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Working Paper Series

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Working Paper Series

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Maximizing Commercial Lenders' Sustainable Impact in Rwanda's Housing Sector

Didas UWAMAHORO* and Frank Gakwaya ABAHO*

Abstract

Rwanda's housing sector plays a pivotal role in the country's socio-economic development, particularly considering its rapidly growing population and urbanization rate. This paper investigated ways for commercial lenders to maximize their sustainable impact in Rwanda's housing sector. Through a combination of quantitative analysis from Census 2022 and existing recent surveys (EICV, FINISCOPE) and 10 key informants' interviews with commercial lenders and policy makers, the research addressed key questions regarding existing financing models, untapped opportunities, constraints, and strategic recommendations.

Findings highlighting its significant role in economic growth. With Rwanda's population projected to nearly triple by 2050, there's a pressing need for significant investments in the housing sector to accommodate the growing demand, especially in urban areas. Residential loans exhibit relatively better loan performance compared to the overall sector, underscoring their importance for economic development.

Furthermore, the paper analyzes household expenditure on rent and housing ownership patterns, emphasizing the predominance of personal savings as the primary source of housing financing. However, the paper recommends Housing Provident Funds and community-based housing loan models. Innovative credit scoring models, group lending, and social guarantee strategies aim to mitigate the risks associated with lending to this segment and promote financial inclusion.

In conclusion, the paper underscores the importance of sustainable financing practices and collaborative approaches to address affordability, accessibility, and environmental concerns in Rwanda's housing sector.

Keywords: *Commercial Lenders', Sustainable Impact.*

1. Introduction

1.1. Overview

The 2022 national survey indicates that Rwanda's population clocked 13,246,394, with an average annual growth rate of 2.3% (that is equivalent to annually adding the entire population of one district such as Nyaruguru or Nyabihu); and the country's population is projected to be 23.6 million by 2052.

Fundamentally, Urbanization significantly improves the livelihood of the citizen as it eases access to basic needs and infrastructure. The most recent census results indicated that urbanization in Rwanda stands at 28%, like in Kenya, and is lower compared to south Africa (66%) and Europe (84%). Furthermore, the census found that ownership of dwellings declined (from 80% in 2012 to 72% in 2022) in favor of tenants (from 15% in 2012 to 22% in 2022), and it was associated with urbanization (in Kigali, 61% are tenants) (NISR, 2022).

To ensure the efficiency of resources and sustainable development, the Development Bank of Rwanda (BRD) is driving key financing interventions in the housing sector such as 'GIRA IWAWE'. This catalytic role of the national development bank has incentivized increased lending from other financial institutions (particularly commercial banks) to support the demand and supply of affordable vertical residential buildings in both rural and urban areas. This saves more land for other purposes, including agriculture.

According to the FinScope report (AFR, 2021), commercial lenders play a vital role in Rwanda's housing sector, providing essential financial support for housing projects. The report shows that a sizable portion of urban households (22%) of those who build houses access financing from commercial leaders, whereas 65% use mostly their own savings. Moreover, the Central Bank indicates that commercial lenders have disbursed FRW 526 billion in residential property financing, representing 16% of the total outstanding loans as of end-December 2022 (NBR-MPFSS, 2022)

1.2. Objective of the paper

The main objective of this paper is to assess the available opportunities for commercial lenders to maximize their sustainable impact in financing Rwanda's housing sector.

1.3. Research Questions

1. How effective are the current financing models provided by financial institutions (commercial and national development banks) in facilitating access to funding to the housing sector in Rwanda?
2. What other untapped financing opportunities can be explored by commercial lenders to boost lending to the housing sector in Rwanda?
3. What are the primary constraints hindering lending to the housing sector in Rwanda to address the demand and supply gaps?
4. What are the key strategic recommendations for commercial lenders to to foster sustainable and climate-resilient housing finance in Rwanda?

2. Literature

2.1. Overview

In a rapidly changing and urbanizing world, the provision of adequate and affordable housing remains a key priority for all governments. However, the concept of housing requires a new understanding to address the pressing issues. (UN-Habitat, 2012)

A well-housed population will advance other investments, including agriculture. However, access to appropriate affordable housing on a small scale has been and remains a mirage for many urban dwellers in the middle- and low-income brackets.

The gap between this demand and supply is thus huge and unsustainable for economic and human development. Although many researchers cite building materials and services as the biggest obstacle to sufficient access to decent and affordable housing, this paper takes the position that access to appropriate finance is equally or the biggest challenge. As a deviation from the conventional, the paper argues for flexibility in access, lending, and credit systems for the middle and low-income groups in Rwanda's urban design projects.

2.2. Mobilize savings and domestic finance

Given that developing countries have limited financial resources for housing and related infrastructure, it is critical for sustainable housing to define financial solutions (UN-Habitat, 2005). Housing finance sources may include conventional mortgage finance, subsidies, microfinance, migrant remittances, and informal finance (Tibaijuka, 2009). Much evidence points to traditional formal finance (e.g., mortgage finance) being largely expensive (unaffordable and inaccessible) for the poor, while high levels of subsidization to achieve affordability (i.e., supply-side subsidies) being unsustainable (ESCAP, 2008). In this situation, some countries have been exploring diverse ways to alter housing finance schemes.

Model 1: Housing Provident Fund (HPF)

This model was piloted by Singapore, China, and Mexico as Alternative Housing Finance Schemes. The HPF was rolled out in Shanghai in 1991 to mobilize private resources to secure long-term funds for meeting housing needs without state subsidy. Modeled on Singapore's HPF, the Chinese HPF scheme involves a compulsory monthly contribution by all employees and employers of a share of workers' salaries to the Fund. While HPF has shown to have several limitations, it is an effective housing finance model that supports housing finance in China. In Mexico, organizations such as FONHAPO (the National Peoples Housing Trust) and SEDESOL (the Secretariat for Social Development) provide mortgages to those without credit histories, seasonal or temporary workers, and those participating in Mexico's large informal economy. (UN-Habitat, 2005)

Model 2: Community Based Housing Loans

A fast-growing strategy for channeling housing finance is getting group loans by the community organization (e.g., against collective land as a credit security), which then on-lends to its members, and takes responsibility for managing the repayment process and making mandatory group monthly repayments to the lender. In these group loan strategies, the whole community is collectively responsible for repaying the loan and developing internal systems for ensuring the repayments are made in full each month, even if some members might have repayment problems. Although savings groups may have no legal power to penalize late-payers, there are several techniques they can work into their loan management systems to accommodate the inevitable repayment problems and to help their neighbors who have problems making repayments. These systems are positive, supportive, realistic, and highly social. When communities design and manage

Model 3: Affordable Housing Programme-My House My Life

Despite a remarkable reversal of inequality in Brazil since the adoption of socially progressive redistributive policies in the 2000s (Cronin, 2011), the country of more than 200 million people has a large proportion of the population living in substandard shelters. To address this, the Brazilian government launched the "My House, My Life" program in 2009, which aims to build 3 million homes for low-income families in just five years. The program is administered by the public Caixa Economica Federal Bank. The second phase of the program, starting in 2011, has been allocated BRL 140 billion, and as in 2012, it was protected from budget austerity cuts.

MCMV provides incentives for housing developers, provided they will offer new homes at a government-approved cap price. Currently, low-income households are eligible to receive an allowance to buy these homes (e.g., up to 90% of the house price if earning less than three times the minimum wage, i.e., less than about USD 1,000), as well as a low-interest mortgage to cover the rest. Before MCMV, mortgages in Brazil were only available for the wealthiest families; only 10% of Brazil's real estate was mortgaged.

MCMV also attempts to incorporate green concerns; e.g., in the second phase of MCMV, single-family houses have to be equipped with solar water heaters, although there are also shortcomings arising from a lack of consistent sustainability requirements. It is very often that new homes, especially in larger cities such as Rio, are built far from the centers of commerce and lack public transportation and community facilities, thus undermining their overall sustainability.

3. Paper Methodology

The paper used a combination of quantitative and qualitative methods for a thorough analysis. A quantitative data re-analysis from secondary sources includes censuses and surveys such as EICV, FiniScope, price statistics, and national accounts, with a more focus on households that have do not own houses, taking into consideration the FRW depreciation against USD from the data source and reports (MPFSS, LFS, and IBES, among others).

Additionally, qualitative primary data collection and analysis from commercial lenders and industry experts explored the best practices for local resource mobilization. The paper collected data from 10 key informants' interviews(KIIs) as per the table below.

Table 1: KII Sample allocation

	Respondents	Respondents
KII		
1	Commercial Bank	2
2	Development Bank	2
3	MFIs	3

Source: Researcher

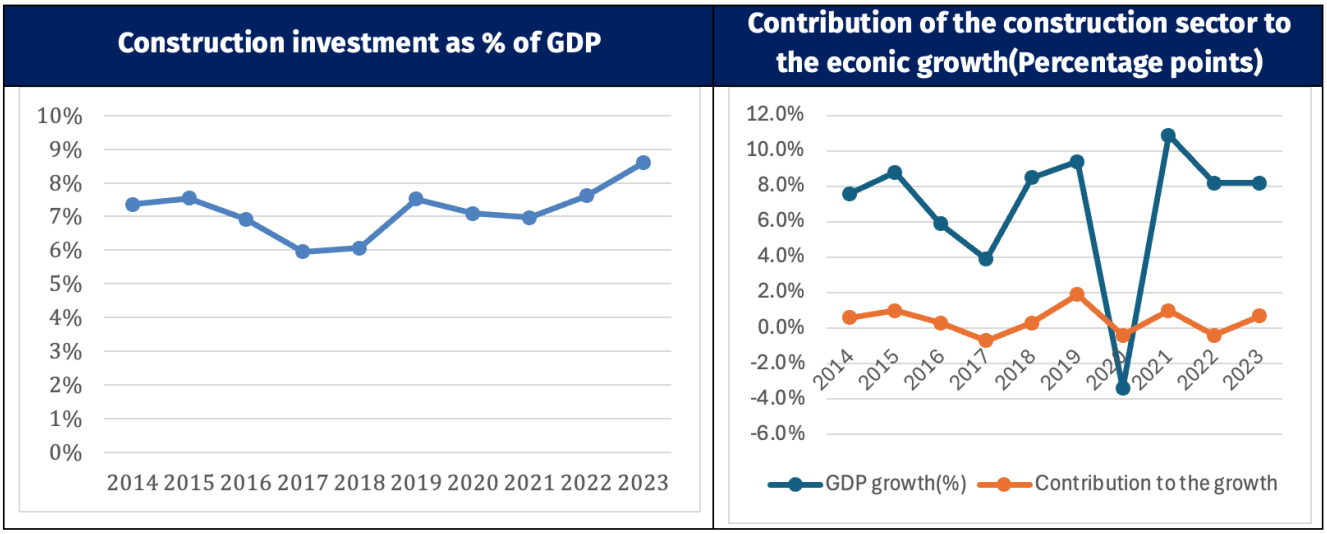
4. Findings and Discussions

4.1. Construction investment

The data shows fluctuations in the share of construction investment in GDP over the years, ranging from a low of 6.0% in 2017 to a high of 8.6% in 2023. There is an overall upward trend observed from 2014 to 2023, indicating a gradual increase in the contribution of construction investment to the GDP. Investment in housing stimulates demand for construction materials, labor, and other related industries, leading to job creation and income generation.

The contribution of the construction sector to GDP growth varied across years, influencing the overall economic performance. In years with higher contributions from construction, such as 2019 (1.9%) and 2021 (1.0%), the GDP growth rates were notably higher, indicating the substantial impact of construction activity on economic growth.

Figure 1: construction investment as a % of GDP and Sector contribution to the economy growth.



Source: NISR, National Account, 2023

In summary, the construction sector plays a significant role in driving economic growth in Rwanda by contributing positively to GDP expansion in most years. Its contributions highlight the sector's importance as a key driver of economic activity, employment generation, and infrastructure development. Policymakers should recognize and support the construction sector's role in fostering economic growth through targeted policy incentives and investments to ensure sustainable and inclusive development.

4.2. Population growth whereas the size of the country is stable.

Rwanda ranks as the second-most densely populated country in Africa and among the top 20 globally. As such, the country's approach to housing should align with best practices observed in the most densely populated economies worldwide. Examples include Macau (20,497 people per square kilometer), Monaco (15,255), Singapore (7,681), Hong Kong (6,480), and Mauritius (644).

Between 2002 and 2050, Rwanda's total population will almost triple, from 8.1 million to 23.1 million. Correspondingly, population density will increase significantly, from 378 H/Km2 in 2002 to 876 H/Km2 in 2050. This substantial rise indicates a higher concentration of people within urban areas, leading to increased pressure on available land.

Moreover, the urbanization rate will surge from 17% in 2002 to 66% by 2050. This rapid urbanization highlights the shift of the population from rural to urban areas, further exacerbating the demand for housing in urban centers.

Table 2: Trend for population with projections

	2002	2012	2022	2028	2035	2050
Total population (millions)	8.1	10.5	13.3	15.1	17.5	23.1
Population Density (H/Km2)	378	415	501	572	664	876
Urbanization rate (%)	17	17	28	36	45	66

Source: NISR, RHPC 2022

To ensure the efficient use of land and accommodate the growing population, significant investments in the housing sector are imperative. There is need to increase investments – on both the demand and supply sides – to ensure provision of adequate housing infrastructure to meet the rising demand, particularly in urban areas experiencing rapid urbanization. Without adequate investment in the housing sector, there is a risk of overcrowding, informal settlements, and inefficient land use practices, which can have adverse social, economic, and environmental consequences.

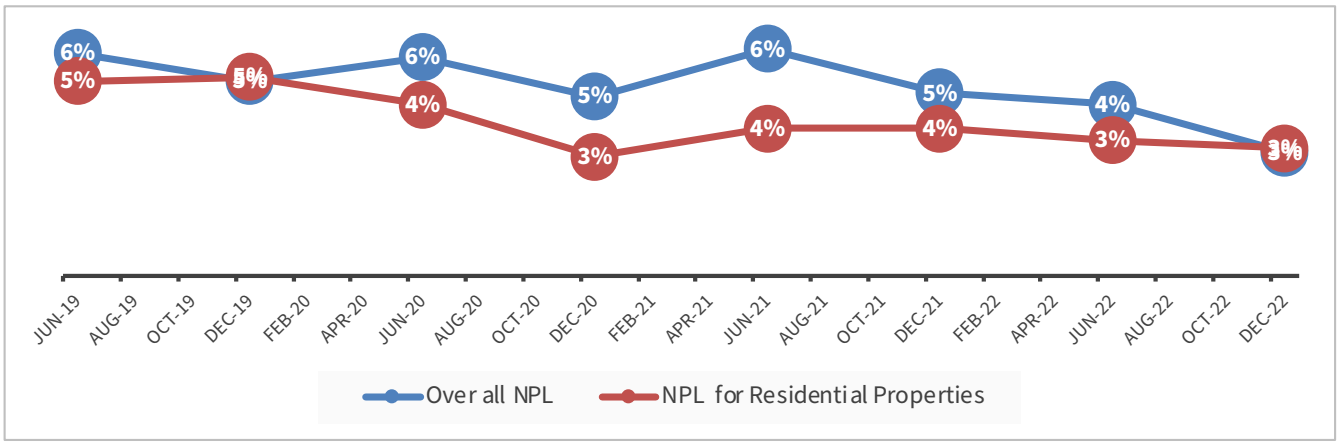
Therefore, policymakers, urban planners, and real estate developers should prioritize investments in the housing sector to effectively address the housing needs of the expanding population. This entails the development of affordable housing solutions, sustainable urban planning strategies, and infrastructure investments to ensure the efficient use of land and promote inclusive and sustainable urban development.

4.3. Performance of loans to residential/housing sector

A review of data from the Central Bank regarding the the outstanding loans by activity in Rwanda for the year 2022, the sector's total outstanding loan amount was at FRW 3,306 billion. Among these outstanding loans, residential property loans account for FRW 526 billion, representing approximately 16% of the total outstanding loans.

Furthermore, a review of the share of the sector's overall non-performing loan (NPL) compared to NPL specifically for residential properties over several periods from June 2019 to December 2022. Analyzing these findings indicates that the NPL for residential properties consistently remains below the NPL for the overall sector during each period. This suggests that the residential property sector is performing relatively better in terms of loan repayment compared to the overall sector, which implies investment opportunities in the sector.

Figure 2: Sectoral Non-Performing Loans trends(June-2019 to Dec-2022)



Source: NBR, MPFSS, 2019-2022

4.4. House demand in Rwanda

In urban areas, most residents are tenants (481,325), but there's still a significant number of owners (431,137). This indicates a substantial portion of urban residents have achieved homeownership; furthermore, tenant-occupied households are predominantly found in the City of Kigali at about 61%, a level that is at least three times higher than the percentages observed elsewhere in the country. This higher demand for rental housing in urban areas could be attributed to factors such as higher population density, employment opportunities, and migration trends, whereas in rural areas, there are more owners (1,942,381) than tenants (255,244), emphasizing the significance of house ownership related to Rwandan culture.

In Rwanda, about 72% of the 3.31 million private households are owned by the households occupying them, while about 22% are occupied by tenants and 4% are free lodging. The analysis by area of residence reveals that, in urban areas, households occupied by tenants (about 50%) are slightly more common than owner-occupied households (about 45%). On the other hand, in rural areas, the percentage of owner-occupied households (about 83%) is fairly above the national average, while the percentage of tenant-occupied households (about 11%) is about half the national average. The high prevalence of owner-occupied households in rural areas.

Table 3: Housing demand trends (by location)

	Urban	Rural	Rwanda
Owner	431,137	1,942,381	2,373,518
Tenant	481,325	255,244	736,569
Hire purchase	1,092	2,049	3,141
Free lodging	35,330	110,115	145,445
Staff housing	11,461	16,555	28,016
Temporary camp or settlement	1,343	16,516	17,859
Other	2,556	5,535	8,091
Not stated	43	61	104
Total	**964,287**	**2,348,456**	**3,312,743**

Source: NISR, RPHC 2022

4.5. House demand by types of contracts and income

4.5.1. Distribution of the house demand by types

EICV5 shows that across both urban and rural areas, 63.6% of renting households have a permanent job, and 36.4% have an informal job. furthermore, in urban areas, 53.8% of renting households have a permanent job, while 46.2% have a temporary job whereas in rural areas, a higher percentage, 77.0%, of renting households have a permanent job, while 23.0% have an temporary job.

Table 4: Distribution (Percentage) of the renting household by types of job and residence

	Permanent Job	Temporary Job	Total	Total Household
Urban	53.8	46.2	100	259,995
Rural	77.0	23.0	100	189,231
Total	**63.6**	**36.4**	**100**	**449,226**

Source : Data re-analysis EICV5, 2016/2017

4.5.2. Distribution of the house demand's income by types

These findings show the average monthly salary (in FRW) for renting households categorized by types of job and residence (urban or rural). The below table indicates disparities in average monthly salaries for renting households based on job type and residence, with Temporary job holders earning more in both urban and rural areas compared to those with permanent jobs.

Across both urban and rural areas, households with a permanent job have an average monthly salary for renting of FRW 145,808, while households with an Temporary job have a higher average of FRW 228,199.

Table 5: Average monthly salary (FRW) for renting a household by types of job and residence

Urban/Rural	Permanent Job	Temporary Job
Urban	218,429	256,369
Rural	76,045	147,140
Total	**145,808**	**228,199**

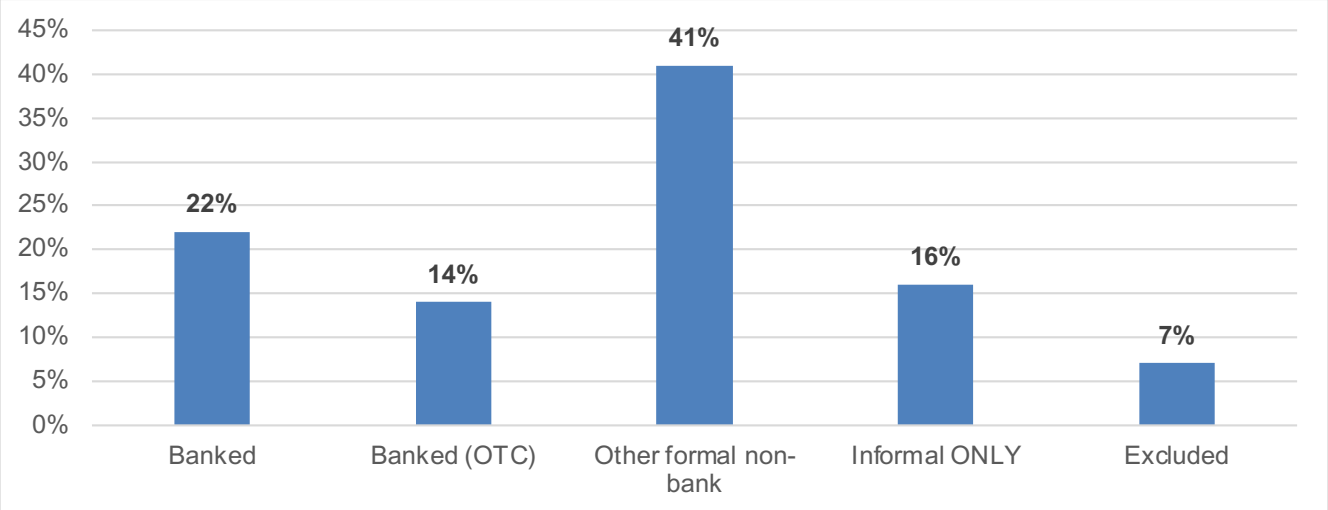
Source : Data re-analysis EICV5, 2016/2017

4.6. Financial inclusion and role of Fis to drive home ownership

4.6.1. Financial Inclusion levels in Rwanda

The FinScope Access Strand serves as a crucial metric for assessing and categorizing financial inclusion efforts. The figure illustrates the percentages of adults categorized as financially included and financially excluded. Approximately 93% (equivalent to 6.7 million individuals) of Rwandans fall under the financially included category, indicating that they utilize either formal or informal financial products or services to fulfill their financial requirements. Specifically, in 2020, the proportion of adults with access to banking products or services stood at 36%.

Figure 3: Financial inclusion

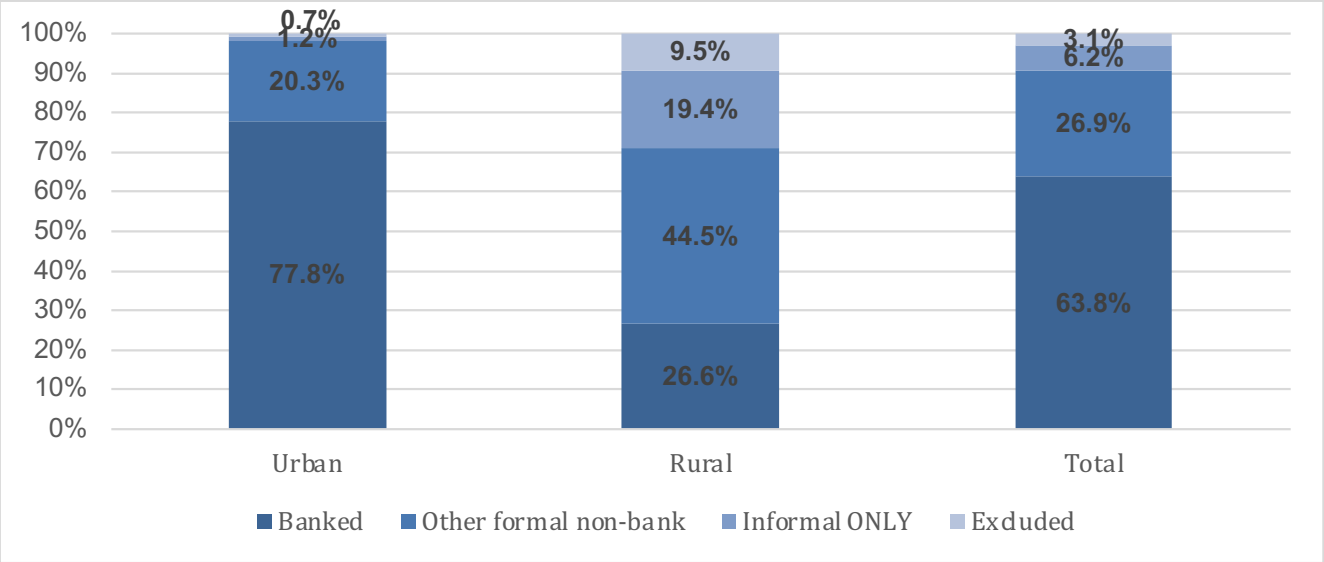


Source: FinScope, 2020

This data represents the levels of financial inclusion among renting households categorized by urban and rural areas.

Figure 4 shows that most renting households have access to formal banking services. In urban areas, 77.8%, whereas in rural areas, only 26.6%. Overall, 63.8% of renting households are banked. This shows greater potential opportunities where the banks can explore different lending scenarios by segmenting the repayment capacity of its clients, aiming to design a respective product.

Figure 4: Financial inclusion for renting households by location



Source: FinScope, 2020

4.6.2. Financial Institutions' role in accelerating home ownership

Overall, personal savings remain the primary source of housing financing in both urban and rural areas, followed by loans from banks. MFIs, SACCOs, and savings clubs play relatively minor roles in housing finance compared to personal savings and banks. While banks play a significant role in urban areas (21.8%), their contribution in rural areas is notably lower (2.4%). Similarly, MFIs and SACCOs contribute slightly more to rural areas (3.7%) compared to urban areas (0.8%). Role of Savings Clubs: Savings clubs play a more significant role in rural areas (4.1%) compared to urban areas (0.4%), indicating a potential preference for informal savings mechanisms in rural communities.

Table 7: Role of Financial Institutions (Banks, MFIs & SACCOs and Savings) for house owning a house- Percentage

	Urban				Rural			
	Bought it	Built it	Other	Total	Bought it	Built it	Other	Total
Used my/our savings	66.0	65.2	2.4	64.9	67.1	75.2	18.4	74.6
Saving groups	0.4	1.6	-	1.4	4.1	5.0	-	5.0
Inherited money	4.1	3.8	-	3.9	4.9	5.0	5.7	5.0
Bank	21.8	19.2	-	19.5	2.4	1.2	-	1.2
MFIs & SACCO	0.8	2.7	-	2.4	3.7	1.9	4.5	2.0
Other	7.0	7.5	97.6	7.9	17.7	11.7	71.4	12.2
Overall	100	100	100	100	100	100	100	100
Total	72,805	320,955	2,404	396,164	86,625	1,580,121	6,869	1,673,616

Source : Data re-analysis FinScope, 2020

4.7. Rental expenditure

Considering the depreciation of the Rwandan currency against the USD during the survey period, analysis of the EICV5 data indicates that the demand for housing, as reflected by household spending on rental fees, falls within the range of FRW 14,000 to 28,000, with 81,949 households falling within this category. Following closely are households in the range of FRW 28,000 to 49,000, totaling 64,870 households.

The data suggests a correlation between the rent amounts (in FRW) range and the number of rooms in households. In lower rental ranges, most households tend to have one or two rooms, whereas higher rental ranges correspond to households with three or four rooms being more prevalent.

These findings underscore the necessity for collaborative efforts among various stakeholders to address the housing demand. This may involve financing low-income earners collectively or facilitating rent-to-own arrangements based on their repayment capacity. Such initiatives could potentially extend tenant durations by enabling family ownership or inheritance arrangements.

Table 8: Percentage of renting in urban area by family size and renting amount.

Number of rooms						
Ranting range (FRW)	One	Two	Three	Four	Total	Number of Households
<7,000	6%	9%	4%	2%	7%	18,737
7,000-14,000	16%	11%	13%	8%	13%	33,509
14,000-28,000	40%	27%	14%	44%	32%	81,949
28,000-49,000	25%	28%	19%	10%	25%	64,870
49,000-75,000	8%	9%	18%	8%	10%	24,873
75,000-100,000	2%	4%	9%	10%	4%	10,234
100,000-150,000	2%	6%	7%	10%	5%	11,972
>150,000	2%	5%	16%	8%	5%	13,851
	100%	100%	100%	100%	100%	
Total	105,218	119,555	25,427	9,796	100	259,995

Source : Data re-analysis EICV5, 2016/2017

The data shows that rental fees in urban locations (particularly Kigali) are borne by 189,000 households, and 12% (22,000 households) have a rental cost ranging above FRW 100,000 per month. Further analysis shows that these households can afford to service the 'rent-to-own' arrangement (if option is available), with most of the beneficiaries preferring the one-to-three-bedroom housing units. Withgovernment interventions, the borrowers can access the housing loans up to a maximum tenure of 20 years, at 11% or less interest, to acquire a mortgage loan of FRW 12,000,000 (RHA, 2024), at a monthly loan repayment instalment amounting to FRW 123,000. On the other hand, those prospective beneficiaries in need of borrowing and monthly repayment instalment of less than FRW 100,000 can afford a house in a rural area where the cost of land is not too high.

Table 9: Percentage of renting in urban area-Kigali by family size and renting amount.

Number of rooms						
Ranting range (FRW)	**One**	**Two**	**Three**	**Four**	**Total**	**Number of Households**
<7,000	2%	3%	0%	0%	2%	4,256
7,000-14,000	14%	9%	9%	3%	11%	20,511
14,000-28,000	41%	27%	10%	51%	32%	60,611
28,000-49,000	26%	31%	19%	11%	27%	50,985
49,000-75,000	9%	10%	21%	8%	11%	20,395
75,000-100,000	2%	5%	11%	9%	5%	8,745
100,000-150,000	2%	8%	9%	9%	6%	10,833
>150,000	3%	7%	21%	9%	7%	12,650
	100%	100%	100%	100%	100%	
Total	**80,377**	**83,536**	**18,095**	**6,979**	**188,986**	**188,986**

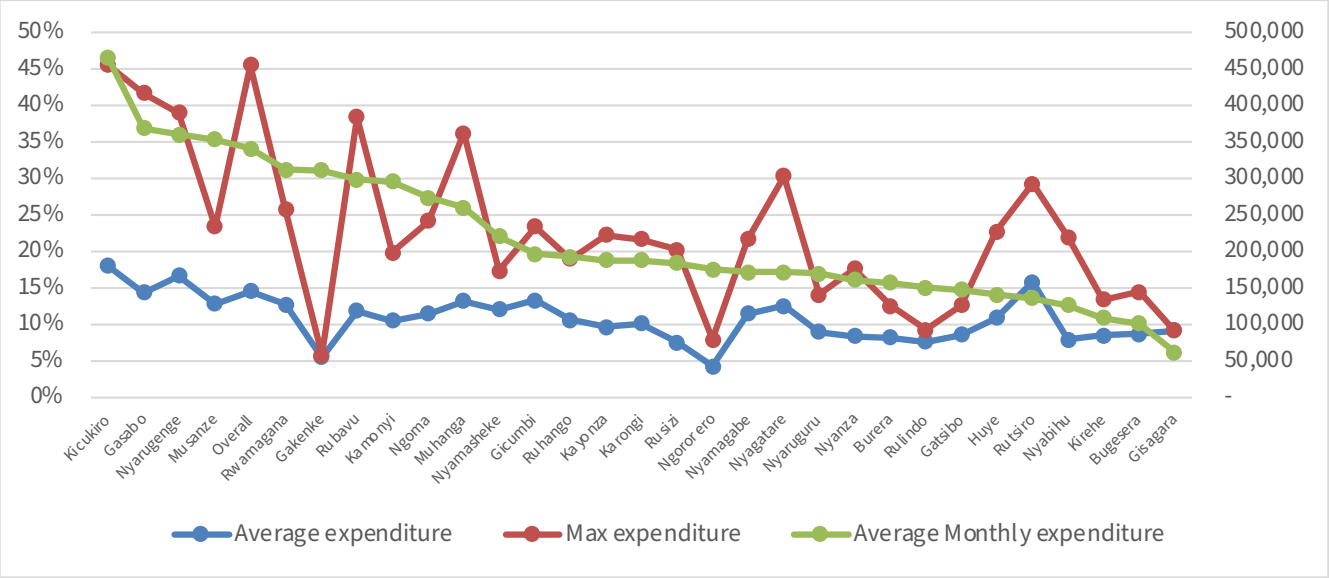
Source : Data re-analysis EICV5, 2016/2017

4.8. The category for upper limit share of the expenditure allocated to house renting

4.8.1. Urban Households

Overall, the findings provide valuable insights into expenditure trends across different districts in Rwanda, highlighting the diversity of economic conditions for urban housing access. The average expenditure on housing is 15%, whereas the maximum is 46% of the total expenditure. The findings show that the average expenditure is FRW 340,700.

Figure 5: Maximum and average shared of renting expenditure in total expenditure for Urban.

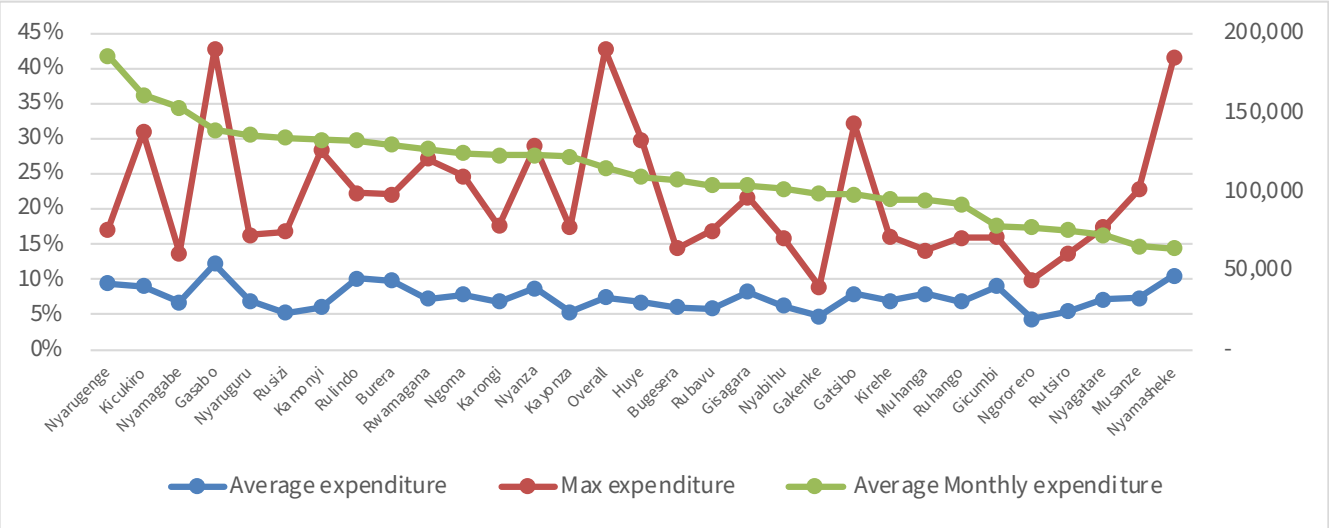


Source: Data re-analysis EICV5, 2016/2017

4.8.2. Rural Households

Overall, the findings provide valuable insights into expenditure trends across different districts in Rwanda, highlighting the diversity of economic conditions for housing access. The average expenditure for rural housing is 7%, whereas the maximum is 43% of the total expenditure.

Figure 6: Maximum and average share of renting expenditure to total expenditure for Rural.



Source: Data re-analysis EICV5, 2016/2017

4.9. Financial products are available to own a house in Rwanda

4.9.1. Gira Iwawe project

The Rwanda Housing Finance Project (RHFP) – under its acronym 'Gira Iwawe' – was initiated in 2019 by the Government of Rwanda (GoR) with funding from the World Bank and implemented by BRD. The project has a budget of US$150 million andaims to enhance housing finance accessibility for households whilst fostering the development of the capital market in Rwanda.

Presently, BRD is executing the project primarily via On-Lending finance to nine partner financial institutions (commercial lenders) including: Bank of Africa, BPR, NCBA, Equity Bank, I&M Bank, Zigama-CSS, Umwalimu-SACCO, and Muganga-SACCO.

Under the Gira Iwawe projects, funds are provided to commercial banks at a subsidized rate of 6%, while end-borrowers are offered mortgage loans – at 11% interest for households with a formal income of FRW 1.2 million; and at 13% for households with incomes ranging between FRW 1.2 million and 1.5 million respectively – with a maximum tenure of up to 20 years.

According to recent data from BRD, the project has facilitated the financing of 5,089 affordable mortgages over the past five years. Among these, the majority (73%) have benefited from an 11% interest rate, resulting in a monthly loan repayment instalment amount equivalent to FRWapproximately 160,000 for a mortgage of FRW 10,000,000.

Table 10: Gira Iwawe project performance from 2019 to end 2023

Tenure	Average amount (Frw)			Total Mortgage
	Monthly income	Monthly Instalment	Loan	
Less than 5	604,956	213,153	14,313,708	182
From 5 to 9	355,500	155,237	7,878,143	800
From 10 to 14	310,972	160,753	10,026,281	2,892
From 15 to 20	353,556	240,013	18,906,411	937
From 20 and above	505,581	256,568	23,152,038	278
Overall	**344,625**	**181,329**	**12,194,146**	**5,089**

To ensure long-term sustainable resource mobilization and product diversification, in December 2023,BRD explored alternative fundraising sources through the first-ever SLB issuance by a national development bank. The innovative new asset class introduced to the market via the Rwanda Stock Exchange enabled the Bank to raise FRW 33 billion from mainly local investors. These funds will be invested in strategic long-term projects (including provision of affordable mortgages to boost supply of green housing units) and this will further incentivize the commercial lenders to increase lending to end-beneficiaries in the housing sector in Rwanda.

Key informant recommendations:

i. The Gira Iwawe facility supports commercial banks in refinancing their mortgage portfolios, resulting in availing affordable mortgage interest rates and longer tenure in the market.

ii. Implementing an on-lending strategy is viable, particularly at concessional rates, responding to the wealth quantiles of the end borrowers.

iii. BRD has successfully promoted financial inclusion across diverse sectors, including the military, police, health, education, and public service, facilitating the mortgage financing for ownership of approximately 5,000 houses.

4.9.2. MFIs model

Despite variations in interest rates and tenure among different Microfinance Institutions (MFIs), the average mortgage interest rate ranges from 16.5% to 21.5%. However, the desired interest rate among clients averages at least 15%, with a maximum tenure of 5 years, contrasting with the desired tenure of 10 years. The absence of concessional funds contributes to an average cost of funds around 9%, limiting the MFIs' ability to provide more impactful mortgage services.

Furthermore, MFIs prioritize women's access to financing, with an average of 20% of mortgages being allocated to women. Additionally, while financing this sector, microfinance institutions adhere to environmental requirements. Despite these challenges, the sector demonstrates a growing portfolio, with an average growth rate of 12% among the surveyed banks. Moreover, due to the substantial client base and effective follow-up mechanisms, the sector maintains a low Non-Performing Loan (NPL) rate, averaging around 3%.

Key informant recommendations:

i. A collaborative effort between the demand side, and MFIs/SACCOs aims to promote regular saving for Gira Iwawe. The government may offer interest subsidies to enhance affordability and extend long-term tenures. Lenders will assess clients' eligibility for homeownership based on various documents, including Mobile Money transaction statements, tax clearances, EBM history, income statements, community testimonies, and formal bill payments.

ii. BRD will continuously mobilize cheaper funds to enhance projects like Gira Iwawe to ensure low interest rates for end-borrowers.

4.9.3. Commercial bank model

While interest rates and tenures differ among the local commercial banks, the average mortgage interest rate observed across the visited banks ranges from 14% to 20%, with an overall average of 17%. There typical tenure for mortgage loans is around 10 years. Deposits serve as the primary source of funding, contributing to an average cost of funds of approximately 8.5%.

Key informant recommendations:

i. Clients typically need to contribute between 10% to 30% of the mortgage loan amount, which often poses a challenge due to their limited incomes. There is a pressing need for government initiatives to raise awareness and promote a culture of saving among the populace.

ii. Implementing vertical building structures, where property rights granted based on construction plans and confirmed upon completion, could present an opportunity for lower-income earners to secure collateral for mortgages.

iii. Encouraging the use of locally produced materials in construction can mitigate the impact of inflation caused by reliance on imported materials, thus reducing high import bills.

iv. Subsidizing the real estate sector can help ensure the affordability of housing prices for end beneficiaries, thereby enhancing access to homeownership opportunities.

4.10. Proposed Sources of Funding for Low-Income Earners

1. ***Rent-to-Own Product:*** Introducing a rent-to-own product where tenants gradually build equity in their homes through monthly rental payments. This allows low- and middle-income earners to transition from renting to homeownership without requiring a large upfront investment, and this can be implemented by a combined effort of the national development bank and other financial institutions in the country..

2. ***Microfinance Institutions (MFIs) and SACCOs:*** Facilitating access to housing loans for low-income earners as group mortgage financing by offering tailored loan products with flexible repayment terms to accommodate the financial constraints of low-income households.

5. Lending Opportunities

There is a lending opportunity for informal earners, especially by ensuring the **flexibility of loan terms,** such as extended repayment periods, or variable repayment schedules aligned with borrowers' income cycles, to mitigate the risk of default during lean periods.

Secondary Financial **Education and Capacity Building** for informal workers to enhance their understanding of mortgage obligations, budgeting, and financial management skills. Empowering borrowers with financial knowledge can improve their ability to manage debt responsibly and reduce default rates.

And lastly, **continuous monitoring** to establish mechanisms for ongoing monitoring of borrower performance and early intervention in cases of financial distress. such as temporary income shocks or unforeseen expenses, to prevent defaults and facilitate successful loan repayment.

5.1. Incentivizing Commercial lenders to provide mortgage loans to informal workers.

Lending to informal workers without a working contract and collateral presents unique challenges for commercial lenders, as traditional risk assessment methods may not be applicable. However, several best practices can help minimize default rates and ensure successful mortgage lending to this segment of borrowers.

This opportunity can be explored by evaluating the borrower’s financial behavior, whereby the commercial lender can implement innovative credit scoring models that take into consideration the borrower’s bill payments, rental history, mobile money transactions, and informal savings group participation. In addition, the model can consider self-declarations and interviews with community leaders. These alternative indicators can provide insights into borrowers' financial behavior and creditworthiness.

5.2. Group Lending and Social Guarantees Models.

Explore the feasibility of group lending models where informal workers form borrower groups or cooperatives to collectively guarantee each other's loans. Social pressure within the group can incentivize timely repayments and reduce default risk. Additionally, consider involving community leaders or influential members as guarantors to provide additional assurance.

6. Conclusion and Implications

The research paper explores the dynamic financing mechanisms available for of Rwanda's housing sector and emphasizing the sectors' critical role in socio-economic development. Key findings highlight the growing demand for housing due to population growth and urbanization, coupled with challenges such as affordability and access to finance. Commercial lenders are identified as pivotal in addressing both demand and supply driven challenges thus maximizing their sustainable impact in the sector.

The implications of the research suggest the need for strategic interventions to promote sustainable housing finance in the country:

1. Encouraging commercial lenders to invest in green residential projects, such as vertical affordable buildings, to optimize land use and support sustainable development.
2. Leveraging existing financing models like the Gira Iwawe project, green financing mechanisms (such as Sustainable Linked Bonds), availing credit enhancements for existing mortgage financing, and advancing policy-driven sustainable initiatives.
3. Implementing alternative housing finance models like housing provident funds, rental-to-own and community-based housing loans to cater to low-income earners.

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Blockchain Technology Regulation and Financial Inclusion in Rwanda

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Abstract

This paper explores current legislative frameworks and examines how they affect the financial services industry's use of blockchain technology. With a focus on comprehending how these policies function as barriers or enablers, the study attempts to disentangle the intricacies associated with implementing blockchain technology to promote financial inclusion. The potential of blockchain technology to transform financial services and close accessibility gaps is becoming more and more apparent as it gets traction. On the other hand, the regulatory environment is crucial in determining how this revolutionary technology develops. The inquiry assesses current laws critically in an effort to determine how well they support the objectives of encouraging financial inclusion through the use of blockchain technology. Determining the obstacles that stand in the way of the broad adoption of blockchain technology is essential for formulating solutions. This study adds to a more comprehensive understanding of the challenges the financial services sector faces in utilizing blockchain technology to its fullest for inclusive financial practices by identifying regulatory roadblocks. The research also looks at legal structures that support the use of blockchain technology. Stakeholders can take advantage of a favourable environment, promoting innovation and financial inclusion, by identifying and emphasizing supportive regulations. The analysis conducted here can provide policy makers, business professionals, and tech innovators with valuable insights for improving or creating policies that facilitate rather than obstruct the use of blockchain technology in financial services. The research's ultimate goal is to provide a thorough understanding of the regulatory dynamics pertaining to blockchain technology in the financial industry. It adds to the continuing discussion on how to create legal frameworks that not only allow but actively encourage the use of blockchain technology to improve financial inclusion globally by illuminating obstacles and enablers.

1. Introduction

In many developing economies, access to suitable financial services remains a significant obstacle (Chinaka, 2016). 1.7 billion People globally still do not have any access to banks at all, according to a new report from the World Bank Group (Abdulhakeem & Hu, 2021). The adoption of blockchain technology within the banking industry has come to light as a ground-breaking phenomenon, greatly impacting financial inclusion. Blockchain technology has shown potential not only in enhancing financial services but also in integrating previously marginalized people and communities into mainstream financial institutions (Mhlanga, 2023). The study explores blockchain technology regulations and financial inclusion in Rwanda. It is frequently assumed that blockchain is just a cryptocurrency tool. However, this decentralized ledger has many uses outside of the financial industry; the safe and fair use is what regulation aims to guarantee. By enabling underprivileged groups to access transparent financial services, adopting blockchain technology can improve financial inclusion. Blockchain technologies are also anticipated to bring unique advantages that may accelerate the adoption of new technology (Hughes et al., 2019).

Insurance offers defence against monetary losses brought on by unanticipated circumstances. Financial inclusion can prevent people from sinking further into poverty by providing low-income individuals with accessible insurance solutions that meet their needs (Hillier, 2018). Remittance services also help families in underdeveloped nations by enabling migrants to send money home to maintain stability and well-being (Yeboah et al., 2021). Having access to credit enables people and companies to manage their cash flow, make investments in their enterprises or education, and improve their standard of living (Karlan & Morduch, 2010). 31% of adult people worldwide lack access to financial services and are still without a bank account. Centralization, remoteness, intermediary expenses, and a lack of trust regarding financial institutions are some of the causes contributing to this problem (Abdulhakeem & Hu, 2021). Blockchain's decentralized network operation can enable access to financial services without depending on conventional banking infrastructure. By doing away with middlemen and simplifying procedures, blockchain can drastically lower transaction costs. Also, for those without official identification, blockchain technology can be used to construct a safe, unchangeable digital identity, amongst other benefits.

In Rwanda, financial infrastructure has been more readily available in recent times, although there are still barriers to overcome. The nation has improved financial inclusion significantly, especially with the help of initiatives like digital payment systems and mobile banking. In Rwanda, mobile money services like Airtel Money and MTN Mobile Money are extensively utilized. Through these services, customers can use their mobile phones to carry out a variety of financial operations, including bill payment, money transfers, and airtime purchases (Yumvuhore, 2022). Access to financial services has significantly improved as a result, particularly in rural areas with inadequate traditional banking systems. The Rwandan government has taken a number of steps to expand access to financial services and financial inclusion. To encourage the growth of the financial industry, for instance, the National Bank of Rwanda (BNR) has implemented regulatory measures, such as programs to increase the utilization of digital financial services (Dusengimana, 2016).

With its ability to solve a number of issues pertaining to efficiency, security, and transparency in trade transactions, blockchain technology offers the potential to greatly boost trade in Rwanda. Immutable and transparent transaction records are made possible by blockchain technology. This implies that all supplychain transactions can be transparently tracked on the blockchain, giving an insight into the flow of goods from manufacturer to customer (Sunny et al., 2020). Effective supplychain management is essential for facilitating trade for Rwanda, a country that mostly depends on exports and agriculture. Supplychain users can see the progress and condition of commodities in real

time with blockchain. By reducing storage expenses for goods, providing greater accuracy in demand projections, and decreasing interruptions, this visibility enhances supply chain management.

Blockchain-based systems have the potential to offer firms in Rwanda simpler and more effective trade finance solutions. Blockchain technology may mitigate the risk for lenders and lower the cost of financing for importers and exporters by automating trade documents and establishing a transparent and safe environment for trade finance transactions (Jain & Sedamkar, 2020). Blockchain can assist Rwandan exporters in validating their conformity to worldwide standards and regulations, which would increase the commercial viability of their goods. Exporters can offer verifiable evidence of product integrity and quality to overseas consumers by logging certificates, quality inspections, and other compliance-related data on the blockchain. Ultimately, by enhancing transparency, efficiency, and security in conjunction the whole supply chain, blockchain technology has the capability to completely transform trade facilitation in Rwanda. To create and execute blockchain-based solutions tailored to the unique requirements and obstacles of Rwandan commerce, companies, government organizations, and technology suppliers will need to work together before the technology is widely used.

Smart contracts, or autonomous agreements with the contents of the agreement specifically put into code, are made possible by blockchain technology. Trade transaction operations including payment settlements, import clearance, and conformance checking can all be streamlined with smart contracts. This process of automation cuts expenses, expedites transaction processing, and eliminates the need for mediators (Akhnoukh, 2023). By offering a safe and irreversible record of trade documents, such as invoices, bills of lading, and certificates of origin, blockchain technology assists with speeding up the customs and border control procedures. Cross-border trade becomes more efficient and rapid as a result of the reduction in the time and paperwork required for customs clearance.

By giving underprivileged groups, such as those living in rural or isolated locations, access to financial services, blockchain technology can improve financial inclusion (Mhlanga, 2023). Blockchain technology has the potential to lower costs and promote availability to financial services by enabling safe, transparent, and effective transactions (Nguyen, 2016). In doing so, the circular economy is promoted. By extending the life of goods and materials through recycling, reuse, and other methods, the circular economy seeks to reduce waste and optimize the value of resources. The following gaps exist in literature:

I. There is a research vacuum regarding the potential use of blockchain technology in the current financial system to enhance or replace the antiquated SWIFT network (Abdulhakeem & Hu, 2021).

II. Gap also exists in the research on regulations of blockchain (Ramchandra et al., 2022).

III. Rwanda has been utilizing several strategic techniques to foster a digital economy, similar to other countries lagging behind in creating an economy centred on knowledge. Reviewing Rwanda's standing in relation to the leading nations in digitalization reveals a significant disparity in terms of 3D printing, cloud computing, automation and robots, digital platforms, and policy flexibility. Because of the inadequate infrastructure and inadequate laws pertaining to the digital economy, the nation is finding it difficult to adjust to digitalization (Kwizera, 2020).

IV. Regulations that support the expansion of digital financial services in rural areas must to be created and revised. Policymakers need to make sure that laws encourage competition, innovation, and consumer protection (Mugisha, 2024).

Adoption of blockchain technology for financial inclusion is heavily influenced by the regulatory environment. In Rwanda's efforts to promote financial inclusion in particular, regulation is essential for blockchain technology to become widely used. In the absence of regulation, problems like market manipulation, fraud, and money laundering spread widely and threatens security and confidence (Werbach, 2018). Investment and creativity may be discouraged by inconsistent practices brought about by a lack of legal frameworks. Clear rules and standards provided by regulatory agencies provide consumer protection, promote a stable environment for financial transactions, and promote blockchain adoption (Igbinenikaro & Adewusi, 2024). For these reasons, a regulated environment is necessary to reduce risks, improve transparency, and foster trust among users and other blockchain ecosystem stakeholders.

In order to determine potential obstacles or enablers for the integration of blockchain technology in financial services, the current study delves into the regulatory frameworks that are in place at the moment. The aim of the study is to investigate the current regulatory frameworks to identify any barriers or facilitators to the deployment of blockchain technology in the financial services industry.

The study would address the following objectives:

1. To assess the existing regulatory frameworks governing financial services and recognises how they may impact the integration of blockchain technology.
2. To analyse the possible challenges hindering the seamless integration of blockchain technology within the current financial services landscape.
3. To investigate the regulatory enablers that could facilitate the successful incorporation of blockchain technology into financial services, identifying supportive policies and frameworks.
4. To examine the perceptions and attitudes of key stakeholders, including regulators, financial institutions, and users, towards the integration of blockchain technology in financial services.
5. To examine how blockchain technology regulation affects financial inclusion in Rwanda.

The study would address the following research questions:

1. How can the existing regulatory frameworks governing financial services be assessed in relation to their potential impact on the integration of blockchain technology?
2. What are the possible challenges that hinder the seamless integration of blockchain technology within the current banking sector?
3. Who are the regulatory enablers that could facilitate the successful incorporation of blockchain technology into financial services? What supportive policies and frameworks are identified?
4. What are the perceptions and attitudes of key stakeholders, such as regulators, financial institutions, and users, in relation to the integration of blockchain technology in financial services?
5. How does blockchain technology regulation affect financial inclusion in Rwanda?

The study would address the following research hypotheses:

1. Current regulatory frameworks pose significant challenges to the integration of blockchain technology in financial services.
2. Adapting and updating regulatory frameworks will facilitate the successful integration of blockchain technology in financial services.
3. Standardizing international regulatory standards will enhance the global integration of blockchain technology in financial services.
4. Blockchain technology regulation will enable financial inclusion in Rwanda.

2. Review of Literature

2.1. Stakeholder and Players in Financial Inclusion in Rwanda

One of the pillars of socio-economic development is financial inclusion, which is based on giving people and community's access to a broad range of financial services regardless of their location or level of income (Abimbola et al., 2018). Efforts to address these issues are a part of larger financial inclusion programs, which seek to give everyone access to reasonably priced, high-quality financial services that will help their target markets achieve their financial needs. For distant areas that typically rely on agriculture as their primary source of income, the lack of financial inclusion is typically worse (Chinaka, 2016). Blockchain technology is particularly notable as a driver of innovation and accessibility as the financial ecosystem struggles with the need to address socioeconomic gaps (Toufaily et al., 2021). Blockchain is a decentralized, transparent, and secure system of information that stores transactional records (Puthal et al., 2018). Using open-source software, this technology enables the decentralized management of transaction data on a global network of computers.

A wide range of stakeholders and organizations are involved in Rwanda's financial inclusion environment, and utilizing blockchain technology to improve accessibility to financial services is a major focus (Mugisha, 2024). Government agencies including the Ministry of Finance and Economic Planning (MINECOFIN) and the National Bank of Rwanda (BNR) are spearheading the initiative (Kaniba, 2001). These organizations are essential in establishing rules and putting plans into action to foster financial inclusion by utilizing cutting-edge technologies like blockchain. Another important group of stakeholders are commercial banks and microfinance organizations. Their responsibility is to use blockchain-based solutions to reach more under-banked and unbanked people and promote greater financial inclusion. These banks hope to establish safe and effective channels for lending, savings, and transactions by collaborating with blockchain developers and digital companies.

The goal of financial inclusion in Rwanda is also greatly aided by Non-Governmental Organizations (NGOs) and Foreign Development organizations (Rwamigabo, 2017). Additionally, the rise of mobile network providers and fintech companies rejuvenates Rwanda's financial inclusion ecosystem. These flexible organizations take advantage of the decentralized nature of blockchain technology to provide affordable and easily navigable solutions, such peer-to-peer lending platforms and mobile wallets, to meet the demands of a wide range of consumers. The relationship between blockchain technology and financial inclusion in Rwanda underscores the need for stakeholders to work together to close the gap that exists between underprivileged regions and the traditional banking industry.

The National Bank of Rwanda (BNR) and the Ministry of ICT and Innovation are mainly in charge of regulating blockchain technology and financial inclusion in Rwanda with the goal of ensuring safe, inclusive financial services and digital transformation in the country (Umuhoza, 2023). Rwanda is well-positioned to make major advancements toward equitable economic development by embracing creativity and cooperation. With an open financial system, Rwanda offers opportunities in the cross-border features of blockchain technology. When compared to traditional banking systems and remittance providers, blockchain can lower transaction fees for cross-border payments. The time required to transmit and receive money can be greatly decreased by achieving real-time or almost immediate cross-border transactions (Finken & Finkemeyer, 2019). Blockchain technology can improve the supply chain's traceability and transparency of items, which can lower fraud and guarantee product authenticity. It can also give authorities unchangeable, transparent financial transaction records, which will improve the effectiveness of compliance monitoring. In order to promote commerce and economic progress, blockchain can help the East African Community (EAC) and other regional organizations integrate economically more (Wilhelm, 2019).

The decentralized and transparent nature of blockchain technology presents a promising opportunity to transform conventional financial institutions and expand financial services accessibility to underserved and unbanked communities (Gupta & Jain, 2023). The revolutionary potential of blockchain technology has been a focus point for researchers and regulators alike in the constantly changing financial services industry. Now that there is an integration of technology and financial inclusion, it is more important than ever to examine and understand the legal frameworks that now either support or hinder the use of blockchain in the financial services industry (Chang et al., 2020).

2.2 Challenges in the Financial Sector in Rwanda

Similar to many developing nations, Rwanda's financial sector faces a number of obstacles that limit its stability and expansion (Mwega, 2016). Insufficient availability of financial services is a major problem, especially in rural areas with lack of infrastructure and banking facilities. The absence of accessibility impedes the ability of individuals and businesses to receive necessary financial products including insurance, savings accounts, and loans, which in turn hinders attempts to reduce poverty and promote economic development. The relatively modest size of Rwanda's financial market presents another difficulty. The market's small size may limit consumer access to a wide range of financial services and products, as well as competition and innovation (Mutandwa & Kwiringirimana, 2015). This may lead to increased financial services expenses and a shortage of specialized products to satisfy the various demands of various customer groups.

Concerns regarding the stability and regulation of the financial sector are also very important. The financial system in Rwanda is still developing, and it is important to make sure that it is adaptable to unexpected events like unstable regions or worldwide recessions. To do this, regulatory frameworks need to be strengthened, risk management techniques need to be improved, and transparency and accountability must be fostered. Stability and trust among investors are also maintained by recognizing that reaching unbanked or under-banked populations is difficult when using the conventional banking infrastructure. Fin-tech innovations, however, provide chances to get around these obstacles by offering substitute avenues for delivering financial services, like digital payments and mobile banking. In the study by Ramchandra et al. (2022), the effect of blockchain technology on the banking industry was evaluated. How the banking industry is poised to undergo a significant transformation through the use of blockchain technology was highlighted. It was found that blockchain technology appears to be a possible technology that can be used in addressing the issues of banks' inefficiencies by impeding third parties, raising bank efficiency, and cutting costs. It was revealed that elimination of third parties contributes to the efficiency and customer transparency of the transactions. A gap in the study is on how regulatory framework supports or discourages the adoption of blockchain technology.

The current study delves into the regulatory frameworks that are in place at the moment. To sum up, resolving these issues in Rwanda's financial system calls for cooperation between the government, financial institutions, regulators, and other interested partners. To create a more open, sturdy, and long-lasting financial system that supports Rwanda's goals for economic growth and development, attempts must be made to increase the availability of financial services, improve awareness of finance, encourage rivalry in the markets, reinforce supervision by regulators, and adopt fin-tech innovations.

2.3 Regulatory structures and the use of blockchain technology to promote financial inclusion in Rwanda

In Rwanda, regulatory frameworks are crucial in forming the country's financial environment and assuring security, stability, and inclusion (Biedermann, 2016). The Rwandan government has demonstrated a proactive approach towards promoting financial inclusion by enacting law that enable financial services accessibility for every citizen, with a special focus on those residing in economically disadvantaged communities. The following are some of the primary regulations and policies relating to blockchain technology and financial inclusion in Rwanda:

1. Financial inclusion initiative:

As part of its larger plan for economic development, the Rwandan government has made financial inclusion a priority. In an effort to improve financial accessibility, the National Bank of Rwanda has implemented initiatives that include the development of agent banking networks in rural areas and the promotion of digital financial services (Mugisha, 2024).

2. Cryptocurrency Regulation

In order to reduce the dangers related to money laundering, fraud, and safety for consumers, the Central Bank of Rwanda (BNR) has adopted a methodical approach to cryptocurrency regulation. Cryptocurrency trading platforms and service providers must register with the BNR and adhere to know-your-customer (KYC) and anti-money laundering (AML) laws (Barr et al., 2021)..

3. Data Privacy and Security

As blockchain technology becomes more widely used, data security and privacy are becoming more important in order to safeguard customers' financial and personal data. Regulations are in place, in order to ensure that blockchain-based platforms follow global standards for cyber-security and data protection (Wilhelm, 2019).

Using blockchain technology to enhance financial inclusion within current regulatory frameworks is one novel approach. With its unchangeable record system and open structure, blockchain technology is a possible tool for improving financial inclusiveness in Rwanda. Regulatory agencies are able to reduce operating expenses, simplify procedures, and decrease dangers connected to conventional financial systems by utilizing blockchain technology (Yeoh, 2017). Also, consumers are more trusting of blockchain due to its open structure and unbreakable nature, which creates an atmosphere that is favourable for financial inclusion. To take full advantage of the revolutionary potential of blockchain technology and guarantee that it adheres to current laws, Rwanda is adapting its regulatory institutions to support blockchain-based financial services. Regulatory bodies work together with fintech companies and other relevant parties to create solid regulations that strike the right equilibrium between safety for customers, creativity, and regulatory monitoring.

There are opportunities and challenges associated with Rwanda's hovering regulatory void and the blockchain technology's rapidly expanding potential for speeding up financial inclusion (Maimbo, 2020). The lack of specific legislative frameworks suited to this cutting-edge technology's unique applications in Rwanda creates an intricate environment as it develops momentum, especially in transforming financial services. The safety of consumers, economic stability, and regulatory compliance are at jeopardy due to the lack of comprehensive legislation specifically designed for blockchain technology. Improper use, fraud, and even financial system instability are possible in the absence of explicit regulations. Furthermore, the lack of clarity concerning legislative frameworks may discourage investment and creative thinking in blockchain-based solutions, impeding their ability to significantly improve financial inclusion.

Although blockchain has the capacity to considerably boost financial inclusion in Rwanda, unclear regulatory environment poses a significant obstacle (Adewale & Oyewole, 2023). To close this regulatory gap, policymakers in Rwanda must give the greatest emphasis to creating a strong regulatory framework that promotes innovation while minimizing risks. Know-your-customer (KYC) regulations, anti-money laundering (AML) procedures, data privacy, smart contract standards, and blockchain application-specific conflict resolution procedures should all be covered under this framework. To create rules that effectively balance innovation and risk management, government agencies, financial institutions, technology developers, and other stakeholders must work together. Through strategic engagement with the blockchain community and utilization of global regulatory experiences' best practices, Rwanda can create an environment that is beneficial to the responsible implementation of blockchain technology, hence advancing financial inclusion.

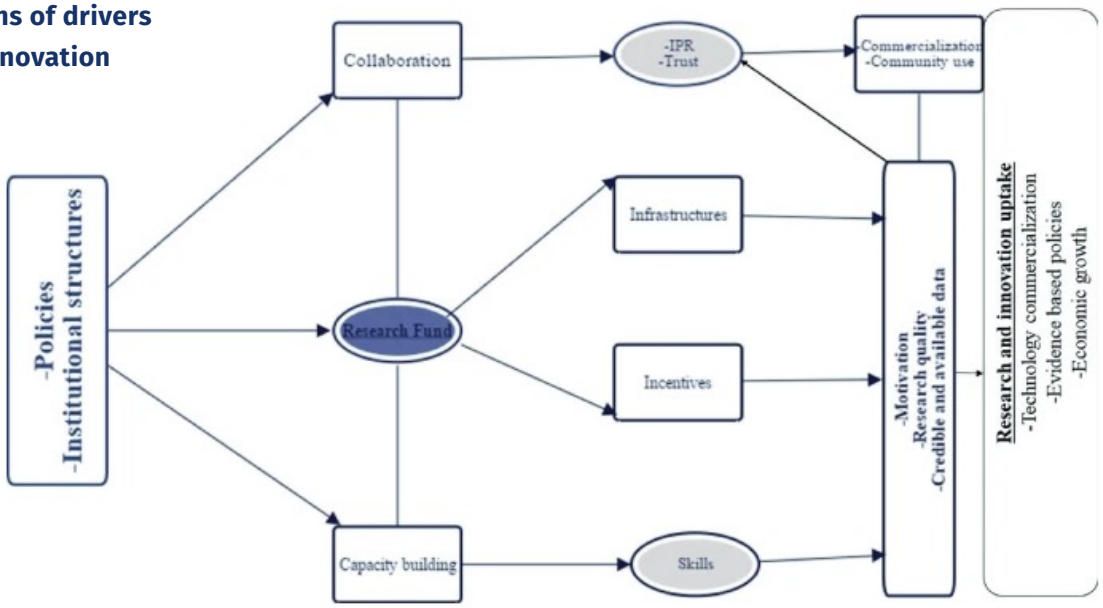
The study analyses the regulatory frameworks that oversee the financial services sector in various jurisdictions as it probes more into this analysis. Through a thorough examination of the legal, policy, and compliance environments, the study aim to pinpoint the subtle obstacles that stand in the way of the smooth implementation of blockchain technology. At the same time, it aims to highlight regulatory frameworks that serve as enablers, creating an environment that is favourable to the broad implementation of blockchain solutions. Understanding the dynamic interaction between regulatory frameworks and technological innovation is emphasized in particular in this study. By doing this, it sheds light on how regulatory uncertainty or transparency affect financial institutions', entrepreneurs', and other stakeholders' desire to invest in and use blockchain-based solutions. Furthermore, the study investigates how cooperative efforts, laws and regulations could support the development of a favourable atmosphere for the investigation and application of blockchain technology in the financial services industry.

2.4 Regulatory Framework Analysis in Rwanda

The study looks at Rwandan regulatory frameworks that are impacted by blockchain technology, with a particular emphasis on consumer protection, legal clarity, compliance requirements, financial access, anti-money laundering measures, and innovation assistance. It assesses the ways in which these rules impact financial inclusion, encouraging fair access to financial services via blockchain developments. Beyond just guaranteeing legal compliance, Rwanda's regulatory system impacts the country's commercial environment, investment environment, and general economic progress (Behuria & Goodfellow, 2016).

Figure 1: perceptions of drivers for research and innovation uptake in Rwanda

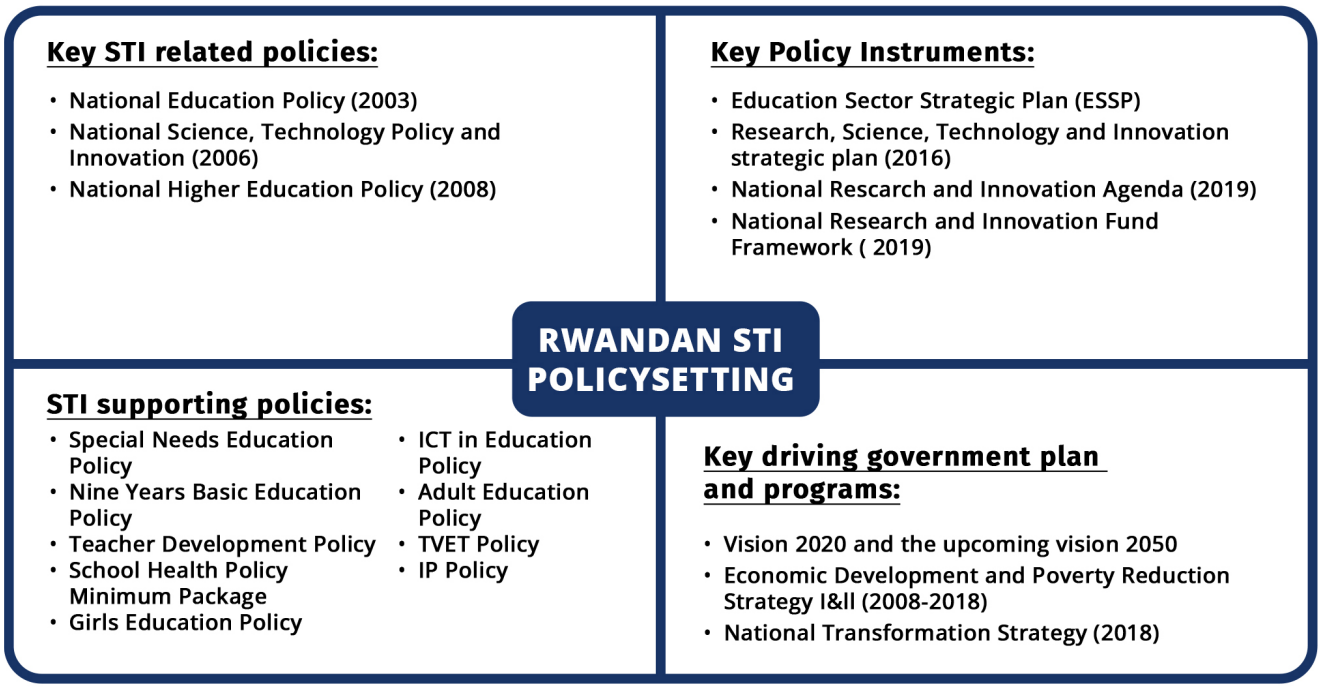
Source: (Yongabo, 2021)



The regulatory structure promotes investment, fosters innovation, and promotes entrepreneurship by offering clarity and certainty. In addition, it promotes sustainable development objectives by guaranteeing the safety of customers, employees, and the environment. The regulatory framework in Rwanda provides standards, rules, and guidelines that are designed to ensure public interests are protected, growth is stimulated, and conformity is ensured (Bonde et al., 2015). Rwanda's regulatory structure is based on its government's commitment to improving accountability, efficiency, and openness. As the principal regulatory authority in charge of managing trade, investment, and business operations in the nation, the Rwanda Development Board (RDB) is essential in this respect. The RDB makes it easier to register firms, grant authorizations, and uphold regulatory standards by using digital platforms and simpler procedures, thereby reducing administrative challenges and enhancing ease of doing business.

Key areas like telecommunications, energy, banking, and healthcare are regulated by industry-specific regulators in addition to the RDB. The responsibility for guaranteeing equal treatment, safeguarding consumers, and complying to industry standards falls on these regulatory bodies. In this vein, the Rwanda Utilities Regulatory Authority (RURA) regulates the electricity and telecommunications industries, licensing operators, establishing prices, and keeping an eye on service quality in order to encourage affordability and efficiency (Karamuka, 2014). In order to boost competitiveness and stimulate trade, Rwanda also integrates its regulatory framework with worldwide and regional standards. Rwanda integrates its legislation with those of its neighbours and trading partners as a member of the East African Community (EAC) and a party to several global treaties. Rwanda's appeal as an investment destination is increased by this arrangement, which also promotes regional unity and eases cross-border trade.

Figure 2: Policy setting in Rwanda



Source: (Yongabo, 2021).

Rwanda also gives regulatory changes the most attention in order to take advantage of emerging possibilities for development and address growing difficulties (Ansoms, 2008). To adapt to changing demands, the government periodically analyses current laws, gets input from interested parties, and proposes new legislation. In addition to preserving the rule of law and safeguarding the interests of the public, this pre-emptive approach to regulation guarantees flexibility and response to changing economic trends.

The regulatory framework of Rwanda is distinguished for its transparency, efficiency, and conformity to global norms (Abbott, P., & Sapsford, 2021). The regulatory framework is essential to Rwanda's socio-economic development strategy because it protects public interests, encourages competition, and creates a favourable business climate. Rwanda seeks to significantly improve its regulatory environment to promote sustainable growth and prosperity through on-going reforms and stakeholder engagement.

2.5 Compliance requirements

The implementation of blockchain technology in Rwanda for financial inclusion is greatly influenced by the country's current policies (Mugisha, 2024). To improve financial services accessibility for its residents, particularly those residing in economically disadvantaged areas, the nation has demonstrated a strong desire to utilize cutting-edge technologies. But there are differences in how current laws support or obstruct the use of blockchain technology. Regarding the adoption of emerging technologies, such as blockchain, Rwanda has shown itself to be proactive. The administration has demonstrated its approval for programs that use technologically advanced solutions to advance financial inclusion. In an effort to better understand blockchain technology and investigate its possible uses in the financial industry, regulatory bodies have shown intent for engagement with the industry's stakeholders.

Furthermore, Rwanda has put in place a number of programs to foster an atmosphere that is favourable to blockchain development (Korpela, 2018). These include creating regulatory certainty on the use of blockchain and crypto-currencies technology, encouraging collaborations between the public and private sectors to promote innovation in financial services, and setting up working directory for fin-tech start-ups to test their blockchain-based solutions in an environment that's secure. But despite these initiatives, there are still issues that could prevent blockchain technology from being widely used for financial inclusion. The requirement for more regulatory transparency and safety is one of these issues. Even while Rwanda has made advances in establishing regulations regarding various areas of blockchain technology and cryptocurrencies, there might still be gaps in regulation that allow for doubt or concern and impede certain stakeholders from fully adopting blockchain solutions.

Furthermore, the distributed structure of blockchain technology may not always be succinctly harmonized with the current regulatory system. To maintain adherence and safeguard consumers, certain legal responsibilities, such Know Your Customer (KYC) and Anti-Money Laundering (AML) protocols, might need to be altered to make allowances for the special features of blockchain-based financial services. The widespread use of blockchain technology in Rwanda is further hampered by issues with infrastructure and technological readiness (Distor et al., 2023). Even while the nation has made progress in enhancing its digital amenities more funding for tandem and technological expertise are still required to enable the successful deployment of blockchain solutions for financial inclusion. Although Rwanda has made progress in integrating blockchain technology for financial inclusion, more has to be done to improve infrastructure and technical capabilities, resolve regulatory issues, and harmonize rules with the decentralized nature of the technology. Rwanda can further unleash the blockchain's capacity to promote financial inclusion and give its people access to reasonably priced and effective financial services by tackling these issues.

2.6 Financial Stability and Risk Management

Through the development of the financial services value chain, FinTech is upending established institutions and generating efficiency improvements. The potential for innovation in the financial sector to result in improved services, more accessibility, and increased efficiency is a major factor driving interest in fin-tech. This innovation entails revolutionizing every facet of the provision of fundamental financial sector services, including risk sharing, payment settlement, and facilitation of borrowing & saving, and capital allocation. Furthermore, the infrastructure and market structure that currently support the delivery of these services in the financial market may undergo significant changes as a result of this process (International Monetary Fund, 2019).

As stipulated by Jameaba (2023), the advent of digitalization has facilitated the emergence of flexible and adaptable open banking frameworks that strengthen financial services providers' collaborations. These models have been made possible by advancements in back-end and front-end technologies, a diversified customer base, enhanced customer experience leverage capacity, and the creation and implementation of financial innovations to bolster competitiveness. However, despite all of its advantages, the majority of banks have not yet implemented blockchain technology because of the on-going uncertainty surrounding the technology's adoption, deployment, and daily operations. The lack of understanding of the blockchain technology business case, regulatory uncertainty, fear of risk, and a number of blockchain-based cryptocurrency exchanges and assets' failures have all contributed to the reduction in blockchain technology acceptance. The consequences of Decentralize Ledger Technology from a legal standpoint are essentially unexplored. In reality, it appears more likely that legal issues than ones related to technology, if any, would impede the adoption of blockchain-based solutions in Africa and around the world (Wilhelm, 2019).

In Rwanda, maintaining financial security in an environment of blockchain adoption requires a regulatory framework that strikes an appropriate equilibrium between innovation and risk management (Uña et al., 2023). The regulatory framework has the objective to minimize potential hazards and shortcomings while promoting the advantages of blockchain technology. The method used starts with an in-depth understanding of blockchain technology and its consequences for the financial industry. The regulatory bodies work with stakeholders and industry professionals to evaluate the possible advantages and disadvantages of blockchain adoption. This entails assessing factors including efficiency, transparency, and security. Rwandan regulators have set precise rules and specifications for blockchain-based financial services and products in order to encourage innovation and investment in the field. These rules ensure that blockchain-based enterprises comply with current financial regulations by outlining the procedures for licensing, operating, and supervising them.

The use of blockchain-based financial products and decentralized finance (De-Fi) platforms has increased rapidly in Rwanda and many other countries (Mhlanga, 2023). These recent financial innovations have some possible risks which must be properly controlled. Some of the risks are: lack of technical expertise, cybersecurity vulnerabilities, inconsistent regulations, and potential resistance from widely recognized financial institutions. Because specific regulatory frameworks on blockchain technology are still developing, compliance issues could arise. The huge importance and sensitive nature of financial transactions makes cybersecurity issues like fraud and hacking serious threats. Furthermore, a lack of competent employees may make it more difficult to deploy and maintain blockchain systems. Adoption may also be slowed by opposition from widely recognized financial institutions. Rwanda may invest in cybersecurity measures, provide training programs to develop local expertise, create clear regulatory rules, and encourage cooperation between blockchain innovators and existing financial institutions in order to reduce these risks.

3. Methodology

The desk methodology was used in this investigation. Secondary data collection is the term used to describe a desk study research strategy. Essentially, this is gathering data using already existing resources, ideally with the advantage of being less expensive than field research. Since the data was readily available through online journals and libraries, our current investigation examined previously published studies and publications.

3.1 Methods and Instruments for Data Collection: Desktop Research

Obtaining secondary data for the evaluation of blockchain technology regulation and financial inclusion in Rwanda was the main goal of the desktop research. The majority of the data come from grey literature, which includes published reports, academic databases, government websites, peer-reviewed journal publications, and academic reports. Data extraction sheets are used to collect the data.

.2 Data Collection/Cleaning & Validation

Academic libraries and internet databases both provided access to the data. Requirements for choosing pertinent data include time period, region, and particular variables of interest. In order to prepare the data for analysis or additional processing, the pertinent information is taken out of the sources that have been gathered, cleaned, and formatted. This process entails changing data kinds, standardizing formats, and addressing inaccurate or missing data. The extracted data is put through quality checks to guarantee correctness, consistency, and completeness. This includes profiling the data, comparing against established benchmarks or standards, and doing validation checks.

3.3 Data Analysis (Qualitative data)

Finding, evaluating, and reporting themes or trends in data are done through the qualitative research technique known as thematic analysis. It can help to examine and comprehend the underlying patterns and meanings in textual or visual data. Since theme analysis is adaptable, it can be used with a wide range of data sets, including written or visual data. Thematic analysis makes it simpler to identify, assess, and understand patterns in qualitative data (Castleberry & Nolen, 2018). Additionally, content analysis is utilized to methodically examine the content of the text and make deductions.

4. Results & Discussions

RQ1: How can the existing regulatory frameworks governing financial services are assessed in relation to their potential impact on the integration of blockchain technology?

The result suggests that the existing regulatory structures in Rwanda are not sufficiently flexible to accommodate the novel aspects of blockchain technology. This could point to the necessity of updating or reforming regulations to take into account the special characteristics and difficulties that blockchain presents for the financial industry. Additionally, the widespread adoption of blockchain technology in financial services is impeded by regulatory barriers. To encourage greater industry integration and innovation, regulations need to be updated or simplified.

RQ2: What are the possible challenges that hinder the seamless integration of blockchain technology within the current banking sector?

One of the main obstacles found in the study was regulatory challenges. In Rwanda, for banks wishing to implement blockchain technology, federal regulations regarding data management and financial transactions provide obstacles because adherence to current frameworks and legislation necessitates major changes. The smooth integration of blockchain is further hindered by a lack of urgency and cultural reservations in conventional banking firms. Banks face internal opposition from stakeholders who are unwilling to embrace change or who are unfamiliar with the potential advantages of blockchain technology. Economic and competitive factors were also noted by the study as challenges. Banks are reluctant to invest in blockchain technology due to the initial expenses involved in putting them into practice and the erratic nature of the return on investment. The banking industry's competitive environment, which includes a stronghold of well-established firms and the rise of fin-tech start-ups, also affects banks' inclination to use blockchain technology.

RQ3: Who are the regulatory enablers that could facilitate the successful incorporation of blockchain technology into financial services? What supportive policies and frameworks are identified?

The study reveals a number of regulatory drivers that are essential to the blockchain technology's successful adoption in the financial services industry in Rwanda. Regulatory agencies that are prepared to adapt or build novel structures in order to incorporate blockchain developments are among these enablers. Furthermore, regulations that promote innovation and assure security in the financial industry were recognized as beneficial. These policies cover issues including know-your-customer (KYC) requirements designed especially for blockchain applications, data protection, and anti-money laundering (AML) legislation. The adoption of blockchain technology is aided by frameworks that are intended to foster partnership, openness, and compatibility among all parties involved in the financial system. In summary, the results offer valuable perspectives on the regulatory environment required for the effective integration of blockchain technology in the financial services industry. They highlight the principal players, laws, and structures that are essential to the deployment and expansion of this technology.

RQ4: What are the perceptions and attitudes of key stakeholders, such as regulators, financial institutions, and users, in relation to the integration of blockchain technology in financial services?

Regulators are somewhat confident about blockchain's potential for security and transparency, but they are also raising fears about regulatory compliance, particularly with regard to know your customer (KYC) and anti-money laundering (AML) standards. They stress that in order to properly manage risks; there must be defined guidelines and control. There is variation among the attitudes of financial institutions. Blockchain is perceived by some as a disruptive force that could threaten established banking structures, but it is also seen by others as a chance for innovation and cost savings through expedited procedures like smart contracts and cross-border payments. Depending on the advantages that are viewed and the willingness to engage in staff training and infrastructure, adoption may differ. Users display a combination of negativity and interest, including both consumers and enterprises. While some people are excited about blockchain-based financial services because they believe they will improve efficiency, save costs, and increase security, others are apprehensive because they worry about privacy, volatility, and the learning curve that comes with using new technologies. Trust in the organizations using the technology and in the technology itself may have a big impact on user sentiments.

RQ5: How does blockchain technology regulation affect financial inclusion in Rwanda?

Financial inclusion in Rwanda is impacted greatly by the regulatory framework surrounding blockchain technology. Strict laws may inhibit creativity and prevent blockchain solutions from being widely used. On the other hand, inclusive and well-balanced regulatory frameworks create a favourable atmosphere for financial services based on blockchain technology. According to our analysis, Rwanda's proactive approach to blockchain regulation has aided in the integration of decentralized financial systems, improving the unbanked population's access to banking services.

Also, the first hypothesis that current regulatory frameworks pose significant challenges to the integration of blockchain technology in financial services in Rwanda is accepted. The second hypothesis that adapting and updating regulatory frameworks will facilitate the successful integration of blockchain technology in financial services is also accepted; lastly, the third hypothesis that standardizing international regulatory standards will enhance the global integration of blockchain technology in financial services is also accepted. All four hypotheses are accepted.

5. Recommendations

- Establishment of an extensive policy structure suited to the application of blockchain technology in the financial industry in conjunction with regulatory agencies and other stakeholders. Regulation compliance, consumer protection, and innovation should all be balanced within this framework.
- Encourage the creation of precise and explicit rules governing blockchain technology and the financial services industry. Adoption is hampered by uncertainty; therefore removing it will promote investment and innovation in the industry.
- Initiate educational programs to raise public, policymaker, and financial institution understanding of the advantages and possible hazards of blockchain technology. This will help people comprehend the limitations and possibilities of the technology.
- Promote cooperation amongst regulators, financial institutions, tech companies, and other interested parties to jointly develop solutions that tackle regulatory issues and take advantage of blockchain's revolutionary potential for financial inclusion.
- Encourage the creation of standards for interoperability so that various financial systems and blockchain platforms can interact and transact with one another without difficulty. Standardization will encourage scalability and compatibility, which will encourage wider usage.
- Put strong data privacy and security measures in place first in order to safeguard customer information and reduce the possibility of fraud or data breaches related to blockchain technology. It is imperative to prioritize adherence to global best practices.
- Make ensuring that regulatory frameworks are accessible and meet the requirements of those who are marginalized, such as those living in remote areas and those with little access to conventional financial services. These populations shouldn't unintentionally be denied access to blockchain-based solutions because of regulations.
- To stay up with changing market dynamics and technology breakthroughs, create procedures for routinely reviewing and modifying current regulations. Encouraging innovation without sacrificing regulatory supervision requires regulatory frameworks to be agile and flexible.
- Utilizing global best practices in blockchain regulation for financial inclusion through international cooperation and knowledge-sharing projects. Rwandan regulatory strategies can be developed with the use of lessons learned from other regimes.

6. Conclusion

In summary, the study revealed the complex relationship between current laws and the application of blockchain technology to improve financial inclusion in Rwanda. After a thorough research, the study identified the barriers and facilitators that these restrictions present to the development and use of blockchain technology in the financial industry. Our findings highlight how important regulatory frameworks are in determining how blockchain innovation is shaped in the nation. Although certain policies have created a favourable atmosphere for experimentation and development, others have posed significant obstacles, varying from unclear compliance requirements to explicit prohibitions on specific blockchain applications. It is clear that blockchain technology has enormous potential to transform financial services and promote equitable economic growth in Rwanda, even in the face of obstacles from current rules. Therefore, it is imperative that regulators and legislators have continuous conversations with industry players in order to develop a cooperative strategy for improving regulatory frameworks that strike a balance between encouraging innovations and protecting the interests of consumers.

Additionally, the study highlights the significance of taking preventative measures to improve clarity regarding regulations and create a supportive atmosphere for blockchain adoption. To resolve issues and accelerate compliance procedures, this includes programs like regulatory sandboxes, focused capacity-building projects, and stakeholder meetings. Rwanda must now keep up its efforts to create an environment that is favourable to blockchain innovation in order to take advantage of the technology's revolutionary potential to promote sustainable development and financial inclusion objectives. Rwanda can lead the way in blockchain adoption in the area and create new avenues for inclusive growth and economic empowerment for all of its population by adopting a progressive regulatory strategy.

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Climate Related Risks and Green Finance: The Case of Rwanda

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Abstract

In the contemporary era of technological advancement, the global economy faces three significant challenges: environmental change, energy constraints, and financial crises. The reason behind this is that economic progress brings about costs to nations in the form of environmental degradation. A potential solution for achieving harmony between the economy and nature is green finance. Green finance is regarded as financial support for environmentally sustainable development, aiming to significantly reduce greenhouse gas emissions and air pollution. It is crucial to enhance green finance in various sectors such as agriculture, green buildings, environmental protection, and other sustainable initiatives for combating climate related risks and thereby attain economic development of the country. This paper seeks to examine the role of green finance in addressing climate risks, assessing the current state of climate risks in Rwanda, analyzing the challenges and opportunities for banks in implementation of green finance as well as well as draw inferences that are relevant to policies for enhancing the effectiveness of green finance in combating climate risks.

Keywords: *Environment; Green finance; Climate Risks; Green investments; Renewable energy*

1. Introduction

Green financing is increasingly becoming essential in business risks management. All nations, whether developed or developing, strive to embrace green financing as one of the mitigation measures. Green finance is a broad concept. It embodies the provision of finance in a manner that supports investments that is climate friendly. Such investments are underpinned by regulatory measures such as support financial market participants play a role in research and development for creating pollution treatment facilities, ecological protection and restoration, as well as promoting the utilization of non-fossil energy.

It is projected that global green financing in green infrastructure will reach USD40 trillion between 2012 and 2030. That speaks to the fact that green financial products and services are increasingly becoming integral in fostering sustainable relationships, given the inherent connection between the business sector and the environment. In light of the intensifying threat of climate change, there is need to evaluate the effectiveness of green finance initiatives in mitigating climate-related risks, particularly in regions vulnerable to its adverse effects. Despite increasing recognition of the importance of green finance, the extent of its impact on combatting climate-related risks in Rwanda remains unclear. (UN-Habitat, 2023)

Based on the foregoing, this paper seeks to assess the effectiveness of green finance mechanisms in addressing climate change challenges and enhancing resilience in Rwanda. We delve into the intricacies of green financing, highlighting its importance in the context of the environmental impact of business operations. In so doing, we highlight the challenges and opportunities for banks in implementation of green finance as well as draw inferences that are relevant to policies for enhancing the effectiveness of green finance in combatting climate risks.

The approach of this paper is to undertake a comprehensive assessment of literature alongside a critical the examination of observed trends in the context of Rwanda that infuses qualitative expert interviews. The exploratory approach that we take acknowledges that not many studies specific to Rwanda's Green finance market have been undertaken. We anticipate that this will open the ground for further deeper exploration of the subject.

The rest of the paper is organized as follows. Section 2.0 provides a background that supports the understanding of climate related risks and green finance in a general context as well as how that relates to the situation in Rwanda. This is flowed in Section 3.0 by literature overview with a leaning on the connection between climate risks, green economy and green finance. Sectio 4.0 outlines the green growth landscape in Rwanda and zooms in on the aspect of green finance upon which conclusions and inferences are drawn in Section 5.0.

2. Contextual Background

Climate change presents significant risks to businesses. Until recently, the financial impacts of climate change were not widely considered by business leaders. That view has evolved, and many business leaders are now mainstreaming it. Climate risk is the exposure to damage or loss due to climate change. It presents threats to business operations and bottom lines through both physical risks and transition risks.

Understanding climate risk and its impact on businesses is crucial for making informed decisions and taking steps to mitigate potential consequences. By recognizing the challenges climate risk presents and taking proactive measures, businesses can ensure they are prepared to respond to the current and expected increased costs of climate change to their business (Radicle,2023). Businesses that embrace climate risk management will likely have a greater opportunity to achieve long-term success and resilience.

The threat of climate risk for businesses is multi-faceted and impacts many aspects of operations. Physical risks are the most obvious, presenting direct impacts of climate change on businesses and their assets, such as flooding and wildfires. Transition risks are a newer type of climate risk but are becoming increasingly important as the world shifts towards a low-carbon economy. These risks arise from policy changes, technological advancements, and shifts in market preferences that can impact the value of certain assets or business models. Transition risks are a vital consideration for businesses looking to remain competitive in a changing world. Liquidity risks involve legal and reputational consequences for entities that contribute to climate change or fail to adequately address it.

The world is currently confronting an unparalleled climate crisis, with profound implications for both the environment and economies. The higher carbon dioxide (CO2) emissions from developed countries have led to climate risks that disproportionately affect developing nations. The failure of developed nations to meet developing countries' expectations regarding climate finance further compounds this imbalance. An important question arises: why do countries with lower greenhouse gas (GHG) emissions bear the greatest burdens of climate challenges?

The International Energy Agency (IEA) highlights that the carbon emissions of China, the United States and India account for 85% of the world's total. This situation sparks debates about the injustice of carbon emissions and economic development. For example, although Bangladesh's global GHG emissions are less than 0.35%, it is considered the most vulnerable country to climate risks, with estimates suggesting potential losses of 2% and 9.4% of its gross domestic product (GDP) by 2050 and 2100 due to climate risks, as indicated by the global climate risk index published annually by German Watch, a Germany-based international organization. (IPCC, 2018.)

2.1. Concept of Green Finance

Green finance broadly involves the mobilization and utilization of funds from diverse sources to enhance the natural environment and mitigate the impacts of climate change-induced disasters, whether natural or human-made. The United Nations Framework Convention on Climate Change (UNFCCC) defines green finance as financial support—coming from public, private, and alternative sources—aimed at backing actions for both mitigation and adaptation to address climate change challenges. It stands as a crucial objective within the realm of sustainable development.

The financial sector assumes a pivotal role in the battle against climate change by supporting initiatives that reduce climate-related risks and alleviate the repercussions of adverse climate events. Institutional investors with a long-term perspective can contribute to the rebalancing and redistribution of risks associated with climate change, thereby upholding financial stability. Various financial instruments, such as catastrophe bonds and indexed insurance, serve as hedging mechanisms against the escalating risk of natural disasters. Additionally, instruments like green stock indices, green bonds, and voluntary de-carbonization initiatives play a role in redirecting investments towards environmentally friendly sectors.

From a regulatory standpoint, central banks and other oversight bodies are adapting their frameworks and practices to address the intricate risks posed by climate change. This adaptation involves enhancing climate risk disclosure and classification standards, empowering financial institutions and investors to better evaluate their climate-related exposures. Simultaneously, it aids regulators in comprehensively assessing systemic risks within the financial system.

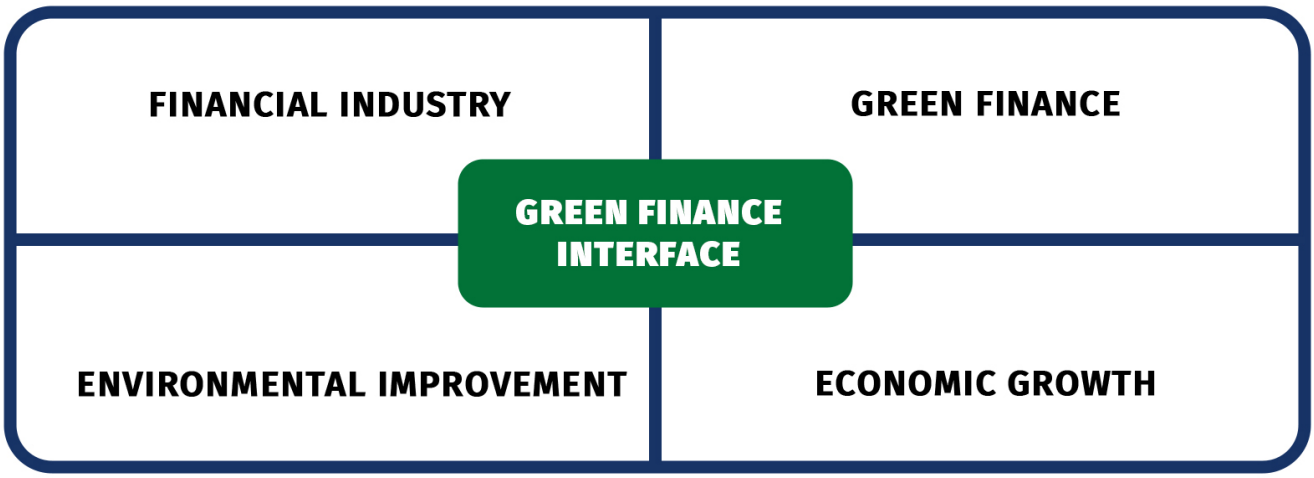
Since 1990s natural contemplations have begun to assume a greater part in the field of venture fund, affecting and molding the hierarchical schedules representing loaning choices. Green fund covers the change of the regions of natural corruption, for example, air contamination, water contamination and shortage, encroachment of streams, uncalled for transfer of mechanical, medicinal and family waste, deforestation, and loss of open space and loss of biodiversity. It must be eco-accommodating and can add to destitution easing. It is a key way to deal with fuse the monetary part in the change procedure towards low-carbon and asset proficient economies, and with regards to adjustment to environmental change. (Chaudhary and Bhattacharya 2006).

Green finance can be categorized into three main types: the framework of green, financing, financial support for industries or firms, and financial markets. Concerning climate change, green financing encompasses both mitigation and adaptation projects. Many private investors often perceive the risks associated with environmentally sustainable initiatives as not justified by the expected returns. Public financing mechanisms can potentially tip the balance in favor of perceived profitability by offering soft loans or guaranteeing credits from private banks, for example. Public funding plays a crucial role in stimulating private investment. As noted by the United Nations Economic and Social Commission for Asia and the Pacific, it can contribute to Financing an Inclusive and Green Future (Hee, 2010).

A basic but important question is: how does green finance work? Green enterprises and innovations are currently in different stages of advancement, thus necessitating varying levels of funding from diverse capital sources. Generally, there are three primary sources: domestic public finance, global public finance, and private sector finance. Domestic public finance refers to direct funding by a government, while global public finance involves funding from international organizations and multilateral development banks. Private sector finance encompasses both local and global financing sources. Green financing can be structured in various ways using different investment frame work.

Green finance plays a pivotal role in low-carbon, environmentally friendly development as it serves as the nexus between the financial sector, climate change, and economic growth (Figure 1). The transition to a green industry often encounters a gap between knowledge and action, with the missing link being "green finance." Many proposals for green industries require financial investment, and numerous business models in the green sector are untested or uncertain. Consequently, traditional finance may find it challenging or economically unattractive to support these unproven or unconventional green industrial proposals (Gao, 2009)

Figure 1: The Green Finance Interface



Source: Compiled by author

The figure illustrates a symbiotic relationship between the financial industry, green finance, environmental improvement, and economic growth.

Positioned on the left side, highlights the traditional financial sector's role in impacting the environment.

On the right side, emphasizes the emergence of sustainable financial practices and their potential to drive economic development.

At the center lies the "Green Finance Interface," symbolizing the integration of green finance principles into traditional financial systems, which serves as a bridge between financial activities and environmental sustainability goals.

The product package by the private sector can be broadly summarized below.

Table 1: Green Finance Products

Retail Finance	GREEN FINANCE	Corporate /Investment Finance
• Green Mortgage • Green Home Equity Loan • Green Commercial Building Loan • Green Car Loan, Credit Card		• Green Project Finance • Green Securitization • Green Venture Capital & Private Equity • Technology Leasing • Carbon Finance
Asset Management		**Insurance**
• Fiscal Fund (Treasury Fund) • Eco Fund, Carbon Fund • Cat Bond (Natural Disaster Bond) • Eco ETF		• Auto Insurance • Carbon Insurance • Catastrophe Insurance • Green Insurance

Source: Compiled by author

2.1.1. Green Finance Assets and Liability Products for Banks

Green Finance Liability Products

According to UNEPFI 2019, Green liability products on the liability side of a bank's balance sheet refer to financial instruments and services that banks offer, which are specifically designed to support environmentally sustainable projects and initiatives. These products are part of green finance, aiming to mobilize capital for projects that have positive environmental impacts. Here are some key green liability products commonly associated with green finance:

Green Bonds

These are debt securities issued by banks to finance projects that have environmental benefits, such as renewable energy, energy efficiency, sustainable agriculture, and pollution prevention for-example a bank might issue a green bond to raise funds specifically for lending to solar or wind energy projects.

Green Deposits

These are deposit products where the funds are exclusively used to finance green projects. Customers deposit their money with the assurance that it will support sustainable initiatives for-example: An individual or corporate customer deposits funds into a green savings account, and the bank uses these deposits to finance renewable energy projects.

Green Savings Accounts and Certificates of Deposit (CDs):

These products allow customers to save money while ensuring their deposits are used to support green projects. For-example a green CD might offer a fixed return to the depositor, with the bank using the funds to finance environmentally friendly projects.

Sustainability-Linked Bonds

These bonds are issued with terms linked to the issuer's sustainability performance targets. If the bank meets or exceeds specific environmental goals, the bond terms may include financial incentives or penalties. The bank has a liability to repay the bondholders, with the added condition of performance-based adjustments for-example a bank issues a sustainability-linked bond with a lower interest rate if it achieves a certain reduction in its carbon footprint.

Green asset products:

According to UNEPFI 2019, Green finance asset products for banks encompass various financial instruments and services tailored to support environmentally sustainable projects and initiatives. Banks can offer various green finance asset products to promote and fund environmentally friendly projects. Some of the key examples of green assets for banks are highlighted below:

Green Bonds

Debt securities issued to finance projects that have positive environmental benefits. These projects can include renewable energy, energy efficiency, clean transportation, sustainable water management, and more.

Green Loans

Loans specifically designed to support projects that improve environmental sustainability.

Sustainable Investment Funds

Investment funds that focus on companies or projects with strong environmental, social, and governance (ESG) practices.

Energy Efficiency Financing

Loans or leases provided for projects that enhance energy efficiency in buildings, manufacturing processes, and other areas.

Renewable Energy Financing

Financial products aimed at supporting the development and deployment of renewable energy sources like solar, wind, and hydroelectric power.

Green Mortgages

Mortgages that offer better terms for homes meeting certain environmental standards, such as energy efficiency or sustainable building certifications (e.g., LEED).

Green Asset-Backed Securities (ABS)

Securities backed by pools of green assets, such as loans for electric vehicles or energy-efficient equipment.

Climate Bonds

A type of green bond specifically aimed at raising funds for projects that mitigate or adapt to climate change.

Sustainability-Linked Loans (SLLs)

Loans with terms that vary based on the borrower's achievement of predefined sustainability performance targets.

Green Equity Investments

Direct investments in companies that operate sustainably or are involved in green projects.

Green Project Finance

Long-term financing for large-scale green infrastructure projects, such as renewable energy plants or sustainable urban development.

2.1.2. Public and private Green Finance

According to green finance institute (HIVE) 2022, Green finance, which refers to financing investments that provide environmental benefits, and that this involves both public and private sectors. The roles and contributions of both private and public sector in combating climate change are highlighted below:

Public Green Finance

1. Government Bonds and Grants

Green Bonds: Governments issue green bonds to finance projects that contribute to environmental sustainability, such as renewable energy projects, energy efficiency programs, and climate resilience infrastructure.

Subsidies and Grants: Governments provide financial assistance and subsidies to encourage investments in green technologies and infrastructure.

2. Policy and Regulation

Regulatory Frameworks: Governments create regulations and standards that mandate or encourage sustainable practices. These include carbon pricing, emissions trading systems, and renewable energy mandates.

Incentives: Tax incentives, rebates, and other financial incentives are offered to businesses and individuals to adopt green technologies and practices.

3. Public Investment Funds

Sovereign Wealth Funds: Some countries use their sovereign wealth funds to invest in green projects, focusing on long-term sustainable returns.

Development Banks: Institutions like the World Bank and regional development banks fund large-scale green projects, particularly in developing countries.

4. Research and Development

Governments fund research and development (R&D) to foster innovation in green technologies, ensuring the development of more efficient and cost-effective solutions.

Private Green Finance

Private Equity and Venture Capital

Investment in Green Startups: Private equity and venture capital firms invest in early-stage companies developing innovative green technologies, such as clean energy, sustainable agriculture, and waste management solutions.

Impact Investing: Investors focus on projects and companies that deliver measurable environmental benefits alongside financial returns.

Green Bonds and Loans

Corporate Green Bonds: Corporations issue green bonds to raise capital specifically for environmental projects. These bonds attract investors who are committed to sustainability.

Green Loans: Banks and financial institutions offer loans with favorable terms for projects that have positive environmental impacts.

Sustainable Asset Management

ESG Investing: Asset managers incorporate Environmental, Social, and Governance (ESG) criteria into their investment decisions, directing capital towards sustainable companies and projects.

Green Funds: Mutual funds and ETFs (Exchange-Traded Funds) focused on sustainability and green investments attract individual and institutional investors.

Corporate Social Responsibility (CSR):

Sustainability Initiatives: Companies integrate sustainability into their business strategies, investing in energy-efficient practices, waste reduction, and sustainable supply chains.

Reporting and Transparency: Businesses enhance transparency by reporting on their environmental impact and sustainability efforts, which can attract more investment.

Collaboration Between Public and Private Sectors

1. Public-Private Partnerships (PPPs):

Joint Ventures: Governments and private companies collaborate on large-scale green projects, sharing risks and benefits. Examples include infrastructure projects like renewable energy installations and public transportation systems.

Blended Finance: Combining public and private funds to de-risk investments in green projects, making them more attractive to private investors.

2. Innovation and Scaling

R&D Partnerships: Collaborative efforts in research and innovation, supported by both public funding and private investment, accelerate the development and deployment of green technologies.

Scaling Solutions: Successful pilot projects funded by the public sector can be scaled up with private sector investment, ensuring wider adoption and impact.

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2.1.3. Green washing Concept

According to UN 2022, Greenwashing presents a significant obstacle to tackling climate change. By misleading the public to believe that a company or other entity is doing more to protect the environment than it is, greenwashing promotes false solutions to the climate crisis that distract from and delay concrete and credible action.

Greenwashing manifests itself in several ways – some more obvious than others. Tactics include:

- Claiming to be on track to reduce a company's polluting emissions to net zero when no credible plan is actually in place.
- Being purposely vague or non-specific about a company's operations or materials used.
- Applying intentionally misleading labels such as "green" or "eco-friendly," which do not have standard definitions and can be easily misinterpreted.
- Implying that a minor improvement has a major impact or promoting a product that meets the minimum regulatory requirements as if it is significantly better than the standard.
- Emphasizing a single environmental attribute while ignoring other impacts.
- Claiming to avoid illegal or non-standard practices that are irrelevant to a product.
- Communicating the sustainability attributes of a product in isolation of brand activities (and vice versa) – e.g. a garment made from recycled materials that is produced in a high-emitting factory that pollutes the air and nearby waterways.

Since the adoption of the Paris Agreement in 2015, an increasing number of companies have pledged to reduce their greenhouse gas emissions to net zero - a level where any remaining emissions would be absorbed by forests, the ocean or other "carbon sinks." However, those claims are often based on questionable plans, including emissions offsetting and "insetting" – rather than actual emission cuts. As such, the transparency and integrity of such claims remain critically low and risk creating a failure to deliver urgent climate action.

To limit climate change and preserve a livable planet, emissions need to be cut nearly in half by 2030 and reduced to net zero by 2050. Every fraction of a degree of warming matters and, as put by the former chair of the High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities, "the planet cannot afford delays, excuses, or more greenwashing".

Greenwashing undermines credible efforts to reduce emissions and address the climate crisis. Through deceptive marketing and false claims of sustainability, greenwashing misleads consumers, investors, and the public, hampering the trust, ambition, and action needed to bring about global change and secure a sustainable planet.

Combating Greenwashing

Transparency: Companies should provide clear, specific, and verifiable information about the environmental benefits of their products and practices.

Third-Party Certifications: Using reputable third-party certifications and standards can help validate claims and build consumer trust.

Holistic Approach: Ensuring that sustainability claims are part of a comprehensive, company-wide commitment to environmental responsibility, rather than isolated actions or marketing gimmicks.

2.2. Africa's climate financing and green growth needs

Africa requires approximately USD242.4 billion annually from 2020 to 2030 to fulfill its Nationally Determined Contributions (NDCs) and a minimum of USD1.3 trillion annually to address sustainable development needs, thereby achieving green growth objectives. Based on the latest NDC submissions as of April 2023, the African Development Bank estimates that Africa's total financing requirements to effectively combat climate change amount to roughly USD 2.7 trillion over the period 2020-2030, with a range between USD2.6 trillion and USD2.8 trillion. Annually, this translates to an average of USD242.4 billion, with a lower bound of USD234.5 billion and an upper bound of USD250 billion.

Climate finance in Africa is predominantly sourced from public finance, which exceeds private finance by a factor of six. Climate action financing in Africa reached an average of $29.5 billion in 2019/2020, constituting 4.5 percent of the global climate finance total of $652.6 billion.

The transition to green growth and the implementation of desired climate actions necessitates readiness and adequate financial resources. An assessment of green growth readiness conducted by the African Development Bank and the Global Green Growth Institute (GGGI) across seven African countries—Gabon, Kenya, Morocco, Mozambique, Rwanda, Senegal, and Tunisia—revealed a high level of political commitment to green growth, primarily supported by climate and green growth policies and strategies. However, in several other countries, evidence indicates limited alignment between climate and green growth strategies and sectoral policies, along with incomplete implementation plans, technical capacity and financing gaps, and weak regulations hindering green growth readiness in some nations. The combined macroeconomic impacts of climate change could potentially reduce Africa's GDP by up to 3% by 2050, according to the (OECD,2022).

3. Review of Literature

Emergent literature points to the potential of commercial funding attuning itself to green principles. Heim and Zenklusen (2005) highlights the notion that investors in the stock market have become environmentally conscious and tend to avoid industries that do not adhere to pollution norms. The ability to accurately determine and account for environment related issues is however in question. Wagner and Schaltegger (2006) points to the unresolved issue of the necessity for universally accepted and applicable accounting and reporting standards with indicators for any industry, contending that that social and environmental reporting and accounting should be developed and implemented concurrently.

Weber, Fenchel, and Scholz (2008), based on a survey of UNEP banks and non-UNEP banks, reports that the analysis of environmental risks was integrated only during the due diligence phase at loan application, not throughout the entire life of the loan, especially the monitoring phase. The report indicates that banks lack a complete understanding of the impact of environmental risks on their loan portfolios. Verma et al. (2012) emphasizes that there are obstacles impeding the growth of green financial products.

Green products have not positioned themselves as economically viable options, as many lower-cost alternatives exist in the market. Unlike Europe, where the market for green financial products and services is growing substantially, the global market is in its early stages, lacking clear boundaries and unified characteristics distinguishing it from traditional industries. Financial institutions, particularly banks, play a crucial role in contributing to the creation of a strong and successful low-carbon economy. They should expand the use of environmental information in credit extension and investment decisions, proactively improving their environmental performance and creating long-term value for their business. In the future, businesses with higher carbon footprints may be viewed as riskier, leading banks to favor financing new technology solutions that capture or reduce carbon emissions Höhne et al. (2012).

An empirical study by Jha & Bhome (2013) on steps taken to adopt green banking, assessing the awareness of bank employees, associates, and the general public on green banking issues through primary data collection from 12 bank managers, 50 bank employees, and 50 general customers affirms the potential of green finance by way of the increasing product menu. The research finds that found that online banking, green loans, power-saving equipment, green credit cards, the use of solar and wind energy, and mobile banking were widely adopted banking strategies. Khandewal (2013) suggests tips for green banking, including online banking, waste management, maintaining a clean and hygienic environment, green banking in rural branches, green credit cards, and green loans. Goel (2016) concludes that India has great potential to create the green infrastructure needed for green finance by overcoming barriers and creating awareness among corporate citizens.

IFC (2016) analysis shows that various actors have made significant efforts to gain traction in incentivizing and measuring green finance, demonstrating that it is possible to estimate green finance flows through private financial institutions. Nevertheless, the text also underscores the need for additional efforts to enhance the accountability and visibility of green finance. The bond market stands out with advanced definitions and tracking, serving as a potential model for other sectors.

In banking, IFC (2016) call for refining existing tracking processes for loans, while institutional investors are urged to develop transparent decision-making approaches, transitioning from awareness to practical implementation. A comprehensive understanding of the current state of green finance is crucial for a thorough analysis against policy targets. It can also provide insights for multinational organizations, national governments, regulators, the private financial sector, and data providers and standard setters. China's regulation requiring banks to regularly disclose their green loan data sets an example that other countries contemplating similar regulations could learn from, drawing on both China's policy implementation and insights derived from the collected data.

The outlined next steps offer specific action points for each stakeholder group to enhance tracking and shape the future of green finance by leveraging existing sources of information. Wang and Zhi (2016) conducted a study in Beijing, concluding that green finance represents an innovative financial model aimed at environmental protection and achieving sustainable resource utilization. They argue that, if the market mechanism of green finance is rational, it can guide fund flows, effectively manage environmental risks, and optimize the allocation of environmental and social resources. Effective policy regulation, according to the study, can prevent information asymmetry and address moral hazards.

Based on the available literature on green finance, it is evident that a significant portion of green investment is increasingly being funded through banks. By integrating environmental considerations into their decision-making processes, banks can better handle the risks associated with lending to polluting sectors and contribute to strengthening the financial system's resilience. The Rwandan banking sector stands to play a crucial role in directing the necessary resources for financing the green transformation. However, existing studies suggest that green finance is scarcely prevalent in India. Beyond theoretical considerations, there is limited empirical evidence explaining this underperformance, and there is a lack of comprehensive knowledge about the concept of green finance, green finance products, and their mechanisms.

3.1. Climate Change Mitigation and adaptation

According to IPCC 2022, Mitigation involves efforts to reduce or prevent the emission of greenhouse gases (GHGs) into the atmosphere. The aim is to limit the magnitude and rate of long-term climate change, Adaptation refers to the process of adjusting to actual or expected climate change and its effects. The goal is to reduce vulnerability and enhance resilience to the impacts of climate change.

Table 2: Comparison between Adaptation and Mitigation to climate change

Aspect	Adaptation	Mitigation
Objective	Minimize harm from climate impacts	Reduce GHG emissions to slow climate change
Focus	Managing current and future climate risks	Addressing root causes by cutting emissions
Temporal Scope	Short to medium term	Long term
Examples	Building flood defenses, developing drought-resistant crops	Installing solar panels, promoting electric vehicles
Implementation	Often local/regional	Requires global/national coordination
Benefits	Immediate relief, tailored solutions	Long-term stabilization of climate, multiple co-benefits
Challenges	Resource-intensive, sometimes temporary	High initial costs, requires sustained effort

Source: (IPCC, 2022)

Examples of mitigation and adaptation to climate change

IPCC, 2022 highlights the following to be Mitigation examples:

Energy: Transitioning to renewable energy sources like wind, solar, and hydroelectric power to reduce reliance on fossil fuels.

Transportation: Promoting electric vehicles and public transportation to decrease emissions from cars and trucks.

Forestry: Implementing reforestation and afforestation projects to absorb CO2 from the atmosphere.

Industry: Improving energy efficiency and adopting cleaner technologies in manufacturing processes.

IPCC, 2022 highlights the following to be Adaptation examples:

Infrastructure: Building sea walls and flood defenses to protect against rising sea levels and storm surges.

Agriculture: Developing and planting drought-resistant crop varieties to cope with changing precipitation patterns.

Urban Planning: Designing cities with improved drainage systems to handle increased rainfall and prevent flooding.

Public Health: Enhancing healthcare systems to deal with heatwaves and the spread of climate-sensitive diseases like malaria and dengue.

4. Rwanda's green growth and green finance landscape

Rwanda's Vision 2050 articulates the bold long-term ambition of "the Rwanda we want" to be upper middle-income by 2035 and a high-income country by 2050, thereby transforming the economy and modernizing the lives of all Rwandans. Rwanda's Vision 2050 aims at transforming Rwanda into an upper-middle-income by 2035 and a high-income country by 2050 with a carbon-neutral and climate-resilient economy to serve to transform and modernize the economy that aligns with several international treaties committing the country to an ambitious green growth and climate resilient development path. The Vision 2050 and vision for the Green Growth and Climate Resilience Strategy (GGCRS) anchors the economy to be a developed, climate resilient, and carbon neutral economy by 2050.

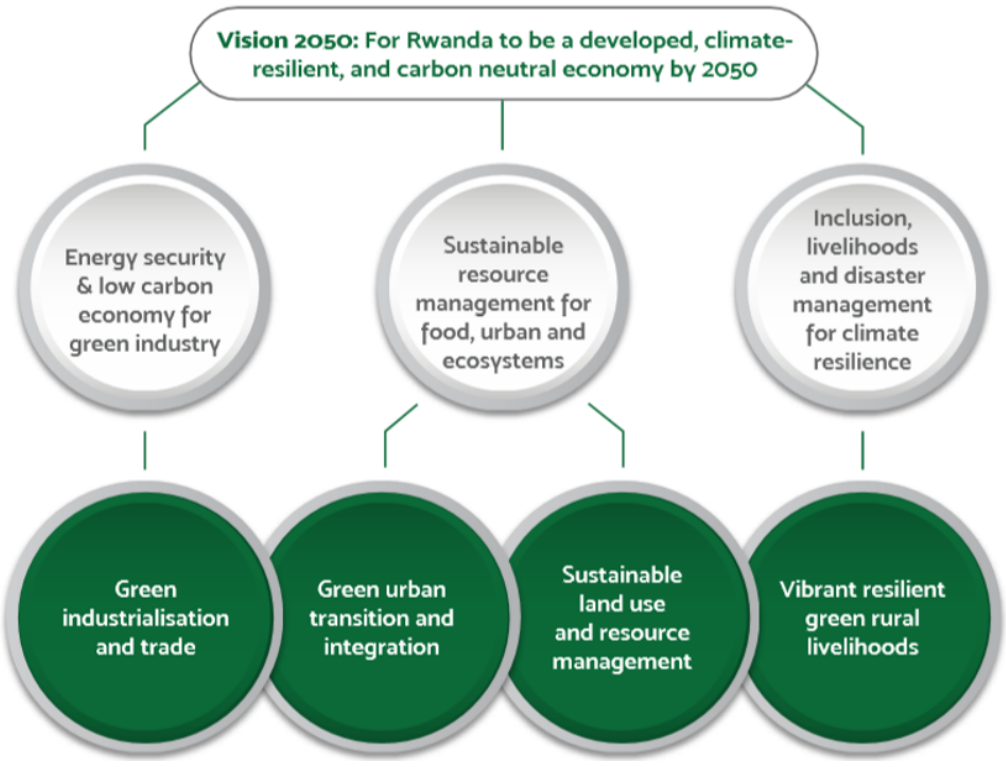
The GGCRS has three Strategic Objectives:

- To achieve Energy Security and Low Carbon Energy Supply that supports the development of Green Industry and Services and avoids deforestation.
- To achieve Sustainable Land Use and Water Resource Management that results in Food Security, appropriate Urban Development and preservation of Biodiversity and Ecosystem Services.
- To ensure Social Protection, Improved Health and Disaster Risk Reduction that reduces vulnerability to climate change impacts.

Together these objectives relate to the elements upon which Vision 2050 are built, namely the infrastructure and systems that enable low-carbon growth and sustainable resource use, the natural capital and associated spatial development that ensure sustainable development, and the human capital development and economic inclusion that will build the resilience of the Rwandan people.

The strategic Framework for Rwanda's Green Growth and Climate Resilience Strategy is encapsulated by Figure 2.

Figure 2: Strategic Framework for Rwanda's Green Growth and Climate Resilience Strategy

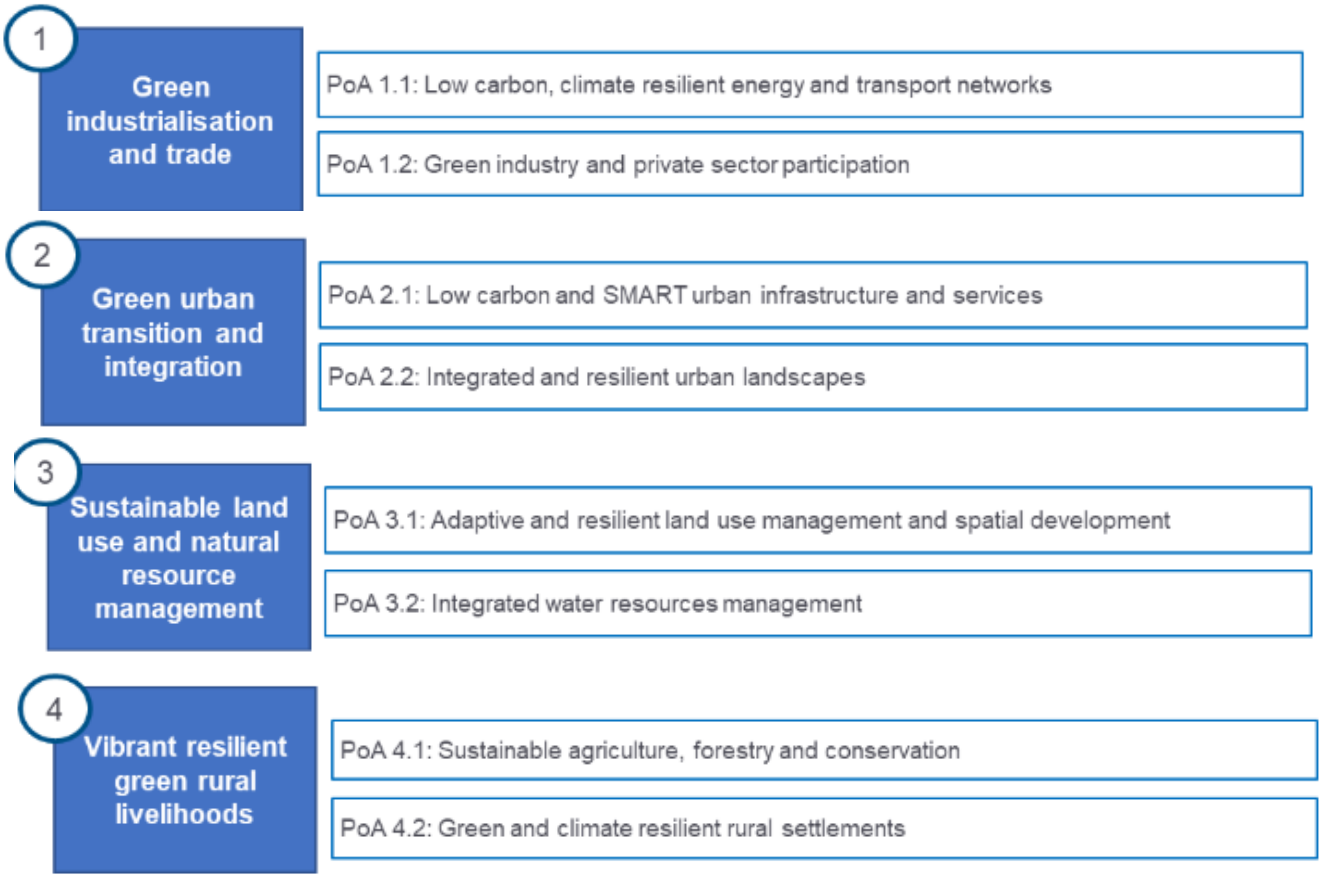


Source: (GGCRS, 2021)

To achieve a climate resilient and green economic future, the GGCRS is built around four Thematic Programme Areas, with each being focused on two Programmes of Action (PoAs) which have been designed to address the most important areas of work required to deliver strategic intent toward the GGCRS objectives and cover a balanced focus between mitigation, adaptation, and green growth:

The four Thematic Programme Areas include: Green industrialization and trade, green carbon transition and integration. Sustainable land use and resource management and vibrant resilient green rural livelihoods.

Programmes of Action (PoAs) for each thematic programme Areas



Rwanda has long been a leader in environmental initiatives within the region. The country took early measures such as banning plastic bags in 2008 and becoming the first African nation to ban single-use plastics in 2019. Despite these efforts, achieving its national plan to reduce emissions by 38% and cut up to 4.6 million tons of carbon dioxide by the end of the decade requires USD11 billion. To drive green growth, Rwanda established FONERWA, the largest green fund in Africa. However, the country heavily relies on foreign aid, with external grants and loans making up 40% to 60% of annual development budgets, posing challenges for the conservation and management of natural resources.

The 2017 Rwanda Green Investment Baseline Study predicts a 20.9% increase in green growth by 2030, with significant investments expected in energy, transport, agriculture, and forest plantations. As a rapidly growing nation undergoing urbanization and economic structural changes, Rwanda is vulnerable to climate change effects, experiencing extremes of flooding and drought that impact agriculture and infrastructure. Climate-related disasters in 2018 cost Rwanda over USD200 million in damages, and the costs have continued to rise since then. (Republic of Rwanda, 2020). In 2011, Rwanda developed its Green Growth and Climate Resilience Strategy to guide the country's response to climate change. The strategy has positioned Rwanda to play its part in the global response and, as a result, the country hosted the 28th Meeting of the Parties to the Montreal Protocol at which the Kigali Amendment was agreed. (Rwanda's updated NDC, 2020)

Rwanda's firm commitment to climate action can be seen in this revised NDC, which increases ambition in all components. It is particularly focused on transparency, clarity and the monitoring of the goals we have set for ourselves. The report demonstrates Rwanda's progress and commitment to identifying targets for reducing emissions across sectors through inter-ministerial cooperation, working with sub-national entities, mobilizing domestic resources, and support from bilateral and multilateral donors. This document, therefore, is a testament to the spirit of community that is needed to address climate change.

4.1. Sector wise Climate Change Vulnerability and Risk for Rwanda

While the enablers of climate finance are still finding their footing, the financial industry grapples with limited knowledge and information architecture regarding climate change. The emerging frameworks and contextualized approaches, coupled with the sector's immaturity in embracing green finance, create knowledge gaps among financial institutions. Nonetheless, these players are beginning to acknowledge the threats posed by climate change to their businesses and the growing emergence of climate-related risks. Recognizing the need to respond to climate risks and capitalize on related opportunities, financial institutions are yearning for a paradigm shift.

According to (GGCRS, 2021), Climate change poses a threat to all sectors of the Rwandan economy, and efforts towards preparedness are necessary in every sector. However, the nature of some sectors (their raw materials, inputs, systems and processes, and the outputs or contributions) is such that certain sectors are substantially more at-risk to climate change than others.

In Rwanda, the sectors that are most vulnerable, and therefore must place a considerable emphasis on building adaptive capacity, are Water, Sanitation and Hygiene (WASH) and Waste, agriculture, and natural resources management (land and water resources, including forestry). Urban settlements and energy also require adaptation. In relative terms, transport and industries and mining have less of an imperative in the near future to focus heavily on adaptation.

WASH and Waste

Water is the principal channel through which climate change impacts are manifested. This makes water access and supply the most vulnerable of Rwanda's sectors, with significant implications for water services and sanitation. Climate change is expected to create greater variability in water availability, including shifts in seasonality and distribution of rainfall. With rising temperatures and increased evapotranspiration, this is also expected to lead to greater aridity in dry areas.

At the same time, warmer temperatures are likely to increase the demand for water (for consumption and cooling) as well as exacerbate public health challenges if solid waste cannot be effectively managed. This coupled with demographic and economic factors (rising population and economic growth) can lead to operational challenges for cities and settlements relating to WASH and Waste.

Agriculture

Climate change is a threat-multiplier to agriculture, enhancing risks already felt from climate variability, particularly through changes in the availability of water, and through temperature shifts that affect crop growing patterns. Rwanda is starting to experience more extremes, with the dry regions in the east and south becoming more arid (and projected to see more droughts), and wet regions in the north and west becoming more humid and moist (and projected to see more floods and landslides) (PSTA 4, Republic of Rwanda, 2018).

A number of assessments suggest that climate impacts in Rwanda such as higher temperatures, increased dryness (in some regions), and higher evapotranspiration, may alter the extent of areas suitable for agriculture and the length of growing seasons, affecting crop yields (e.g., for tea, coffee, maize, beans, wheat, fruit, and groundnuts) as well as hunger and nutrition (PSTA 4, USAID, 2019).

Furthermore, there is a higher risk of soil erosion due to more extreme rainfall events in certain regions. In addition, climate change may alter the occurrence and distribution of pests that harm or damage crops and livestock, such as the berry borer beetle and rift valley fever (USAID, 2012).

Natural Resources (Land, Forestry and Water Resources Management)

Rwanda's land is vulnerable to climate change from the increased risk of natural hazards (floods, droughts, landslides), particularly as land use changes cause slope destabilization and soil erosion. Loss of biodiversity may impact nature based tourism. Climate change is expected to create greater variability in water availability, including through shifts in seasonality and distribution of rainfall. With rising temperatures and increased evapotranspiration, this is also expected to lead to greater aridity in dry areas (USAID, 2012). The changing hydrological cycle also has implications for groundwater availability, indirectly through extreme weather events; increases in rainfall can lead to rapid runoff and flooding, which reduces groundwater recharge because too much rain at one time exceeds soil absorption capacity. Heavy rainfall also increases siltation of rivers and lakes (USAID, 2019; Rwanda Water Resources Board, 2019).

Urbanization and Settlements

Climate change poses a threat to cities and human settlements in Rwanda in a number of ways. Temperature rise may affect population health in the form of heat stress and heat exhaustion (or, in severe forms, heat strokes), given that the urban heat island effect exacerbates rising temperatures significantly in built-up areas. Rising temperatures also increase demand for cooling and water usage, leading to pressure on essential services.

Most acutely, urban settings are at risk from extreme weather occurrences such as intense rainfall events, due to changes in drainage patterns in built areas. Kigali, for instance, has suffered highly damaging floods annually for the last several years, compounded by issues of waterlogging. Given the density of many of Rwanda's cities and its hilly, uneven topography, extreme rain events also bring an elevated risk of landslides (Republic of Rwanda, 2018). Cities and urban infrastructure in Rwanda are vulnerable to both chronic and acute climate change impacts. Disaster risk reduction and disaster management, as well as urban drainage and storm water management are pressing adaptation needs.

Energy

The energy sector in Rwanda is vulnerable to climate change impacts in two principal ways. Firstly, given the large share of hydropower in the country's electricity mix, increased variability in rainfall (including more frequent drought conditions in eastern and southern Rwanda) poses a risk to the reliability and availability of hydropower. Alongside this, an increase in rainfall intensity which leads to landslides and sedimentation of water bodies affects key infrastructure.

Secondly, for thermal power facilities there may be increased requirements for cooling systems, due to an anticipated rise in average ambient temperature due to climate change. Beyond these two factors, other potential challenges to the power sector from climate change include an increase in demand for residential and commercial cooling (in response to higher temperatures), which creates pressure on power supply, and extreme weather events, which could damage power sector assets or temporarily disrupt fuel supply chains due to localized disasters such as floods and landslides. While Rwanda's current Nationally Determined Contributions (NDC) does not include adaptation actions related to the energy sector, it may be prudent for the sector to assess its vulnerability more robustly to climate change related trends in power consumption, as well as disruption from extreme weather events. (Republic of Rwanda, 2018).

Transport

The transport sector faces several of the risks faced by the urban sector and the industry sector in terms of infrastructure damage, loss, and depreciation. Higher temperatures are known to cause tarmacs at airports to melt, and temperature variability (extreme highs and lows) are known to cause roads to buckle and crack (IPCC, 2014; Ministry of Infrastructure, 2021).

Moreover, transport systems and networks can face disruption from extreme weather events such as floods or landslides, causing supply chain interruptions (IPCC, 2014). In the context of adaptation, transport systems such as roads and bridges have an important role to play in strengthening resilience; if designed and constructed with adequate roadside drainage and higher permeability, they can alleviate some of the risks of flooding in certain areas (IPCC, 2014; Ministry of Infrastructure, 2021). Transport infrastructure is vulnerable to damage from climatic hazards, and can also play a more proactive role in enhancing a region's resilience through more climate-responsive design.

Industries and Mining

No major climate change study or instrument in Rwanda has examined the vulnerability of the industry, manufacturing, and mining sector to climate change. This is because the sector is typically focused on as a target for mitigation. However, climate change impacts do have implications for the sector and decision-makers and planners in the sector would be well advised to interrogate the need for adaptation action.

Chief amongst these concerns is supply-chain disruptions to key industries and manufacturing units due to climate change, both as a result of rapid-onset events (extreme weather disasters such as floods and landslides) and slow-onset events (droughts and shifts in agricultural growing regions). Acute climate hazards can also pose a risk of physical damage and depreciation to capital assets. Given the key role of agro-based industries in Rwanda, and the vulnerability of crops and livestock to climate change, disruptions to the value-chains of agribusiness ought to receive attention. Industry is not regarded as a highly climate-vulnerable sector. However, disruptions to supply chains and damage to physical assets are a reason for the sector to examine adaptation options as needed.

4.2. Green finance opportunities

For Rwanda to achieve its ambitious goals of Vision 2050, its financial institutions, like their global counterparts, need confidence in investing in pioneering green projects. Despite the evolving frameworks and approaches in climate finance, the financial industry grapples with limited knowledge and information architecture related to climate change. Financial institutions are beginning to recognize the threats posed by climate change to their businesses and the associated risks, prompting a growing awareness and desire for a paradigm shift.

The Green Climate Fund (GCF) and the International Union for Conservation of Nature (IUCN) have signed a funding agreement for the "Transforming Eastern Province through adaptation" (TREPA) project, with co-financing from the Government of Rwanda and other Project Executing Entities. The six-year investment project is a collaborative effort involving IUCN, the Government of Rwanda through Rwanda Forestry Authority (RFA), Cordaid, CIFOR-ICRAF, Enabel, and World Vision. The TREPA project aims to restore over 60,000 hectares of drought-degraded landscapes in the Eastern Province of Rwanda through activities such as reforestation, agroforestry, pastureland restoration, and erosion control in seven districts. (IUCN, 2023)

Cordaid, as part of the TREPA project, is actively engaging microfinance institutions (MFIs) in the Eastern Province to promote Green Finance. Through partnerships with four selected MFIs, namely RIM Ltd, Duterimbere IMF, Umutanguha Finance PLC, and Goshen Finance Company, Cordaid is focusing on enhancing financial inclusion, particularly among women and youth, and encouraging investments in climate-resilient agriculture and tree products. (IUCN, 2023)

Cordaid facilitates capacity-building and knowledge-exchange sessions for partner MFIs to deepen their understanding of climate financing and the business prospects tied to the TREPA project. The collaboration aims to reshape the policies and strategies of MFIs, aligning them with a green orientation. (IUCN, 2023)

Additionally, Cordaid has partnered with Umurenge SACCOs (Savings and Credit Cooperative Organizations) in the Eastern Province, recognizing their role as the financial backbone of the region. The collaboration aims to leverage the influence of SACCOs to drive climate adaptation efforts, providing knowledge and skills to offer loans for climate-adaptive ventures and extending credits to farmer groups engaged in climate adaptation activities. (IUCN, 2023)

The partnership between Cordaid, MFIs, and SACCOs aims to make a significant impact on financial inclusion for the initially targeted 250,000 individuals. By promoting climate-resilient businesses, the collaboration seeks to exceed the project targets and contribute to building climate resilience in the Eastern Province. (IUCN, 2023)

On a global scale, climate finance research is limited, with the study highlighting the scarcity of academic discussions and research on the topic in Rwanda. The study emphasizes the unique contribution of analyzing the association between climate finance and climate risks, providing empirical evidence for the impact of climate finance on climate risk. The collaboration between Cordaid, MFIs, and SACCOs in the Eastern Province is positioned to create a powerful synergy for building climate resilience and promoting sustainable growth. The partnership is expected to unlock new opportunities and innovative solutions, fostering a more sustainable and climate-resilient Eastern Province. (IUCN, 2023)

Furthermore, the launch of Ireme Invest, a green investment facility, represents a groundbreaking initiative by the Government of Rwanda through the Rwanda Green Fund and the Development Bank of Rwanda. With an initial capitalization of over USD100 million, Ireme Invest aims to strengthen Rwanda's ownership of climate finance, offering various financial instruments tailored to meet the private sector's needs. The facility includes a Project Preparation Facility providing grants for early-stage project activities and a Credit Facility offering credit guarantees and concessional loans through the Development Bank of Rwanda. Ireme Invest is designed to catalyze green and low-carbon private investment in Rwanda, focusing on blended finance and creating a more resilient and sustainable society. (IUCN, 2023)

Partners

Ireme Invest has launched with its first capitalization round of USD 104 million expected from:

Table 2: Financing Partners

Institutions	Nature	Amount
European Investment Bank	A credit line	Euro 20 million
Agence Française de Développement	A credit line	Euro 20 million
Foreign, Commonwealth and Development Office of the Government of the United Kingdom	A grant	GBP 7 million
Global Climate Partnership Fund	A credit line	USD 15 million
Development Bank of Rwanda	A capitalization fund	USD 22 million

Source: (IUCN, 2023)

4.2.1. The additionality of banks

The societal benefits of green finance are eloquently articulated in Emeritus, Preethi Thomas et al., (2021). Banks are therefore seized on the strategic benefits of mainstreaming green finance in their operations. The commercial imperatives of such mainstreaming and underpinned by the following:

Mitigating Climate Change Risks: Green finance initiatives help mitigate the risks associated with climate change by supporting environmentally sustainable projects and investments. By financing renewable energy, energy efficiency, and other green projects, banks contribute to reducing greenhouse gas emissions and combating climate change.

Meeting Regulatory Requirements: Many governments are implementing regulations and policies to encourage or mandate financial institutions to adopt sustainable practices. Participating in green finance can help banks comply with these regulations, avoid penalties, and maintain their operating licenses.

Managing Reputation and Stakeholder Expectations: Consumers, investors, and other stakeholders increasingly expect businesses, including banks, to demonstrate their commitment to environmental sustainability. Participating in green finance allows banks to enhance their reputation as responsible corporate citizens and attract socially conscious customers and investors.

Seizing Business Opportunities: Green finance presents significant business opportunities for banks. By financing green projects and investments, banks can tap into growing markets for renewable energy, sustainable infrastructure, and environmentally friendly technologies. This can diversify their revenue streams and contribute to long-term profitability.

Reducing Financial Risks: Investing in environmentally sustainable projects can help banks reduce their exposure to certain financial risks, such as those associated with fossil fuel assets or industries vulnerable to climate-related disruptions. Green finance offers opportunities for banks to allocate capital towards more resilient and future-proof investments.

Innovation and Differentiation: Participating in green finance encourages banks to innovate and develop new financial products and services tailored to the needs of environmentally conscious customers and businesses. This can help banks differentiate themselves in a competitive market and stay ahead of evolving regulatory and consumer trends.

Long-Term Value Creation: By integrating environmental considerations into their lending and investment decisions, banks can contribute to the long-term sustainability and resilience of the economy. Green finance initiatives support the transition to a low carbon and environmentally sustainable future, fostering economic growth and stability over the long term.

4.2.2. Challenges for Banks

The aforementioned opportunities for banks listed have to confront a number of challenges if the full potential of green finance is to be realized. These challenges include the following:

- Absence of an Integrated Green Financial System: There is a pressing need for a standardized and adaptable green financial framework to ensure alignment with sustainable growth goals. This system must distinguish genuine environmentally beneficial projects from those lacking tangible green impact. It should update guidelines for the issuance of green bonds, ensuring projects contribute to environmental objectives. Moreover, a comprehensive evaluation mechanism based on carbon emissions rates should be implemented to guide businesses towards greener practices.
- Information Asymmetry in Green Finance: Integrating Environmental, Social, and Governance (ESG) criteria into corporate disclosures is vital to enhance transparency and promote responsible investment practices. Rwanda faces a lack of awareness regarding ESG principles among market entities, necessitating the adoption of a model that combines willingness and reporting. Strengthening ESG ratings and investment mechanisms through external evaluations and incentives for self-disclosure can further bolster green finance credibility.
- Insufficient Incentives for Eco-Friendly Consumption: To stimulate green finance and achieve carbon reduction goals, a comprehensive policy framework with market-driven incentives is essential. Targeted subsidies for eco-friendly projects, especially in underdeveloped regions, along with tax incentives for companies implementing green initiatives, can encourage broader participation in carbon reduction efforts. Additionally, establishing a tiered tax system and facilitating access to financing through grant programs can incentivize green investment.
- Lack of Policy and Standards Coordination: Incoherent policies and standards, coupled with a limited variety of green financial products, pose significant challenges. Establishing consistent and internationally aligned green financial standards is crucial, along with diversifying financial instruments beyond traditional green credit. This includes developing products like green stocks, bonds, and insurance to encompass various sectors, ensuring a comprehensive approach to low-carbon transformation. (Zhou 2022).

4.2.3. Expert perspectives on the challenges

Acknowledging that the challenges outlined above are binding in the case of Rwanda, this paper reports perspectives of expert interview with senior credit analysts from top 5 banks in Rwanda. The key informant interviews reveal that implementing green finance in Rwanda confronts challenges unique to the country's economic, social, and environmental context. The challenges include the following:

- Limited Awareness and Demand: Rwanda have limited awareness among both banks and consumers regarding the importance and benefits of green finance. Educating the population about the advantages of sustainable investment and green projects could be a challenge.
- Lack of Regulatory Framework: The regulatory framework for green finance in Rwanda is in in its nascent stages, making it challenging for banks to navigate the regulatory landscape and comply with any existing or forthcoming regulations related to sustainable finance.
- Access to Data and Information: Access to reliable environmental data and information related to potential green projects is limited in Rwanda. Banks face difficulties in assessing the environmental impact and risks associated with such projects due to data gaps.
- Capacity Building: Building internal capacity within banks to assess, manage, and finance green projects is a challenge. Training staff and developing expertise in areas such as environmental risk assessment and sustainable finance might be necessary. This comes with a cost and getting appropriate trainers in a bit challenging.

- Financial Viability of Green Projects: Green projects face financial viability challenges, especially in the early stages of development. Banks might be hesitant to finance such projects due to concerns about profitability, particularly due to uncertainties regarding revenue streams or cost-effectiveness.
- Access to Funding: Banks in Rwanda face challenges in accessing funding sources specifically earmarked for green finance initiatives. Limited availability of green finance instruments or funding mechanisms could hinder banks' ability to scale up their green finance activities.
- Infrastructure and Technology: Infrastructure limitations and technological constraints pose challenges for implementing green projects in Rwanda. For instance, the lack of renewable energy infrastructure or sustainable transportation systems which could impede the development of green projects in these sectors.
- Partnerships and Collaboration: Building partnerships and collaboration with relevant stakeholders, including government agencies, non-governmental organizations, and the private sector, is crucial for the successful implementation of green finance initiatives. However, establishing effective partnerships requires significant effort and coordination.

Addressing these challenges would require a concerted effort from various stakeholders, including banks, government institutions, international organizations, and civil society, to create an enabling environment for green finance in Rwanda. This might involve policy interventions, capacity-building initiatives, awareness campaigns, and the development of supportive infrastructure and regulatory frameworks tailored to the country's specific context.

5. Conclusion and Recommendations

5.1. Conclusion

In this study, we conducted a comprehensive assessment of the impact of green finance in combating climate related risks in Rwanda. Climate risks pose significant challenges to the global economy and the stability of financial markets. However, they also present opportunities for sustainable investments and the development of green finance. By integrating climate risk analysis into financial decision-making processes, investors can identify risks, enhance risk management, and support climate-resilient assets. Green finance plays a crucial role in mobilizing capital towards sustainable projects and fostering innovation. As the world strives to mitigate the impacts of climate change, the integration of climate risks into green finance will continue to shape the future of the financial sector.

At economic growth rate of 10% in Q4,2023, Rwanda's speedy expansion of industrialization and modernization has resulted in environmental challenges such as pollution and excessive energy consumption. To address this, the concept of green finance has to be given a special attention, with the objective of promoting sustainable development by supporting financial events, environmental protection, and green stability. Green finance aims to promote the harmonious development of financial activities, environmental protection, and sustainable development. It is no longer just a global trend, but an essential component for both developed and developing countries to achieve sustainable growth.

In Africa, Rwanda is leading the way in researching and implementing green financial policies, which have the potential to reduce credit risk, increase financial transparency, and promote sustainable growth. Rwanda's financial authorities are exploring the inclusion of green financial products in macro-prudential policy research, National Bank of Rwanda has set climate risk guidelines to guide the banking industry in transition to green financial system. It also is imperative to develop diversified new green financial products that will accelerate the transition to a green financial system in Rwanda.

The Rwandan government's efforts in promoting green economy have been substantial, with constant efforts to implement climate change policies and guidelines as well as aligning these policies to conversional national short, medium and long-term programs. Nevertheless, we suggest that establishing a unified green financial system, mandatory green financial disclosures, and promoting green consumption incentive mechanisms could help the Rwandan green financial system achieve even greater success in the future.

5.2. Study Recommendations

Policy recommendations on the impact of green finance on climate-related risks in Rwanda should focus on both incentivizing and regulating sustainable financial practices while also building resilience to climate change. The study suggests the following recommendations:

Firstly, there is a need for a collective effort to enhance sustainable finance's impact on addressing climate change. The public sector can support riskier yet crucial projects, while the private sector can fund the transition to lower carbon emissions and accurately assess risks in the market.

Central to emission reduction efforts should be the implementation of higher carbon prices. This approach encourages mitigation actions, generates revenue for necessary investments, and assists those most severely affected by climate change.

Additionally, data transparency, disclosures, and standardized classifications. Addressing data gaps and enhancing disclosures are vital for attracting financial resources to support climate-friendly investments. Consistent and accessible climate-related data can facilitate informed decision-making and encourage investment in sustainable projects across different economic structures.

The establishment of robust regulatory frameworks for green finance initiatives is crucial for ensuring transparency, accountability, and credibility in investment practices.

This involves defining clear criteria for green projects, establishing targets for green financing, and implementing reporting requirements for financial institutions. Central banks play a vital role in assessing risks and managing governance challenges to effectively integrate climate considerations into their strategies. Regulatory evolution is necessary to ensure that sustainable financial products contribute meaningfully to climate action, prevent greenwashing, and uphold quality standards. A unified global regulatory approach, along with collaboration on standards and oversight, can enhance the credibility and effectiveness of sustainable finance efforts.

Incentivize Green Investments: Provide financial incentives such as tax breaks, subsidies, or low-interest loans for green projects and investments. This can encourage financial institutions and investors to prioritize climate-friendly initiatives and allocate more resources towards renewable energy, energy efficiency, sustainable agriculture, and other environmentally beneficial projects.

Capacity Building and Awareness: Invest in capacity building programs to enhance the knowledge and skills of financial institutions, regulators, and stakeholders on green finance principles and practices. Additionally, raise awareness among businesses, investors, and the general public about the importance and benefits of investing in climate-resilient projects.

Integration of Climate Risk Management: Integrate climate risk assessment and management into financial decision-making processes. Encourage financial institutions to conduct climate risk assessments of their portfolios and incorporate climate-related factors into their risk management frameworks to mitigate potential losses associated with climate change impacts.

Collaboration and Partnerships: Foster collaboration among government agencies, financial institutions, development partners, and civil society organizations to facilitate the mobilization of green finance and support the implementation of climate-resilient projects. Public-private partnerships can leverage resources, expertise, and networks to scale up investments in sustainable development.

Green Bond Market Development: Promote the development of a domestic green bond market to facilitate the issuance of green bonds by public and private entities. This can attract international investors interested in environmentally sustainable investments while providing a new source of financing for climate-related projects in Rwanda.

Inclusive and Equitable Access: Ensure that green finance initiatives prioritize the needs of vulnerable communities and promote inclusive and equitable access to financing for climate adaptation and mitigation projects. This may involve targeted support for smallholder farmers, women entrepreneurs, and marginalized groups to participate in green investment opportunities.

Rwanda governments should develop country architecture to mobilize private financing for climate action and green growth, including domestic financial institutions. It should also strengthen governance and accountability systems to ensure that proceeds from private finance generate the expected and maximum impact for green growth.

Monitoring and Evaluation: Establish robust monitoring and evaluation mechanisms to track the effectiveness and impact of green finance initiatives on climate resilience and sustainable development goals. Regular assessments can inform policy adjustments and identify areas for improvement in promoting green finance in Rwanda.

This study is subject to certain limitations which need consideration. Firstly, it exclusively examines the impact of green finance on climate risks in Rwanda, without conducting a comprehensive analysis of its effects on the country's sustainable green development. It is advisable for future research to undertake a detailed examination of individual green financial instruments such as green credit, green bonds, and green credit cards to ascertain their role in promoting green economic growth and to identify any constraints they may encounter in Rwanda. Secondly, data availability posed challenges during the study, especially concerning Rwanda, where minimal research exists on green finance and climate risks. Nevertheless, we anticipate that this study will establish a solid foundation for future researchers.

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Inclusive Innovation: Bridging the Digital Divide through Mobile Financial Services in Rural Areas

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Abstract

This research investigates the landscape of mobile financial services and barriers to digital inclusion in rural Rwanda, aiming to provide practical solutions for promoting financial access and inclusive innovation. Through a survey of 500 individuals across provinces and qualitative interviews with key stakeholders, the study assesses mobile money usage, identifies barriers to digital inclusion, and proposes actionable strategies. Findings reveal varying adoption rates of mobile financial services across provinces, with limited network coverage, affordability constraints, and low digital literacy identified as primary barriers. Proposed solutions include infrastructure investment, digital literacy programs, and affordable mobile financial services offerings. The implications of the research underscore the importance of targeted interventions to bridge the digital divide and promote inclusive development. Recommendations are provided for policymakers, financial institutions, and technology providers to accelerate progress toward universal digital access. This study contributes to the discourse on digital inclusion in rural contexts and highlights avenues for future research in evaluating the effectiveness of implemented interventions and exploring emerging technologies for enhancing digital access.

Keywords: *Financial Technology, Mobile Financial Services, Inclusive Innovation, Rural Rwanda, Digital Divide*

Introduction

The financial landscape of Rwanda is undergoing significant transformation, driven by the interplay of financial technology, innovation, and sustainability. Within this context, our paper titled "Inclusive Innovation Bridging the Digital Divide through Mobile Financial Services in Rural Rwanda" seeks to explore the transformative potential of mobile financial services. Rwanda's commitment to comprehensive financial inclusion and sustainable development provides a compelling backdrop for our research, acknowledging the complexities shaping the country's financial sector. Our study aims to uncover the impact of mobile financial services on bridging the digital divide and empowering rural communities, motivated by Rwanda's aspirations for inclusive economic growth.

Our research objectives are multifaceted, aiming to provide an in-depth exploration of the current landscape of mobile financial services in rural Rwanda, examine their contribution to enhanced financial inclusion, and identify challenges and opportunities associated with their deployment. By offering practical recommendations for policymakers, financial institutions, and technology providers, we seek to foster inclusive innovation within Rwanda's financial landscape. As we navigate through subsequent sections, including a thorough literature review, presentation of research methodology, discussion of key findings, and conclusion, we aspire to shed light on the transformative potential of mobile financial services in bridging the digital divide and realizing inclusive innovation in rural Rwanda.

The financial landscape in Rwanda has evolved significantly in recent years, propelled by a commitment to comprehensive financial inclusion and sustainable economic development. Despite progress highlighted by the National Institute of Statistics of Rwanda (NISR) in expanding financial services across the country, disparities persist, particularly in rural areas where access to traditional financial services and digital technologies remains limited (NISR, 2023). This notable digital divide underscores the challenges hindering inclusive finance realization, particularly in rural Rwanda, where limited physical infrastructure and distance from traditional banking institutions contribute to financial exclusion (NISR, 2023).

Motivated by the need to address these disparities and capitalize on emerging opportunities within the financial sector, our research aligns with the overarching theme of the conference, "The Financial Technology, Innovation, and Sustainability Interplay in Rwanda – Emerging Opportunities and Risks." Our paper, "Inclusive Innovation Bridging the Digital Divide through Mobile Financial Services in Rural Rwanda," aims to explore the transformative potential of mobile financial services in overcoming barriers to financial inclusion, especially in rural settings. The significance of this research focus is underscored by the NISR data, emphasizing the disparity between urban and rural areas in financial infrastructure and the promising role of mobile financial services in fostering inclusive innovation and empowerment (NISR, 2023).

Data from the National Institute of Statistics of Rwanda (NISR) highlights that a substantial portion of the rural population still faces limited access to traditional financial services and digital technologies. This research problem is rooted in the recognition that the digital divide poses a barrier to inclusive economic development in Rwanda, especially in rural regions where urban areas benefit from more advanced financial infrastructure.

In addition to addressing the digital divide, gender inclusivity remains a significant concern in Rwanda's financial landscape. Despite progress in expanding financial services, disparities persist between men and women in access to and utilization of formal financial services (NISR, 2023). Women, particularly those in rural areas, face unique socio-economic challenges that hinder their financial inclusion, including limited access to education, land ownership, and decision-making power within households (Kabeer, 2005). These disparities not only perpetuate gender inequalities but also constrain economic opportunities for women, thereby impeding overall socio-economic development. Thus, integrating gender inclusivity into financial inclusion initiatives is imperative for fostering equitable access to financial services and empowering women to participate fully in the formal economy.

Despite efforts to expand the reach of mobile financial services, critical barriers to digital inclusion persist in rural areas, including insufficient network coverage, affordability constraints, and low levels of digital literacy. Socio-cultural factors and entrenched inequalities further compound these challenges, underscoring the complexity of the digital divide issue in rural Rwanda. Without targeted interventions to address these barriers, marginalized populations risk being left behind in an increasingly digitalized financial landscape, perpetuating cycles of poverty and exclusion.

In response to these pressing challenges, this research aims to investigate innovative solutions and strategies that can effectively bridge the digital divide and promote financial inclusion in rural Rwanda. By assessing the current landscape of mobile financial services, identifying barriers to digital inclusion, and proposing practical solutions, the study seeks to inform policymakers, financial institutions, and technology providers on actionable steps to enhance digital access and empower rural communities. Through collaborative efforts and stakeholder engagement, sustainable pathways towards inclusive innovation can be forged, driving positive change and fostering economic empowerment in rural Rwanda.

Literature Review

Financial Inclusion in the Global Context

Financial inclusion has emerged as a key driver of economic development worldwide (Demirgüç-Kunt & Klapper, 2012). Scholars have underscored its role in reducing poverty, promoting entrepreneurship, and fostering overall economic well-being. However, the challenge lies in extending these benefits to marginalized populations, particularly in rural areas, where traditional financial services often fall short (Beck et al., 2007).

The Digital Divide and Financial Inclusion

The concept of the digital divide is deeply intertwined with discussions on financial inclusion. As digital technologies become integral to financial services, disparities in access to these technologies can exacerbate existing financial exclusion (Kumar & Best, 2006). Rural communities, in particular, face challenges due to limited internet connectivity and technology infrastructure (Donner & Tellez, 2008).

Mobile Financial Services as a Catalyst for Inclusion

Mobile financial services have emerged as a transformative force in addressing these challenges. Literature suggests that mobile money platforms, often accessible via basic mobile phones, can bridge the gap by providing convenient and cost-effective financial services to remote populations (Jack & Suri, 2014). Studies highlight the success stories of mobile banking initiatives in various developing countries (Mas & Morawczynski, 2009).

Barriers to digital inclusion in rural areas

Access to digital technology and the internet has become increasingly crucial for participation in modern society and the economy. However, rural areas often face unique challenges that hinder digital inclusion, perpetuating disparities in access to information, services, and opportunities. This literature review examines the key barriers to digital inclusion in rural areas, drawing insights from academic research and empirical studies.

Infrastructure Limitations

One of the primary barriers to digital inclusion in rural areas is the lack of adequate infrastructure, particularly in terms of broadband internet access and network coverage. Research by Braun et al. (2019) highlights the significant disparities in broadband availability between urban and rural areas, with rural regions often lagging due to higher deployment costs and lower population densities. Limited infrastructure not only restricts internet access but also undermines the quality and reliability of digital services, hindering their effective utilization by rural residents (Hao & Nath, 2018).

Affordability Constraints

Financial constraints pose another significant barrier to digital inclusion in rural areas. Despite the decreasing cost of digital devices and internet services over time, affordability remains a challenge for many rural households, particularly those with low incomes (Braun et al., 2020). The cost of purchasing smartphones, computers, and internet subscriptions can be prohibitive for rural residents, limiting their ability to access and benefit from digital technologies (Castells & Qiu, 2019). Additionally, ongoing expenses such as data plans and maintenance further exacerbate the affordability barrier, particularly in resource-constrained settings (Lievrouw & Livingstone, 2016).

Digital Literacy and Skills Gaps

Limited digital literacy and skills gaps represent significant barriers to digital inclusion in rural areas. Research by Warschauer & Matuchniak (2010) emphasizes the importance of digital literacy in enabling individuals to navigate online platforms, utilize digital tools effectively, and critically evaluate digital information. However, rural populations often lack access to formal education and training programs that can build these essential skills (Mossberger et al., 2017). As a result, many rural residents struggle to harness the full potential of digital technologies, impeding their participation in the digital economy and society.

Socio-Cultural Factors

Socio-cultural factors, including language barriers, cultural norms, and attitudes toward technology, also influence digital inclusion in rural areas. Research by Ngarava & Maphosa (2018) highlights the role of cultural perceptions in shaping individuals' willingness to adopt and engage with digital technologies. In some rural communities, traditional beliefs and practices may discourage the use of digital tools or limit access to information online (Waldron et al., 2019). Language barriers, particularly in multilingual societies, can further compound these challenges, limiting access to digital content and services available in local languages (Mbarika et al., 2019).

Barriers to digital inclusion in rural areas are multifaceted and complex, encompassing infrastructure limitations, affordability constraints, digital literacy gaps, and socio-cultural factors. Addressing these barriers requires holistic strategies that prioritize investments in digital infrastructure, promote affordability and accessibility, enhance digital literacy and skills development, and engage communities in culturally sensitive approaches to technology adoption. By addressing these challenges, policymakers, practitioners, and stakeholders can advance digital inclusion efforts and unlock the transformative potential of digital technologies for rural development and empowerment.

Practical solutions to overcome barriers to digital inclusion in rural areas

Addressing the barriers to digital inclusion in rural areas requires the implementation of practical solutions that effectively mitigate challenges and enhance access to digital technologies and opportunities. Drawing insights from academic research and empirical studies, this literature review examines key practical solutions aimed at overcoming barriers to digital inclusion in rural areas.

Infrastructure Development

Investments in digital infrastructure play a crucial role in expanding access to digital technologies in rural areas. Research by De Silva et al. (2020) underscores the importance of infrastructure development, including broadband expansion, network deployment, and improved connectivity solutions such as satellite internet. Initiatives such as the Federal Communications Commission's (FCC) Rural Digital Opportunity Fund in the United States demonstrate the significance of public-private partnerships and targeted funding mechanisms in accelerating infrastructure development and bridging the digital divide (FCC, 2020).

Community-Based Initiatives

Community-based initiatives and grassroots organizations play a vital role in promoting digital inclusion in rural areas. Research by Gurstein (2017) emphasizes the importance of community networks and local partnerships in fostering digital literacy, skills development, and technology adoption. Community centers, libraries, and telecenters serve as hubs for digital learning and access to technology resources, providing training programs, workshops, and support services tailored to the needs of rural residents (Hudson, 2018).

Mobile Solutions and Innovation

Mobile solutions and innovations offer scalable and cost-effective approaches to overcoming barriers to digital inclusion in rural areas. Research by Qiang et al. (2019) highlights the transformative potential of mobile technologies, particularly mobile phones and smartphones, in extending digital access to remote communities. Mobile-based initiatives such as mobile money, mHealth, and agricultural extension services leverage existing infrastructure and consumer devices to deliver essential services and information to rural populations (Aker & Mbiti, 2010).

Digital Skills Training and Capacity Building

Investments in digital skills training and capacity-building programs are essential for empowering rural residents to effectively navigate digital technologies and platforms. Research by Warschauer & Matuchniak (2010) emphasizes the importance of lifelong learning and skills development in fostering digital literacy and digital citizenship. Training initiatives, such as the International Telecommunication Union's (ITU) Digital Skills Toolkit, offer modular and customizable resources for individuals, communities, and organizations to enhance their digital competencies and capabilities (ITU, 2020).

Challenges in Deploying Mobile Financial Services in Rural Areas

However, the successful deployment of mobile financial services in rural settings is not without challenges. Infrastructure limitations, such as poor network coverage and electricity shortages, can hinder the widespread adoption of these services (Catalytic Advisory Group, 2018). Additionally, concerns about digital literacy and trust in new technologies remain pertinent (Mbiti & Weil, 2011).

Opportunities for Inclusive Innovation

Despite these challenges, the literature identifies several opportunities for inclusive innovation. For instance, collaborative efforts between the public and private sectors, coupled with targeted regulatory frameworks, can create an enabling environment for the sustainable deployment of mobile financial services in rural areas (GSMA, 2016).

Gaps in Current Knowledge and Areas for Further Research

While existing literature provides valuable insights, gaps, and areas requiring further research persist. Limited attention has been paid to understanding the nuanced socio-cultural factors influencing the adoption of mobile financial services in specific regions, such as rural Rwanda. Moreover, there is a need for in-depth studies examining the long-term sustainability and scalability of mobile financial services initiatives in the context of developing economies (Dabla-Norris et al., 2015).

The literature underscores the transformative potential of mobile financial services in promoting inclusive innovation and bridging the digital divide. However, nuanced challenges and opportunities demand focused research efforts to inform targeted strategies for deploying these services sustainably in rural Rwanda.

Methodology

Research design and approach

This research employed a mixed-methods approach to comprehensively investigate the role of mobile financial services in bridging the digital divide and fostering inclusive innovation in rural Rwanda. The combination of qualitative and quantitative methods allows for a nuanced understanding of the complex dynamics at play.

Data collection

For data collection, quantitative data was gathered through a survey administered to a stratified random sample of individuals in rural areas across Rwanda's provinces. The survey covered topics such as mobile financial service usage, access to traditional financial services, digital literacy, and socio-economic demographics, providing quantitative insights into the prevalence and impact of mobile financial services in bridging the digital divide. Additionally, qualitative data was obtained through in-depth interviews and focus group discussions with key stakeholders, including community members, local leaders, mobile service providers, and financial institution representatives. These qualitative methods aimed to capture nuanced perspectives and experiences related to the adoption of mobile financial services in rural settings, exploring community perceptions, barriers to adoption, and potential areas for improvement.

Population and Sampling

The selection of survey participants was stratified based on geographic location (provinces), ensuring representation from diverse rural settings. A random sampling approach was employed to select households within each stratum, with an emphasis on inclusivity and representation of various demographic groups.

The study population encompasses individuals residing in rural areas across Rwanda's provinces. To ensure representation, a stratified random sampling method was employed. The sample size comprised 500 participants, selected proportionately from each province. This sample size was deemed adequate to capture diverse perspectives and experiences regarding mobile financial service adoption and digital inclusion in rural communities.

Data Analysis

For data analysis, both quantitative and qualitative methods were utilized. The quantitative analysis involved descriptive statistics to summarize survey data on mobile financial service usage and demographics, as well as inferential statistical methods like regression analysis to identify factors influencing adoption. Qualitative data from interviews and focus groups underwent thematic analysis to uncover socio-cultural factors shaping adoption. A triangulation approach verified findings from both data sources, enhancing study reliability. The research aimed to understand rural Rwanda's mobile financial services landscape comprehensively, informing recommendations for policymakers and financial institutions.

Results

Table 1: Demographic Information of Participants

Demographic Characteristic	Frequency (n=500)	Percentage
Gender:		
- Male	245	49%
- Female	255	51%
Age Group:		
- 18-30 years	130	26%
- 31-45 years	185	37%
- Above 45 years	185	37%
Education Level:		
- Primary	210	42%
- Secondary	150	30%
- Tertiary	100	20%
- Non- formal education	40	8%

The demographic analysis reveals a relatively balanced representation of genders among the 500 participants, with 49% being male and 51% female. Regarding age distribution, the majority of respondents fall within the 31-45 years category, constituting 37% of the sample, followed closely by individuals aged above 45 years and those aged 18-30 years, each accounting for 37% of the participants. In terms of education level, the largest proportion of respondents have completed primary education (42%), followed by secondary education (30%), tertiary education (20%), and 8% reported no formal education. These demographic characteristics provide a diverse and representative sample for analyzing mobile financial service usage and digital inclusion barriers in rural Rwanda.

Table 2: Distribution of Respondents by Province and

Province	Farmer	Business	Teacher	Healthcare Worker	Other
Northern	60	40	25	12	13
Western	50	45	30	17	18
Eastern	45	35	12	10	18
Southern	70	55	35	25	15
Kigali City	30	22	19	15	14

This table presents the distribution of respondents based on province and occupation. The data reflects the diverse occupational demographics across the provinces of Northern, Western, Eastern, and Southern, as well as Kigali City. Farmers represent the predominant occupational group across all provinces, with the highest numbers observed in the Southern province. Business owners, teachers, healthcare workers, and individuals with other occupations also contribute to varying degrees across the different regions. In Kigali City, respondents from various occupations are more evenly distributed compared to rural provinces.

Current Landscape of Mobile Financial Services in Rural Rwanda

Table 3: Assessment of the Current Landscape of Mobile Financial Services in Rural Rwanda

Province	Mobile Money Users (n=500)	Percentage of Mobile Money Users
Northern	180	36.0%
Western	197	39.4%
Eastern	123	24.6%
Southern	126	25.2%
Kigali City	74	14.8%
Total	**500**	**100.0%**

The analysis of mobile financial service usage across rural Rwanda provinces reveals varying adoption rates. The Western province exhibits the highest percentage of mobile money users at 39.4%, followed by the Northern province at 36.0%. Conversely, Kigali City has the lowest percentage of mobile money users at 14.8%. These findings suggest that mobile financial services have gained significant traction in rural areas, particularly in the Western and Northern provinces. The lower adoption rate in Kigali City may be attributed to higher access to traditional banking services and greater familiarity with alternative payment methods.

Table 4: Gender Disparities in Mobile Money Usage in Rural Rwanda

Province	Male Users	Female Users	Male Percentage	Female Percentage
Northern	42	27	60.0%	40.0%
Western	46	17	73.0%	27.0%
Eastern	32	23	58.2%	41.8%
Southern	35	21	62.5%	37.5%
Kigali City	15	19	44.1%	55.9%
Total	**170**	**107**	**61.4%**	**38.6%**

The table presents gender disparities in mobile money usage across different provinces in rural Rwanda. In all provinces, there is a higher percentage of male users compared to female users. For instance, in the Northern province, 60.0% of mobile money users are male, while only 40.0% are female. This trend is consistent across all provinces, indicating a gender gap in mobile money usage.

The disparities are particularly notable in the Western province, where 73.0% of mobile money users are male, compared to only 27.0% female users. Similarly, in Kigali City, while there is a relatively lower gender gap compared to other provinces, with 44.1% male users and 55.9% female users, the difference still reflects unequal access to mobile financial services between genders.

These findings underscore the importance of addressing gender disparities in financial inclusion efforts in rural Rwanda. Strategies to promote gender equality in mobile money usage may include targeted educational programs to enhance digital literacy among women, initiatives to increase women's access to mobile phones and smartphones, and gender-sensitive policies and interventions aimed at removing barriers to mobile financial services adoption. By closing the gender gap in mobile money usage, Rwanda can achieve more inclusive and equitable financial access, contributing to broader socioeconomic development goals.

Barriers to digital inclusion in rural areas in Rwanda

Table 5: Identification of Barriers to Digital Inclusion in Rural Areas in Rwanda

Barrier	Frequency (n=500)	Percentage
Limited network coverage	**185**	**37.0%**
Affordability constraints	**165**	**33.0%**
Low levels of digital literacy	**145**	**29.0%**
Lack of access to mobile devices	**105**	**21.0%**
Total	**500**	**100.0%**

The analysis of barriers to digital inclusion in rural areas of Rwanda highlights several key challenges. Limited network coverage emerges as the most prevalent barrier, cited by 37.0% of respondents. This indicates that a significant portion of rural residents face difficulties accessing digital services due to inadequate infrastructure. Affordability constraints are identified by 33.0% of respondents, underscoring the financial barriers that impede digital inclusion efforts. Additionally, 29.0% of respondents cite low levels of digital literacy as a barrier, indicating a need for education and training initiatives to enhance digital skills among rural communities. Lack of access to mobile devices is also identified as a barrier by 21.0% of respondents, suggesting that device availability remains a limiting factor for digital access. Addressing these barriers is crucial for promoting digital inclusion and ensuring equitable access to digital services in rural Rwanda.

Practical solutions to overcome the challenges to digital inclusion in rural areas in Rwanda.

Table 6: Proposed Solutions to Overcome Barriers to Digital Inclusion in Rural Areas

Solution	Frequency (n=500)	Percentage
Infrastructure investment for network coverage	220	44.0%
Digital literacy programs	180	36.0%
Affordable mobile financial service offerings	155	31.0%
Community-based digital literacy initiatives	145	29.0%
Total	**500**	**100.0%**

The proposed solutions to overcome barriers to digital inclusion in rural areas of Rwanda highlight several actionable strategies. Infrastructure investment for network coverage emerges as the most commonly suggested solution, with 44.0% of respondents advocating for improved infrastructure to enhance digital connectivity. This underscores the importance of expanding network coverage to underserved rural areas to address the barrier of limited connectivity. Digital literacy programs are also identified as a key solution by 36.0% of respondents, indicating the need for educational initiatives to empower rural communities with essential digital skills. Additionally, 31.0% of respondents propose affordable mobile financial service offerings as a solution, emphasizing the importance of making digital financial services accessible to all socio-economic groups. Community-based digital literacy initiatives are mentioned by 29.0% of respondents, highlighting the role of community engagement in promoting digital literacy and bridging the digital divide. Implementing these practical solutions can help overcome barriers to digital inclusion and facilitate equitable access to digital services in rural Rwanda.

Discussion

The findings from the assessment of the current landscape of mobile financial services in rural Rwanda provide valuable insights into the progress and challenges of digital financial inclusion in the country. In line with the research objective of evaluating the prevalence of mobile money usage, the results reveal varying adoption rates across different provinces. The higher percentage of mobile money users in the Southern and Western provinces compared to Kigali City and the Northern and Eastern provinces aligns with existing literature indicating that rural areas often experience higher levels of mobile money adoption due to limited access to traditional banking services (NISR, 2023).

Comparing these findings with existing literature underscores the significance of mobile financial services in promoting financial inclusion in rural settings. Studies have shown that mobile money platforms play a pivotal role in expanding access to financial services, particularly among underserved populations in developing countries (Jack & Suri, 2014). The higher adoption rates observed in rural provinces suggest that mobile financial services have effectively addressed some of the barriers to financial inclusion in these areas, such as limited physical infrastructure and geographic isolation.

The implications of these findings are significant for policymakers, financial institutions, and technology providers seeking to advance financial inclusion agendas in Rwanda. The higher prevalence of mobile money usage in rural areas highlights the importance of prioritizing investments in digital infrastructure and promoting mobile financial literacy initiatives to further enhance adoption rates. Additionally, the lower adoption rates in urban centers like Kigali City emphasize the need for tailored strategies to address unique barriers to mobile money adoption in urban settings, such as competition from traditional banking services and higher levels of digital literacy.

The findings underscore the transformative potential of mobile financial services in bridging the digital divide and promoting inclusive economic growth in rural Rwanda. By leveraging the insights gained from this assessment, stakeholders can develop targeted interventions to enhance access to digital financial services and empower rural communities to participate more fully in the formal economy.

The interpretation of the gender disparities in mobile money usage reveals a concerning trend that underscores the need for targeted interventions to promote gender equality in financial inclusion efforts. The significantly higher percentage of male users compared to female users across all provinces highlights systemic barriers that hinder women's access to and utilization of mobile financial services in rural Rwanda. These barriers may include socio-cultural norms, limited access to mobile phones, and disparities in digital literacy levels. Addressing these challenges requires multifaceted approaches that prioritize women's empowerment, including initiatives to enhance women's digital literacy, increase their access to mobile phones through affordable device schemes, and promote gender-sensitive financial products and services.

The identification of barriers to digital inclusion in rural areas of Rwanda provides critical insights into the challenges hindering equitable access to digital services. In alignment with the research objective, the analysis reveals several key barriers, including limited network coverage, affordability constraints, low levels of digital literacy, and lack of access to mobile devices. These findings underscore the multifaceted nature of the digital divide and the complex challenges faced by rural communities in accessing and utilizing digital technologies.

Comparing these results with existing literature highlights the persistent nature of these barriers across different contexts. Studies have consistently identified inadequate infrastructure, financial constraints, and limited digital skills as primary obstacles to digital inclusion in rural areas (ITU, 2019). The findings from this study corroborate these findings and underscore the need for comprehensive strategies to address these barriers effectively.

The implications of these findings are profound for policymakers, development practitioners, and technology providers striving to promote digital inclusion in rural Rwanda. Addressing the identified barriers requires a multifaceted approach that combines infrastructure investments, targeted educational initiatives, and innovative solutions to enhance the affordability and accessibility of digital technologies. Moreover, these findings emphasize the importance of adopting context-specific interventions that account for the unique socio-economic and geographical characteristics of rural communities.

By understanding the barriers to digital inclusion and their underlying causes, stakeholders can develop evidence-based policies and programs aimed at narrowing the digital divide and fostering inclusive development. Efforts to improve network infrastructure, increase digital literacy, and make digital services more affordable and accessible have the potential to unlock new opportunities for economic empowerment and social inclusion in rural Rwanda.

The proposed solutions to overcome barriers to digital inclusion in rural areas of Rwanda offer practical insights into addressing the challenges identified in the previous objective. In line with the research objective, the analysis highlights several actionable strategies, including infrastructure investment, digital literacy programs, affordable mobile financial service offerings, and community-based initiatives. These solutions reflect a comprehensive approach to tackling the multifaceted nature of the digital divide and promoting equitable access to digital services.

Comparing these proposed solutions with existing literature reveals common themes and best practices in digital inclusion efforts worldwide. Infrastructure investment has been recognized as a fundamental enabler of digital access, with studies emphasizing the importance of expanding network coverage and improving connectivity in underserved areas (UNESCO, 2019). Similarly, digital literacy programs play a crucial role in empowering individuals with the skills and knowledge needed to effectively navigate digital technologies and participate in the digital economy (OECD, 2020).

The implications of these proposed solutions are significant for stakeholders involved in promoting digital inclusion in Rwanda. By implementing targeted interventions that address the identified barriers, policymakers, development organizations, and technology providers can accelerate progress toward achieving universal digital access and fostering inclusive development. Moreover, the emphasis on community-based initiatives underscores the importance of grassroots engagement and participatory approaches in driving sustainable change.

Through collaborative efforts and strategic investments in digital infrastructure, education, and innovation, Rwanda can unlock the transformative potential of digital technologies to improve livelihoods, enhance social inclusion, and drive economic growth in rural areas. By leveraging these proposed solutions and building on existing initiatives, stakeholders can create an enabling environment for digital inclusion that empowers individuals and communities to thrive in the digital age.

Conclusion

In conclusion, this study has provided valuable insights into the current landscape of mobile financial services and barriers to digital inclusion in rural Rwanda, along with practical solutions to overcome these challenges. The assessment of mobile money usage revealed varying adoption rates across provinces, highlighting the transformative potential of mobile financial services in promoting financial inclusion. Identified barriers such as limited network coverage, affordability constraints, and low digital literacy underscored the complex nature of the digital divide in rural areas. However, proposed solutions including infrastructure investment, digital literacy programs, and affordable mobile financial services offer actionable strategies to address these challenges and foster inclusive development.

Recapitulating the study's objectives, we aimed to assess the current landscape of mobile financial services, identify barriers to digital inclusion, propose practical solutions, and provide recommendations for policymakers and stakeholders. Through a comprehensive analysis of survey data and qualitative insights, we have achieved these objectives, shedding light on the opportunities and challenges of digital inclusion in rural Rwanda.

The gender disparities in mobile money usage revealed by the analysis highlight significant challenges in achieving gender equality in financial inclusion efforts in rural Rwanda. The higher percentage of male users across all provinces underscores the need for targeted interventions to address the underlying barriers preventing women from accessing and utilizing mobile financial services. Factors such as limited access to mobile phones, lower levels of digital literacy among women, and socio-cultural norms may contribute to the observed disparities. Therefore, strategies to promote gender equality in mobile money usage should encompass multifaceted approaches, including improving access to mobile devices, enhancing digital literacy among women, and addressing cultural and social barriers that may inhibit women's participation in mobile financial services. By addressing these challenges and fostering gender-inclusive policies and initiatives, Rwanda can advance towards more equitable and inclusive financial access, empowering women and enhancing overall socioeconomic development in rural communities.

The implications of this research are significant for policymakers, financial institutions, and technology providers, emphasizing the importance of targeted interventions to bridge the digital divide and promote inclusive innovation. By implementing the proposed solutions and recommendations, stakeholders can accelerate progress toward universal digital access and empower rural communities to participate more fully in the digital economy.

Looking ahead, future research directions could focus on evaluating the effectiveness of implemented interventions, exploring the socio-economic impact of digital inclusion initiatives, and assessing emerging technologies to enhance digital access and financial inclusion. Additionally, longitudinal studies tracking the evolution of mobile financial services usage and digital literacy levels over time could provide valuable insights into the long-term sustainability of digital inclusion efforts in rural Rwanda.

In conclusion, this study underscores the transformative potential of mobile financial services in driving inclusive growth and highlights the importance of collaborative efforts to overcome barriers to digital inclusion. By prioritizing investments in digital infrastructure, education, and innovation, Rwanda can build a more inclusive and resilient digital ecosystem that empowers all citizens to thrive in the digital age.

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