influenced the people to adopt the shared e-bike. This aligns with (Fishman, 2016),

which shows that pricing flexibility helps increase the use of shared mobility services. Kigali could introduce subscription options for daily, weekly, and monthly use, along with discounts for students, low-income workers, and bulk purchases. This would make the service accessible to a wider range of people.

### **3. Build public trust through safety initiatives.**

Perceptions of safety play a big role in people’s willingness to ride e-bikes (Factor 3: “Green Image & Safety”). In cities with low cycling rates, Buehler and Pucher (2012) note that safety concerns can be a major barrier. Kigali can address this by running public safety campaigns, providing helmets at docking stations, and offering training sessions to boost rider confidence—especially for women, who this study found are less likely to adopt e-bikes

### **4. Integrate health promotion into e-bike marketing.**

Many respondents valued the health benefits of e-bikes (Factor 4: "Low Maintenance & Health Support"), and research by Oja et al. (2011) shows that active commuting can improve public health. Kigali's e-bike programs might incorporate these benefits into their marketing strategy, portraying e-biking not only as a mode of transportation but also as a method to keep healthy. Collaboration with the Ministry of Health could enhance this message by connecting it to current wellness efforts.

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*Which statistics test is helping you to confirm this statement.*

