

DIGITAL CONNECTIVITY IN BURUNDI AND TANZANIA: PATHWAYS TO DIGITAL DEVELOPMENT IN AFRICA

BY

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| DIGITAL CONNECTIVITY IN BURUNDI |
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ABSTRACT

The pervasiveness of information and communication technology in the contemporary business world is becoming a determinant tool for a Nation's sustainable development. ICT development appears as a catalyst for a country's economic growth and UNSDG achievement. Scholars agree that Digital technologies play a fundamental role in enabling the realization of the Sustainable Development Goals (SDGs) established by the United Nations (UN) in 2015.

This secondary research data examined Burundi and Tanzania's digital connectivity and pathways to Africa's digital development. The relevance of this study was to highlight differences in digital connectivity between the two countries, as there was no previous ICT sector study has compared the two countries before. The study collected and analyzed existing data gathered by other scholars in academic journals; reports; online data; books, and government data. It analyzed content by synthesizing information from different sources as well. The study examined connectivity in Tanzania and Burundi by analyzing data from the ITU Development Dashboard, GSMA, and World Bank data. The findings showed that Tanzania is more advanced than Burundi in terms of ICT development whereas Burundi still lacks internet connectivity in its different regions, leading to a national digital divide.

The digital divide in Burundi is a huge challenge because it hampers internet connectivity to a large number of rural households as many Burundians live in rural areas. The study examined secondly the digital development and SDG advancement in Burundi and Tanzania as ICT is an enabler of UNSDG achievement and Burundi still has ICT development gaps. Results showed that Tanzania has succeeded in harnessing ICT benefits to advance UNSDG achievement, especially UNSDGs 2, 3, 4, 7, 11, and 17, where the United Republic of Tanzania used ICT to boost SDG achievement. The third question was to examine digital development policies in Burundi and Tanzania. Findings showed an explicit difference between the two countries. Tanzania already invested in ICT infrastructure, including broadband networks and the NICTBB to enhance internet connectivity to all its citizens. Burundi also made efforts to increase connectivity but needs further work to improve internet connectivity. Tanzania has implemented initiatives to improve digital literacy, ensuring that its citizens acquire the abilities and knowledge to effectively utilize ICT. Burundi still has issues with digital literacy, with much of the nation lacking digital literacy skills due to the digital divide recorded in rural areas.

Burundi should endeavor to enhance internet connectivity nationwide. The majority of Burundians live in rural areas where there is a digital divide. This category of people once connected would benefit from actual and updated information and get different opportunities. Internet connectivity would help them facilitate and improve their diverse initiatives. Internet connectivity would improve skills for rural people and connectivity would improve rural businesses and entrepreneurial efforts. Consequently, this would facilitate long-term economic development. There is a need for increased awareness of the advantages of ICT development in Burundi. The population should be educated about the benefits of information and communication technology. Introducing initiatives that highlight the positive impact of ICTs on sustainable development and economic growth would motivate the people of Burundi to actively pursue opportunities associated with ICTs.

Keywords: ICT, Digital Development, Digital Divide, SDG, Burundi, Tanzania

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LIST OF ABBREVIATIONS

| Symbols/Abbreviations | Terms | |
|-----------------------|---|--|
| AI | Artificial Intelligence | |
| AR | Augmented Reality | |
| BBS | Burundi Backbone System | |
| CROs | Certificates of Registered Ownership | |
| DT | Digital Technologies | |
| GDP | Gross Domestic Product | |
| GNI | Gross National Income | |
| GSMA | Global System for Mobile Communications Association | |
| HDI | Human Development Index | |
| ICTs | Information and Communication Technologies | |
| IOM | International Organization for Migration. | |
| ITU | International Telecommunication Union | |
| ΙοΤ | Internet of Things | |
| LEO | Low Earth Orbit | |
| MOHCDGEC | Ministry of Health, Community Development, Gender, | |
| | Elderly, and Children | |
| NICTBB | National ICT Broadband Backbone | |
| ONAMOB | Office National des Télécommunications (Burundi | |
| | Telecommunications National Office) | |
| OECD | Organisation for Economic Co-operation and | |
| | Development | |
| SDGs | Sustainable Development Goals | |
| TCRA | Tanzania Telecommunication Company Limited | |
| TELCOS | Telecommunication Control and Regulatory Agency | |
| TTCL | Telecommunications Operators | |
| UN | United Nations | |
| UN MDG | United Nations Millenium Development Goals | |
| UNSDGs | United Nations Sustainable Development Goals | |

(6)

| Symbols/Abbreviations | Terms |
|-----------------------|-----------------------------|
| URT | United Republic of Tanzania |
| US\$ | United States Dollar |
| VNR | Virtual Reality |
| VR | Voluntary National Report |
| WFP | World Food Program |
| Zantel | Zanzibar Telecom Limited |



CHAPTER 1 INTRODUCTION

Digital technologies play a crucial role in facilitating the realization of the Sustainable Development Goals (SDGs) set forth by the United Nations (UN). Clark et al. (2022, p. 1), highlight the importance of broad and inclusive involvement in the digital realm and connectivity in achieving all SDGs. The advancement of technology can accelerate the achievement of the UNSDGs. According to Wynn and Jones (2020, p. 7), quick technological progress could potentially transform how the SDGs are attainable. The initiative of enhancing the working communication system; comprehension of digital competencies and skills; favorable equipment; and a compelling environment would be milestones for achieving the UNSDGs.

According to O'Sullivan et al. (2021, p. 2), a roadmap for action in all societies would enable equitable achievement of SDGs: Digital infrastructure, including an operational communication system that ensures universal and equitable digital connectivity for all; digital capabilities including an educational system offering universal capacity for navigating the digital era; digital commodities offering equipment needed for lowest living standards; and digital governance ensuring an environment that incorporates digital tools into everyday life, with inclusive national policies safeguarding privacy, ethics, and security for all.

Decent information and communication technologies are essential for supporting SDGs. Wynn et al. (2021, p. 1) diagnose growing acknowledgment of the need for suitable Information and communication technologies (ICTs) for supporting and monitoring the advancement of SDGs. ICTs play an essential role in economic growth and SDG achievement. Prieto-Egido et al. (2023, p.2) argue that ICTs are versatile instruments addressing worldwide issues outlined in SDGs.

The degree of digitization is a determinant of entrepreneurial initiatives that can boost the progress of specific SDGs. Herman (2022, p. 1) highlights that the level of national digitalization positively impacts digital entrepreneurship, characterized by innovative and productive entrepreneurial initiatives contributing to attaining all SDGs, especially SDGs 8 and 9.

ICTs play a vital role, with technological innovation boosting SDG efficiency and levels. According to Jones et al. (2017, p. 12), technology and technological innovation are usually considered essential for enhancing effectiveness in sustainability. Enabling sustainable growth, ICTs may increase the diffusion of diverse technologies throughout the economy. Quick adoption of these technologies is essential for accomplishing the SDGs by 2030.

According to Dr. Hamadoun Touré, the ex-Secretary General of the International Telecommunication Union (ITU), the potential of digital technologies to drive socioeconomic transformation in Africa is widely recognized. Dr. Touré emphasizes the transformative nature of ICTs, stating that technology can educate every person in Africa, regardless of location. Furthermore, technology can generate fresh prospects and higher-paying employment opportunities for the African population. Additionally, through the power of technology, healthcare services can be extended to every citizen of Africa, including those residing in the most remote villages (Anwar and Graham 2022, p. 1 citing Touré (2013) speech).

This paper examines digital development with a focus on connectivity and its impact on the developing countries of Burundi and Tanzania. Burundi and Tanzania are East African nations with contrasting connectivity, socio-economic development, and SDG achievement. This study will compare the two countries and try to understand digital connectivity gaps, examining what Burundi might learn from Tanzanian approaches and related national policy differences. It will also propose what Burundi might do to increase digital connectivity.

1.1 National Characteristics of Burundi and Tanzania

Burundi is a landlocked nation with a low economic status situated in East Africa. As per the World Bank (2022), Burundi has a total population of 12.9 million, while Tanzania's population is 65,497,748, approximately five times greater. In Burundi, 86% of the population lives in rural regions, whereas in Tanzania, 63% reside in rural areas (World Bank, 2022). Therefore, Tanzania has a considerably higher percentage of its population residing in urban areas than Burundi.

It stands as one of the least affluent nations globally, Occupying the 185th rank among 189 countries in the 2019 Human Development Index (HDI), reflecting challenging socio-economic conditions. As per the Transformation Index report by the Bertelsmann Stiftung (2022), in 2020 Burundi had a Gini coefficient of 0.68, showing a significant income gap between its wealthiest and poorest residents. Poverty levels have stayed high in recent times, with up to 73% of the population residing in poverty in the year 2020.

The majority of Burundians reside below the poverty line (72%), and in rural areas, this rate rises to 87%. The country's economy heavily depends on the agricultural sector, employing 80% of the workforce but contributing only 40% to the gross domestic product (GDP). In 2017, the economy experienced a recession due to unstable political conditions, low private consumption attributable to decreased food production caused by poor weather conditions, and forced migration of refugees and internally displaced persons (World Bank, 2019; Cowin, 2020). As agricultural activity is rudimentary, yields are not extensive.

Ndoricimpa and Ndayikeza (2023, p. 1) show that since gaining independence in 1962, Burundi has gone through six instances of internal conflicts, occurring in 1965, 1972, 1988, 1991, 1993-2013, and 2015, respectively. The authors emphasize that between 1970 and 2015, civil conflicts, on average, led to an annual reduction in economic growth by 4 percentage points during these conflicts. The civil war from 1993 to 2003 incurred a cost for each Burundian ranging from US\$ 1,290 to US\$ 1,520, and for the entire nation, the cost was estimated to be between US\$ 8 billion and US\$ 10 billion. The most recent civil conflict in 2015 was relatively expensive, causing a reduction in economic growth by 8.9 percentage points. Economic growth declined significantly during these crises, making business life nearly impossible.

Recurring conflicts have detrimentally impacted all national economic prospects and human capital dimensions. Gyimah-Brempong and Corley (2005, p. 299) note that civil conflicts in Sub-Saharan African nations have substantial, statistically significant adverse effects on per capita income growth rates. They emphasize that civil war significantly hampers per capita income growth, even when other factors are considered.

Burundi and Tanzania differ significantly in terms of development. According to the World Bank (2022), Burundi has a GDP of 3.9 US\$ billion, with a per capita GDP of 303.9 US\$, and annual GDP growth of 1.8 %, compared to Tanzania's GDP of US\$ 75.5 billion, per capita GDP of US\$1151.4, and annual GDP growth of 4.6%. These statistical differences illustrate different developmental stages, reflected and amplified by differences in connectivity in Burundi and Tanzania.

1.2 ICT development in Tanzania and Burundi

According to the ITU (2021), In Tanzania, the mobile cellular network coverage extended to 95%, with 85% coverage for 3G networks, and only 13% of the population could connect to 4G networks. In contrast, mobile cellular network coverage in Burundi was lower. While 97% of the population had access to a mobile cellular network, only 51% were covered by 3G, and 4G networks reached 32%. In Tanzania, there were no fixed-line telephone subscriptions per population, but there were 85 mobile cellular subscriptions per 100 inhabitants. In Burundi, mobile cellular subscriptions per 100 inhabitants were 65, and fixed telephones per 100 inhabitants were nonexistent (ITU, 2021). These data further demonstrate differing levels of connectivity in Burundi and Tanzania.

Despite significant differences in the GDP size and growth as well as rates of digital connectivity, both countries have competitive telecommunication sectors with multiple nationally active telecommunications operators. Burundi has four telecommunications operators: Lumitel Burundi; Econet Wireless Burundi (LEO); Smart Burundi; and Onatel Burundi (ONAMOB) (WFP, Logistics, 2022). Tanzania has twice as many: the government-owned Tanzania Telecommunication Company Limited (TTCL); privately-owned Airtel Tanzania; Smart Telecom; Viettel Tanzania Limited (Halotel); MIC Tanzania Limited (Tigo); Vodacom Tanzania; SMILE; and Zanzibar Telecom Limited (Zantel) (WFP, Logistics Cluster, 2022). In both nations, the Vietnamese network provider Viettel

aims at rural market orientation. In Burundi, it operates as Lumitel Burundi and in Tanzania as Viettel Tanzania Limited under the brand Halotel.

This study will examine these differences in connectivity in more detail and why they exist; explore how gaps could be closed and how Burundi could benefit by attaining higher levels of digital connectivity, especially in terms of achieving SDGs. This research is based on political economy and development studies, with a focus on ICT for development.



CHAPTER 2 LITERATURE REVIEW

This literature review outlines the general current state of existing knowledge of digital connectivity and its benefits for sustainable development in different sectors of national lives to understand the implications for African countries of low rates of connectivity and how connectivity may be expanded. This section used data from; the Global System for Mobile Communications Association (GSMA); World Forum Economy; the World Bank, academic articles, and journal articles. First, the concepts of ICT, digital development, and the digital divide will be defined.

Different authors define the concept of ICT diversely, with some constants. Akkermans (2005, p. 10) provides a definition of ICT as technology that involves the electronic acquisition, storage, processing, and dissemination of information, encompassing devices like radio, television, telephone, and computers. According to Chen et al. (2015, p. 29), ICT comprises abilities, software, programs, and technological systems. Basque (2005, p. 34) defines ICT as A collection of technologies grounded in computing, microelectronics, telecommunications, multimedia, and audiovisual elements that, when integrated and interconnected, facilitate the retrieval, storage, processing, and transmission of information. These technologies also promote interactivity among individuals and between individuals and machines.

The idea of digital development refers to a procedure of digital expansion for beneficiaries. It indicates the process of harnessing ICT, including the internet, applications, and digital infrastructure to run businesses in a society. For Lucendo-Monedero et al. (2019, p. 197), digital progress involves ensuring that every household and individual within a society can utilize information and communication technologies (ICTs) to access various essential public and private services, as well as to communicate with both each other and the government.

The opposite of digital development is the digital divide. It is about the gap in digital development where digital access inequalities are recorded. It denotes the absence of

societal access, utilization, and competence in information and communication technology. The digital divide, as defined by the OECD (2001), is the disparity among individuals, households, businesses, and geographic regions at various socio-economic levels concerning the opportunities to access information and communication technologies (ICTs) and utilize the Internet for a diverse range of activities.

The telecommunication industry is essential for digital development and economic growth at the national level. Wickramasinghe and Abd Razak (2023, p. 26) state that the telecommunications industry is foundational for a nation's overall growth. Other research supports this argument. For example, Urama and Oduh (2012, p. 26) highlight that technologies are deemed by nations and internationals as critical instruments for national incorporation because they can enhance healthcare and education services and offer economic prospects to disadvantaged communities.

The development of digital technology is foundational, helping achieve economic growth and development. Digital technology development impacts all the systems of a Nation's lives. For example, Sen and Bingqin (2019, p. 23) point out that expanding digital connectivity and the digital economy illustrate the potential for helping development, as in certain cities in China. Some urban areas of China have succeeded in harnessing digital technology.

Mobile phones are essential tools in the contemporary era. They facilitate logistics and minimize transportation costs, innovating ways to bridge gaps between suppliers, sellers, and buyers to create a space where the issue of value determination may be addressed. Information and communication technologies help economic growth because they facilitate business activities. Grzybowski (2022, p. 50) stresses that mobile money services ease transfers from wealthier to less affluent regions, from more prosperous individuals to those with fewer resources, and from younger individuals to older ones, thus contributing to a decrease in income inequality.

The ICT revolution has impacted all education systems as well. Learning, teaching, and school management have been positively affected by ICT advancement. (Wang, 2022, p. 1) calls ICT an enabler for educational reform, with an impact on students and teachers

that should not be understated. Likewise, the educational sector has been positively impacted by the technological revolution through the creation of opportunities. Tjoa & Tjoa (2016, p.9) show that ICT plays a significant part in realizing the goal of quality education and lifelong learning, as outlined in SDG 4 and SDG11, stipulating that Urban areas and human settlements should embody inclusivity, safety, resilience, and sustainability. Information and communication technology (ICT) aids smart cities in envisioning more efficient utilization of resources in urban environments.

Nevertheless, some African countries risk being left behind due to poor connectivity and a lack of ICT development that affects all national sectors, resulting in low economic levels and non-UN MDG achievement. According to the World Forum Economy (2020), Burundi is lagging in telecommunications development. In 2021, the country code +257 recorded a total of 7.76 million connections, with 7.74 million being mobile phones, equivalent to an average of 0.62 mobile phones per capita. Tanzania is on a good track to developing digital development to meet SDGs. According to GSMA (2019), Tanzania is in the midst of a digital revolution, evident in the increasing number of individuals accessing communication and internet services. This transformation is significantly influencing the country's social, cultural, and economic structures by providing broader access to essential services and enhancing productivity and efficiency across various economic sectors.

The literature review shows how digital technologies have shaped and contributed to economic growth in some developing countries through a potential for contributing to economic growth. ICT is an enabler that contributes to achieving SDGs. By contrast, a lack of digital connectivity may hamper the progress of SDGs which results in a lack of economic growth. Therefore, there may be a relationship between Tanzania's greater connectivity and development progress. The review also shows that Burundi remains behind in terms of connectivity and is likely missing out on diverse development outcomes due to low connectivity rates. By comparing Burundi and Tanzania, two neighboring nations, predictions will be developed for potential social and economic impact if Burundi as the less connected nation can adopt policies to expand connectivity to rival Tanzania in this respect.



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CHAPTER 3 RESEARCH QUESTIONS & METHODOLOGY

3.1 Research Gap and Questions

Despite the low rate of digital connectivity in Burundi, there has been no comprehensive study of the state of connectivity and how it could develop a digital development pathway to help it achieve SDGs. Several African countries are achieving significant improvements in connectivity and economic growth that could provide insights into potential pathways for Burundi. One such country is Tanzania, but no significant study comparing Tanzania and Burundi is present in the literature.

To fill these gaps in the existing body of literature, identify pathways for digital development, and bridge the digital divide in Burundi, this research will ask the following questions:

- 1. What are the differences between Burundi and Tanzania's digital divide and digital development?
- 2. How is digital connectivity supporting the achievement of the SDGs in Tanzania and Burundi?
- 3. What are the policy differences between Burundi and Tanzania, and what should Burundi do to expand its digital development to support the achievement of SDGs?

3.2 Research Methodology and Conceptual Framework

To answer all the questions, secondary research data consisting of collecting and analyzing existing data gathered by other scholars in academic journals; reports; online data; books, and government data will be consulted. The study will analyze content by synthesizing information from different sources.

To answer the first question on connectivity in Tanzania and Burundi, the study will primarily examine data available from the ITU Development Dashboard, and GSMA data. It will also consider other sources, such as the World Bank data. To answer the second question on how digital connectivity is supporting the achievement of the SDGs in Tanzania and Burundi, the study uses the UN SDGs as a structure for evaluating the potential influence of digital connectivity on sustainable development made by the two countries so far. This section will therefore assess Burundi's condition regarding achieving UN SDGS by using data from various UN and Burundi government reports on Burundi's progress toward achieving SDGs. Through this analysis, the study will identify weaknesses and priorities for Burundi in its development agenda. The study will then consider how these challenges may be addressed through greater connectivity. The study then applies insights from the ITU (2021) overview, "Digital technologies to achieve the UN SDGs" which lists different impacts of digital technology on achieving SDGs. Using these insights, the study will analyze how greater connectivity and the expansion of digital technology could support Burundi in achieving diverse development challenges.

The third question is on digital development policy in Tanzania and Burundi, what Burundi should do to expand connectivity to achieve sustainable development, as well as comparative policies and projects made by the two nations to improve ICT development. The study will draw on the areas where ICT in Tanzania has succeeded and propose that Burundi consider and implement them depending on specific needs. Examples will also be drawn from other African countries to identify how Burundi might expand digital connectivity to support SDG achievement.

CHAPTER 4 FINDINGS

4.1 Digital Development in Burundi and Tanzania

4.1.1 Digital Development in Burundi

Internet access remains a significant issue in Burundi, where much of the nation has no Internet coverage. The Telecommunication Control and Regulatory Agency (TCRA) of Burundi observes that until the end of March 2023, 65 % of the Burundian population have mobile phones, but only 24 % have Internet access. The paucity is observed and aggravated in rural areas where the majority of Burundians live. According to Frąckiewicz (2023), this limited penetration may be attributed to factors such as expensive internet services, inadequate infrastructure, and insufficient investments in the sector. Consequently, a significant portion of Burundians face difficulties accessing essential information and services, including healthcare, education, and government services, and are progressively transitioning to online platforms. The total female population of internet users was 1% (ITU, 2017) while the total male population of internet users was 4% (ITU, 2017). The mean monthly fixed broadband internet usage per subscription stood at 116353, while the average monthly mobile broadband traffic per mobile broadband subscription was 31 (ITU, 2021).

According to the ITU (2021), network coverage by population on mobile phone networks was 97%, and 3G network at 51%, whereas the population covered by 4 G networks was only 32%. In terms of Mobile phone ownership, according to ITU (2017), only 18 % owned mobile phones, including 12% of the female population and 25% of males. The ITU (2017) reported that 1% of households owned computers. Rural and urban communities were not distinguished in these studies, and the homes possessing internet connectivity were not identified. There was a 62% mobile cellular subscription rate per 100 inhabitants (ITU, 2021), while fixed telephones per 100 inhabitants were at 0%.

Concerning mobile and fixed broadband subscriptions, there were 8% active mobile broadband subscriptions per 100 inhabitants, 0% fixed broadband

subscriptions per 100 inhabitants, and international bandwidth per internet user recorded at 13% (ITU, 2021). The estimated percentage of individuals utilizing the Internet was 6% (ITU, 2021). In Burundi, mobile and voice baskets (high consumption: a large number of people utilizing mobile and voice services) as per capita (pc) Gross National Income (GNI) was at 56. 9 %. The minimal usage of mobile data and voice services, indicative of a small user base, constituted 29.6% of Gross National Income per capita. Mobile cellular services, as a proportion of Gross National Income per capita, were 25.4%. Furthermore, portable broadband services, relative to Gross National Income per capita, amounted to 13.7%. However, the proportion of fixed broadband services to Gross National Income Per Capita remained unspecified, as per ITU (2019).

3.1.2 Digital Development in Tanzania

According to the ITU (2021), in Tanzania, network coverage by the population on mobile cellular networks was 95%, on the 3G network at 85%, while the population covered by 4 G networks was only 13%. 9% had ICT access at home and 2% of households owned a computer (ITU, 2017). In rural areas, the percentage was 4 % while for urban communities, 3 % of households had home internet access (ITU, 2016). The mobile cellular subscription rate reached 85% per 100 inhabitants (ITU, 2021), with fixed telephones showing a 0% rate per 100 inhabitants. Concerning mobile and fixed broadband subscriptions, there were 18% active mobile broadband subscriptions per 100 inhabitants, and fixed broadband subscriptions per 100 inhabitants were at 0%. International bandwidth per internet user was at 6% (Kbit/s) (ITU, 2021). The average monthly fixed broadband internet usage per subscription was 563, while the average monthly mobile broadband traffic per subscription was 3535 (ITU, 2021).

In Tanzania, the mobile and voice basket (indicating high consumption with numerous users of mobile and voice services) accounted for 22% of GNI per capita. The mobile data and voice basket, which indicates limited usage of mobile and voice services, accounted for 9.6% of GNI per capita. Mobile cellular services represented 7% of GNI per capita, and mobile broadband services constituted 4.9%. However, the proportion of the fixed broadband basket to GNI per capita was not specified, according to ITU (2021). The data illustrating the digital divide and digital development underscore the contrasting levels of connectivity between the two countries, with Burundi exhibiting lower connectivity compared to Tanzania.

4.2 Digital Development and SDG Achievement in Burundi and Tanzania

According to ITU (2021), ICTs can advance each of the 17 UNSDGs. Effective and affordable ICT infrastructure allows nations to commit to the digital economy and increase economic competitiveness and welfare. Information and communication technologies (ICTs) offer the tools to provide excellent goods and services in critical sectors such as healthcare, education, finance, commerce, governance, agriculture, and various other domains. They can decrease poverty and hunger, enhance health, increase job opportunities, enable the fight against climate change, ease energy effectiveness, and promote green cities and societies. So, ICTs are critical tools in all life sectors. Lu (2017) also highlights that ICT is a key enabler of SDG achievement.

This section will compare the SDG attainments of Burundi and Tanzania. As United Nations members, they aspire to a 2030 agenda proclaimed in 2015. Voluntary national reports produced so far will help to illuminate their development level and progress in SDGs. We will analyze SDGs impacted by ICTs through the 2020 voluntary national report of the Republic of Burundi and the July 2023 voluntary national report produced by the United Republic of Tanzania (URT). The analysis will draw on other sources, including published articles, to calibrate their contrasting progress.

4.2.1 Digital Development and SDG 2: Zero Hunger

Nyamba and Mlozi (2012, p. 562) show that considering the 79% penetration rate of mobile phone technology, rural Tanzania had a strong inclination toward embracing technology, likely leading to a positive economic influence. Consequently, mobile phones were seen as a means to provide farmers with access to market information, enhancing their standing in the value chain. This in turn increased their awareness and capacity to make well-informed decisions. In Burundi, with over 90% of the population involved in agriculture, there is no use of digital technology to increase agricultural

productivity or fight for food security. Agricultural practice remains rudimentary, a major difference between Burundi and Tanzania in terms of ICT integration in agriculture. Expansion of ICT development would be critical for Burundi to achieve all UNSDGs. Rosário and Dias (2022, p. 1) explain that processes of transitioning to digital technologies have shown potential in creating and executing sustainable solutions. These solutions may address different challenges, including poverty, species extinction rate, and disparities in opportunities, promoting sustainability. This shows that expanding digital technologies enhances national SDGs.

Dhanaraju et al. (2022, p. 1) show that smart agriculture represents a trend emphasizing the application of ICT in the framework of advanced farm management systems. This includes integrating cutting-edge technology like IoT and cloud computing, which are expected to drive expansion and introduce the adoption of robotics and artificial intelligence in the agricultural sector. Likewise, ICT should help augment agricultural productivity, facilitating the achievement of SDG 2 by enhancing food security and decreasing hunger; as well as SDG9 by innovating with agricultural technology. Akram et al. 2022, p. 13) point out that introducing digitalized technology like the Internet of Things (IoT), artificial intelligence (AI), blockchain, augmented reality (AR), and virtual reality (VR) have the potential to help achieve Sustainable Development Goals (SDGs) relevant to the fashion industry. Integrating these technologies would increase the achievement of SDG1 by decreasing poverty through paid job opportunities; SDG 8 by promoting sustainable economic growth and achieving Goal 8, which focuses on decent work, as well as supporting progress in industry and infrastructure (SDG 9). As Tanzania has adopted ICTS benefits to attain UNSDGs, Burundi should consider ICT investment to accelerate its own SDG progress.

4.2.2 Digital Development and SDG 3: Ensuring Health and Well-Being for

All

Hamad (2019, p. 372) argues that the Tanzanian government, collaborating with the Ministry of Health, Community Development, Gender, Elderly, and Children (MOHCDGEC) and diverse partners, has improved the healthcare sector by

implementing an extensive nationwide eHealth system. This entails establishing health information systems, teleconsultations, e-learning platforms, teleconferencing, electronic health records, and telehealth systems. However, in Burundi, the adoption of digital technologies is still in its early stages.

ITU (2021) shows that improving digital connectivity could drive enhancements in direct patient engagement, health informatics, and telemedicine. Digital health is key to healthcare improvement. ITU (2017) shows that the implementation of connectivity and e-health initiatives has the potential to improve access to healthcare and services, facilitating the exchange of essential health-related information. Awad et al. (2021, p. 4) suggest that healthcare systems progressively reflect that integrating contemporary technologies can optimize the patient journey, starting from symptom recognition to treatment and ongoing care. This shift in approach holds the promise of expanding healthcare accessibility, reducing expenses, and offering personalized services catering to individual requirements. This makes it clear that adopting digital health is critical to advance the achievement of SDG 4, stipulating good health and well-being.

4.2.3 Digital Development and SDG 4: Quality Education

Malero et al. (2015, p. 29) state that the Tanzanian government has initiated projects to integrate ICT at different educational levels, and parallel efforts have been observed in private institutions. As a result, Dodoma municipality private secondary schools exhibit a higher level of preparedness for ICT usage compared to their public counterparts.

In the United Republic of Tanzania, ICT integration in the education system is longstanding. Lembuka (2023, p. 88) shows the use of ICT in education is a wellestablished concept; during the late 1960s and early 1970s, radios were distributed to primary and secondary schools to facilitate access to educational programs created in partnership with Radio Tanzania, Dar es Salaam, and broadcasted. However, in Burundi, there is no utilization of information and communication technology within the educational system. Pedagogical approaches remain traditional, although some students make efforts to use their smartphones and computers for assignments. This may be substantiated by the example of Bazira et al. (2023, p. 13) in Burundi, who assert that almost half of students integrate ICT into pedagogy. Yet the pedagogical approach persists in being traditional, missing ICT integration. The unfavorable national environment is the principal hindrance to the dynamic integration of ICT into the learning process of medical students. The authors point out that lack of institutional vision strategy, failure to execute organizational elements crucial to pedagogical integration dynamics, inadequacy of technical equipment, and cost of materials exceed student financial capacity.

For Xinran Wang (2022, p. 6), the introduction of ICT significantly eases the process of educational transformation with a strong emphasis on teaching. Its primary impact is observed in the domains of learning and teaching, although it also extends to management and research. Within the education sector, ICT serves as a driving force for educational innovation and reform. This demonstrates that if ICTs are well developed in education sectors the Fourth SDG 3 of quality education will be achieved due to ICT development.

4.2.4 Digital Development and SDG 11: Promote inclusivity, safety, resilience, and sustainability in cities and human settlements.

In the United Republic of Tanzania, the report submitted voluntarily (2023) stated that from 2019 to 2022, the issuance of land title deeds for development (CROs) in urban areas rose by 77.9%. During these years, 6,753 residential and commercial structures were built. The land management system was also enhanced by ICT integration in the land sector, resulting in the digitalization of all land records. This includes digitization (scanning and verification) of town and survey plans across all 26 regions of the country, encompassing 30,812 layout plans with 7,241,686 plots, 112,297 survey plans with 2,385,114 plots, and 524,131 title deeds, which have been archived and made accessible (VNR, 2023). In contrast, Burundi has not implemented tangible integration of information and communication technology to create inclusive, safe, resilient, and environmentally sustainable cities and settlements.

Pigola et al. (2021, p. 1) stress that digital technologies (DT) are marked by a capacity for innovation and increasingly play significant economic, social, and environmental roles. This shows that innovation through digital technology integration would boost the attainment of sustainable development objectives, such as SDG 10, which involves reducing inequality, expanding access to information, and generating additional opportunities; SDG 11 by improving urban planning and resource management; and SDG 13 by supporting climate initiatives and environmentally sustainable practices.

4.2.5 Digital Development and SDG 17: Partnerships for Goals

The United Republic of Tanzania promoted initiatives to make all stakeholders aware of the SDGs so that stakeholders in resources were able to dynamize SDG 17 implementation. According to the voluntary national report (2023), Tanzania has also made notable advancements in promoting the adoption and utilization of digital technologies, including investments in digital infrastructure, such as the National ICT Broadband Backbone (NICTBB). Robust policy actions were implemented to guarantee that various stakeholders involving both private enterprises and the broader public could derive advantages from accessing these public assets, thereby fostering comprehensive socio-economic development. However, the voluntary national report (2020) of Burundi lacks mention of information and communication technologies as enablers to boost SDG achievement.

ICT is a catalyst for UNSDG advancement. The United Republic of Tanzania made significant progress in UNSDGs according to the voluntary national report of 2023. Yet the voluntary National Report of 2020 for Burundi, reveals no ICT integration among progress in 17 UNSDGs.

4.3 Digital Development Policies in Burundi and Tanzania

Drawing on the Voluntary National Report (2023), Tanzania has made significant investments in expanding ICT infrastructure, including broadband networks and the NICTBB, to improve digital connectivity. Burundi has introduced ICT infrastructure in different policies and projects, but issues occur due to an enduring digital development gap. A broadband infrastructure priority in Burundi would enhance connectivity access and speed for inhabitants nationwide. For example, Fortune for Africa (2023) indicates that the wireless broadband connectivity initiative, backed by the American Foundation Susan & Craig McCaw and facilitated through the International Telecommunication Union, has a budget of \$845,715. Its primary goal is to extend ICT services to rural schools and hospitals. Moreover, the Burundi Backbone System (BBS), a combined national network utilizing optical fibers and radio beams, links with international fiber optic cables via the East African Backbone System. The primary goals of the BBS include establishing a nationwide transmission network, providing affordable telecommunication services to both urban and rural regions, enhancing national and international bandwidth, and cutting down communication costs. Additionally, the Pan African e-network, presented as a gift by the Government of India to 53 African Union countries, offers distance learning and e-education services. The University of Burundi is responsible for delivering educational services through this initiative, while Roi Khaled Hospital was chosen to provide telemedicine and e-health services. These are among the projects launched to improve digital connectivity in Burundi.

To address challenges related to inadequate telecom infrastructure, the Burundian government has offered support to prominent telecommunication operators (telcos) in constructing a domestic fiber backbone network that has been established, facilitating connections to the submarine cable infrastructure in Kenya and Tanzania. Since its initial launch in early 2014, the network has grown to encompass additional provinces. Additionally, in the early part of 2018, the government launched the Burundi Broadband project to ensure nationwide connectivity through 2025 (Lancaster, 2022). Lancaster adds that to leverage this enhanced infrastructure, the government, in collaboration with ITU, devised an ICT strategy to use telecommunications to promote national socio-economic development until 2028.

Furthermore, providers of satellite internet services have acknowledged the opportunities within the Burundian market and have commenced delivering their services in the nation. Avanti Communications, a company based in the UK, deployed a HYLAS 4 satellite in 2018, offering coverage across the entire African continent, including Burundi, to deliver high-speed internet access even in remote areas. International providers such as

SpaceX's Starlink and OneWeb are also exploring opportunities in the African market potentially enhancing connectivity in Burundi. Satellite internet in Burundi offers several advantages, including bridging the digital divide by offering cost-effective and dependable access to millions who are currently without service. This may significantly impact education, healthcare, and economic development. For instance, remote learning opportunities for rural students and telemedicine services for better healthcare access can be enabled (Frąckiewicz, 2023).

Burundi is poised to take advantage of Elon Musk's Starlink technology in the year 2023 This development could be transformative for the national economy, addressing the digital gap, boosting economic growth, enhancing education, and fostering innovation. Starlink, using satellites in low Earth orbit (LEO) and flexible receiver dishes, provides internet speeds of 50 to 200Mbps worldwide. This state-of-the-art approach may potentially revolutionize internet connectivity in Burundi with unprecedented speed and reliability (Iris News, 2023).

According to the Voluntary National Report (2023), Tanzania has initiated programs to promote digital literacy, ensuring that its population possesses the expertise and proficiency to utilize ICT efficiently. Burundi also launched digital literacy programs, but their reach and effectiveness are inferior. Burundians lack digital literacy skills, which hinders the exploitation of different opportunities despite the implementation of projects aimed at improving connectivity. Burundi should enlarge initiatives to close the digital divide in rural and marginalized areas through projects allocated to expand ICT access. This initiative would allow beneficiaries to become digitally skilled and use digital technology effectively.

The United Republic of Tanzania has initiated e-government services to enhance public service delivery, promote transparency, and facilitate government-citizen interactions (VNR, 2023). The Republic of Burundi should endeavor to introduce egovernment dynamism to improve citizen-government services. This would ideally facilitate online public services; enhance transparency; and reduce corruption. Researchers have noted that the United Republic of Tanzania has utilized ICTs in education to offer e-learning opportunities, potentially enhancing educational access and quality, especially in remote areas. Lembuka (2023, p. 97) explains that national policies emphasize integrating modern technology into teaching and learning processes. As in other developing nations, education system ICT service use is seen as a competitive advantage for enhancing academic achievement in higher learning institutions. However, in Burundi, integrating ICTs into the education system is still a challenge due to a lack of digital development.

Furthermore, the United Republic of Tanzania has implemented telemedicine and healthcare data management to improve access to healthcare through digital technology, especially in remote regions. Burundi is still implementing initiatives to enhance healthcare services but faces digital literacy skills issues. For example, Verbeke et al., (2017, p.90) conducted a study on implementing Burundian the past, present, and future architecture of the national e-health system. Findings were that uneven allocation of hardware equipment in healthcare facilities, largely driven by external donors, resulted in disparities. Internet connectivity posed challenges, and integration of health-oriented digital applications was limited. Paper-based tools still dominate healthcare administration. Uncoordinated development of health ICT in Burundi, marked by an absence of standards, data security risks, data quality variations, inadequate ICT infrastructure, an unregulated e-health sector, and a shortage of skilled personnel, led to numerous issues.

Tanzania has been fostering entrepreneurship and innovative initiatives through support for technology startups and establishing innovation hubs. Burundi has worked to create an environment conducive to entrepreneurship but has encountered economic and political challenges as well as a digital divide. It can look to expand its innovation ecosystem by supporting technology startups and incubators. This initiative would decrease the unemployability of young people and boost national economic growth.

Tanzania has harnessed ICTs for environmental monitoring and conservation, aligning with efforts to fight climate change and promote environmental sustainability. Nevertheless, Burundi faces environmental issues such as floods mainly in Bujumbura City, Gatumba area where water has displaced households. According to IOM (2023), over 10,000 inhabitants were forced to leave their homes because of destructive floods after rainfall in regions of Burundi. Rural dwellers in Gatumba in Bujumbura province were sheltered in schools, churches, and makeshift roadside housing. Loss of livelihoods and damaged businesses resulted from flood destruction of crops.



CHAPTER 5 ANALYSIS: IMPLICATIONS FOR BURUNDI'S DIGITAL DEVELOPMENT

The study aimed to assess the advancements in ICT development accomplished by the Republic of Burundi and the United Republic of Tanzania. First, ICT development in the two countries was compared, showing distinct differences, and in Burundi, a substantial digital divide.

The United Republic of Tanzania already prioritizes ICT. Its voluntary national report (2023) describes the experience of swiftly adopting advanced digital technology, which is currently prevalent in different economic and societal sectors. These technologies are evident in telecommunications, finance, governance, marketing, and service delivery.

For SDG achievement in Tanzania, ICT is already seen as a catalyst in SDG progress and achievement. Burundi has not yet integrated ICT, potentially impeding the country in SDG progress and achievement. This may be substantiated by the fact that in the voluntary national report (2020), ICT does not appear as an enabler for any SDG. Expanding ICT development would enable Burundi to achieve all SDGs. Prioritizing ICT development for Burundi in all sectors would help it accelerate UNSDG attainment, following the precedent of Tanzania.

Policy differences are substantial between Burundi and Tanzania. The United Republic of Tanzania has already commenced the establishment of broadband networks, including the National ICT Broadband Backbone (NICTBB), to allow digital connectivity in all areas and sectors of national life. For the Republic of Burundi, some projects are being implemented to enable improvements such as a wireless broadband connectivity project; BBS; and the Burundi Broadband project.

Burundi should learn from Tanzania's policies and projects by prioritizing broadband infrastructure initiatives to improve connectivity access and quality for residents. This would help Burundian economic growth by multiplying initiatives to close the digital divide in rural, marginalized areas through projects allocated to expand ICT access. The Republic of Burundi should endeavor to introduce e-government to improve citizengovernment interactions. Burundi can spark an innovation ecosystem fostering technology startups and incubators as well as develop data centers to host digital content and services. This would enable data protection and threat prevention.

Developing digital connectivity would help Burundi increase its key domains. If Burundi enhances the ICT sector, education, health, governance and public services, agriculture innovation, and financial inclusion will be improved. Economic development will result. This is substantiated by Telecom Review (2020) which stresses that ICTs can realize sustainable development on a scale, speed, and cost previously unimaginable a decade ago. They function as instruments for advancement in areas such as healthcare, education, finance, governance, and agriculture. Their influence extends to the alleviation of poverty and hunger, health enhancement, educational advancements, climate change mitigation, increased energy efficiency, and the establishment of sustainable cities and communities.



CHAPTER 6 CONCLUSIONS

This study examined digital connectivity in Burundi and Tanzania through pathways to digital development in Africa. The goal was to highlight differences in digital connectivity between the two countries, as no previous ICT sector study has compared Burundi and Tanzania.

The first question was about digital development in Burundi and Tanzania. The findings were that Tanzania is more advanced than Burundi in terms of ICT development. Burundi still lacks internet connectivity in widespread regions, creating a national digital divide. The digital divide recorded in Burundi is a huge issue as it hampers connectivity to big areas of the country.

The second question relates to digital development and SDG attainment in Burundi and Tanzania. ICT is an enabler of UNSDG achievement and Burundi still has ICT development gaps. Results show that Tanzania has harnessed ICT benefits to advance UNSDG achievement, especially UNSDGs 2; 3; 4, 7; 11; and 17, where the United Republic of Tanzania used ICT to boost SDG achievement.

Digital development can empower Burundi to achieve all SDGs. The integration of digital technology would boost SDG achievement such as SDG 4 by improving quality and accessibility; SDG 8 by creating jobs, boosting economic growth, and supporting entrepreneurship; SDG 10 by diminishing inequalities and increasing access to information and creating more opportunities; SDG 11 by improved urban planning and resource management; and SDG 13 by supporting climate initiatives and environmentally sustainable practices. ICTs developed in educational sectors would help the Fourth SDG 3 of quality education to be achieved through ICT development. ICTs would augment agricultural productivity, helping to achieve SDG 2 by focusing on enhancing food security and decreasing hunger; SDG9 through innovation in agricultural technologies; SDG11 by fostering sustainable urban agriculture; and SDG 13 by helping effective resource use through climate resilient agriculture. This shows that ICT growth would allow all SDGs to be achieved.

The third question was to examine digital development policies in Burundi and Tanzania. Findings identified an explicit difference between the countries. Tanzania made foundational investments in developing ICT infrastructure, including broadband networks and the NICTBB to enhance internet connectivity. Burundi also made efforts to increase connectivity but needs further work to improve internet connectivity. Tanzania has implemented initiatives to improve digital literacy, ensuring that its citizens acquire the abilities and knowledge to effectively utilize ICT. Burundi still has issues with digital literacy, with much of the nation lacking digital literacy skills due to the digital divide.

Tanzania has invested in a broadband infrastructure initiative to enhance access and speed. This would benefit Burundians nationwide who are affected by the digital divide. Burundi should develop initiatives to ensure digital inclusion in rural and marginalized areas through projects allocated to expand ICT access. This would train beneficiaries to become digitally skilled and use digital technology benefits effectively.

The Republic of Tanzania has introduced e-government dynamisms to improve citizen-government services to facilitate online public services; enhance transparency; and reduce corruption. Burundi has not yet established this approach that would benefit from time-saving, financial savings, and ultimately economic growth for all Burundians. Developing its technological innovation ecosystem by supporting technology startups and incubators. This initiative would increase employment among young people and boost economic growth nationwide.

Based on the achievements of Tanzania in digital development to achieve the Sustainable Development Goals, the Republic of Burundi should set various short-term priorities to improve its development. Burundi should endeavor to enhance internet connectivity nationwide. The majority of Burundians live in rural areas where there is a digital divide. This category of people once connected would benefit from actual and updated information and get different opportunities. Internet connectivity would help them facilitate and improve their diverse initiatives. Internet connectivity would improve skills for rural people and connectivity would improve rural businesses and entrepreneurial efforts. Consequently, this would facilitate long-term economic development.

There is a need for increased awareness of the advantages of ICT development in Burundi. The population should be educated about the benefits of information and communication technology. Implementing programs that underscore the beneficial influence of ICTs on sustainable development and economic expansion would motivate the people of Burundi to actively pursue opportunities associated with ICTs.

Burundi could develop digital skills training programs for a digitally skilled workforce either in the public or private sectors. The modern business world is becoming more digital in all its sectors. Burundi should be nudged and introduce training programs for its workforce on digital skills to adapt them to the contemporary digital era.

There are categories of Burundians that are marginalized and with low income in the suburban areas. Initiating digital programs allocated to digital inclusion would spark them toward digital benefits. These categories could harness digital development through tech start-ups and mobile money which could enable them to raise their income situation. Digital inclusion can help them to run their businesses through e-commerce, and e-payment. Digital inclusion can help them integrate into financial inclusion.

Burundi should promote ICT infrastructure investment by expanding broadband access and improving network quality. ICT infrastructure development would help Burundians to run their businesses and interactions effectively. This would enhance interactions between citizens in different sectors of the country.

In the long term, Burundi should develop e-government capabilities that streamline interactions between the government and its citizens. This approach allows online public services and enables quick interactions. It helps save time, save money, and improve quality service. The e-government approach would help Burundi to stop using paper-based services. This option would hinder bureaucracy and corruption. It would ameliorate transparency for the country in all its sectors as well.

Cybersecurity mechanisms are fundamental for data protection and security in a country. In the long run, the Republic of Burundi needs to establish cybersecurity dynamisms to protect and prevent data and clouds from cyberattacks.

The research dimension should be enhanced, to make data accessible online for researchers seeking information about Burundian initiatives, projects, and implemented policies. Developing research sectors and publishing research results by putting them online help outsiders to know what is happening in certain sectors/domains of the country.

Much more research is needed on digital development in Burundi, and it is hoped that this research project is one step towards advancing digital connectivity and helping Burundi achieve the UN Sustainable Development Goals. Future research should consider the political economy of telecommunications and the barriers to implementing policies that would enable digital development, connect the unconnected, and reduce inequality in Burundi.



REFERENCES

Articles

- Adeleye, N., & Eboagu, C. (2019). Evaluation of ICT development and economic growth in Africa. *NETNOMICS: Economic Research and Electronic Networking*, 20(1), 31-53. https://doi.org/10.1007/s11066-019-09131-6
- Akram, S. V., Malik, P. K., Singh, R., Gehlot, A., Juyal, A., Ghafoor, K. Z., & Shrestha,
 S. (2022). Implementation of digitalized technologies for fashion industry 4.0:
 Opportunities and challenges. *Scientific Programming*, 2022, 1-17.
 https://doi.org/10.1155/2022/7523246
- Awad, A., Trenfield, S. J., Pollard, T. D., Ong, J. J., Elbadawi, M., McCoubrey, L. E., Goyanes, A., Gaisford, S., & Basit, A. W. (2021). Connected healthcare: Improving patient care using digital health technologies. *Advanced Drug Delivery Reviews*, 178, 113958. https://doi.org/10.1016/j.addr.2021.113958
- Basque, J. (2005). Une reflexion sur Les fonctions attribuées aux TIC en enseignement universitaire. *Revue internationale des technologies en pédagogie universitaire*, 2(1), 30. https://doi.org/10.18162/ritpu.2005.66
- Belloc, F., Nicita, A., & Alessandra Rossi, M. (2012). Whether policy designed for broadband penetration? Evidence from 30 OECD countries. *Telecommunications Policy*, 36(5), 382-398. https://doi.org/10.1016/j.telpol.2011.11.023
- Bertani, F., Raberto, M., & Teglio, A. (2020). The productivity and unemployment effects of the digital transformation: An empirical and modeling assessment. *Review of Evolutionary Political Economy*, 1(3), 329-355. https://doi.org/10.1007/s43253-020-00022-3
- Bonina, C., Koskinen, K., Eaton, B., & Gawer, A. (2021). Digital platforms for development: Foundations and research agenda. *Information Systems Journal*, 31(6), 869-902. https://doi.org/10.1111/isj.12326

- Chen, A. N., Castillo, J. G., & Ligon, K. (2015). Information and communication technologies (ICT): Components, dimensions, and its correlates. *Journal of International Technology and Information Management*, 24(4). https://doi.org/10.58729/1941-6679.1051
- Clark, S., MacLachlan, M., Marshall, K., Morahan, N., Carroll, C., Hand, K., Boyle, N., & O'Sullivan, K. (2022). Including digital connection in the United Nations sustainable development goals: A systems thinking approach for achieving the SDGs. *Sustainability*, *14*(3), 1883. https://doi.org/10.3390/su14031883
- Dhanaraju, M., Chenniappan, P., Ramalingam, K., Pazhanivelan, S., & Kaliaperumal, R. (2022). Smart farming: Internet of things (IoT)-based sustainable agriculture. *Agriculture*, 12(10), 1745. https://doi.org/10.3390/agriculture12101745
- Gyimah-Brempong, K., & Corley, M. E. (2005). Civil wars and economic growth in subsaharan Africa1. *Journal of African Economies*, 14(2), 270-311. https://doi.org/10.1093/jae/eji004
- Herman, E. (2022). The interplay between digital entrepreneurship and sustainable development in the context of the EU digital economy: A multivariate analysis. *Mathematics*, 10(10), 1682. https://doi.org/10.3390/math10101682
- Hebert, R. F., & Link, A. N. (1989). In search of the meaning of entrepreneurship. Small Business Economics, 1(1), 39-49. https://doi.org/10.1007/bf00389915
- Jimoyiannis, A., & Komis, V. (2007). Examining teachers' beliefs about ICT in education: Implications of a teacher preparation program. *Teacher Development*, 11(2), 149-173. https://doi.org/10.1080/13664530701414779
- Jones, P., Wynn, M., Hillier, D., & Comfort, D. (2017). The sustainable development goals and information and communication technologies. *Indonesian Journal of Sustainability Accounting and Management*, 1(1), 1. https://doi.org/10.28992/ijsam.v1i1.22
- Junghans, A., & O.E. Olsson, N. (2014). Discussion of facilities management as an academic discipline. *Facilities*, 32(1/2), 67-79. https://doi.org/10.1108/f-10-2012-0078

- Malero, A., Ismail, A., & Manyilizu, M. (2015). ICT usage readiness for private and public secondary schools in Tanzania, a case of Dodoma municipality. *International Journal of Computer Applications*, 129(3), 29-32. https://doi.org/10.5120/ijca2015906791
- Marsh, R. M. (2014). Modernization theory, then and now. *Comparative Sociology*, *13*(3), 261-283. https://doi.org/10.1163/15691330-12341311
- Mcdonald, H., & Ingvarson, L. (1997). Technology: A catalyst for educational change. Journal of Curriculum Studies, 29(5), 513-528. https://doi.org/10.1080/002202797183883
- Mtega, W. P., & Msungu, A. C. (2013). Using information and communication technologies to enhance the accessibility of agricultural information for improved agricultural production in Tanzania. *THE ELECTRONIC JOURNAL OF INFORMATION SYSTEMS IN DEVELOPING COUNTRIES*, 56(1), 1-14. https://doi.org/10.1002/j.1681-4835.2013.tb00395.x
- Ndoricimpa, A., & Ndayikeza, M. A. (2023). Economic costs of civil conflicts: The case of Burundi. *Defence and Peace Economics*, 1-24. https://doi.org/10.1080/10242694.2023.2232971
- Nduwimana, S., & Sindayigaya, I. (2023). Entry and mobility in technical and vocational education in Burundi. Open Journal of Social Sciences, 11(07), 11-20. https://doi.org/10.4236/jss.2023.117002
- O'Sullivan, K., Clark, S., Marshall, K., & MacLachlan, M. (2021). A just digital framework to ensure equitable achievement of the sustainable development goals. *Nature Communications*, *12*(1). https://doi.org/10.1038/s41467-021-26217-8
- Papaioannou, S. K., & Dimelis, S. P. (2007). Information technology as a factor of economic development: Evidence from developed and developing countries. *Economics of Innovation and New Technology*, 16(3), 179-194. https://doi.org/10.1080/10438590600661889

- Perez, C. (2004). Technological revolutions, paradigm shifts, and socio-institutional change. *Globalization, Economic Development, and Inequality*. https://doi.org/10.4337/9781845421625.00016
- Pigola, A., Da Costa, P. R., Carvalho, L. C., Silva, L. F., Kniess, C. T., & Maccari, E. A. (2021). Artificial intelligence-driven digital technologies to the implementation of the sustainable development goals: A perspective from Brazil and Portugal. *Sustainability*, 13(24), 13669. https://doi.org/10.3390/su132413669
- Prieto-Egido, I., Sanchez-Chaparro, T., & Urquijo-Reguera, J. (2022). Impacts of information and communication technologies on the SDGs: The case of Mayu Telecomunicaciones in rural areas of Peru. *Information Technology for Development*, 29(1), 103-127. https://doi.org/10.1080/02681102.2022.2073581
- Rosário, A., & Dias, J. (2022). Sustainability and the digital transition: A literature review. *Sustainability*, *14*(7), 4072. https://doi.org/10.3390/su14074072
- Sen, G., & Bingqin, L. (2019). The digital Silk Road and the sustainable development goals. *IDS Bulletin*, 50(4). https://doi.org/10.19088/1968-2019.137
- Wickramasinghe, S. R., & ABD Razak, K. (2023). The impact of the telecommunication industry as a moderator on poverty alleviation and educational programs to achieve sustainable development goals in developing countries. *Journal of Informatics and Web Engineering*, 2(1), 25-37. https://doi.org/10.33093/jiwe.2023.2.1.3

Books

- Anwar, M. A., & Graham, M. (2022). *The digital continent: Placing Africa in planetary networks of work*. Oxford University Press.
- Knight, F. H. (2012). Risk, uncertainty, and profit. Courier Corporation.
- Landes, D. S. (1969). The Unbound Prometheus Technical change and industrial development in Western Europe from 1750 to the present.
- Sætra, H. S. (2023). *Technology and sustainable development: The promise and pitfalls of techno-solutionism*. Taylor & Francis.

Webpages

- Africa Union (2014). Burundi Backbone Systems is applying its technological capabilities to enrich all walks of Burundian life. Retrieved September 11, 2023
- Banque Africaine de Developpement (2022). Le nouveau rapport sur les odd en afrique montre que les progrès sont faibles et appelle à une plus grande action pour atteindre les objectifs. Retrieved August 21, 2023 from https://www.afdb.org/fr/news-and-events/press-releases/le- nouveau-rapport-surles-odd-en-afrique-montre-que-les-progres-sont-faibles-et- appelle-une-plusgrande-action-pour-atteindre-les-objectifs-57404
- Bertelsmann Stiftung (2022). Country Report Burundi. Retrieve September 22, 2023, from https://btiproject.org/fileadmin/api/content/en/downloads/reports/country_re port 2022 BDI.pdf
- Burundi Times (2023). Only 24 percent of the Burundian population access the internet. Retrieved September 21, 2023, from https://www.burunditimes.com/only-24percent-of-Burundian-population-access-internet/
- Esselaar, S. and Adam, L. (2013). what is happening in ICT in Tanzania? Retrieved September 4, 2023, from https://researchictafrica.net/publications/Evidence for ICT Policy Action/P

olicy_Paper_11Understanding_what_is_happening_in_ICT_in_Tanzania.pdf

- Fortune for Africa (2023). Optic Fiber in Burundi. Retrieved August 17, 2023 from https://fortuneofafrica.com/burundi/optic-fibre-in-burundi/
- Fortune of Africa (2023). projects implemented in ICT in Burundi. Retrieved August 24, 2023, from https://fortuneofafrica.com/burundi/projects-implemented-in-ict-in-Burundi/
- Fortune of Africa (2023). The Optic Fiber in Burundi. Retrieved August 24, 2023 from https://fortuneofafrica.com/burundi/optic-fibre-in-burundi/

- Frąckiewicz, M. (2023). Exploring the Potential of Satellite Internet in Burundi. Retrieved August 10, 2023 from https://ts2.space/en/satellite-internet-in-burundi-2/#google_vignette
- Grzybowski, L. (2022). Disruptive Technologies in South Africa and Sub-Saharan
 Africa: The Case of Mobile Telecommunications Services. African Economic
 Research Consortium.
 https://publication.aercafricalibrary.org/server/api/core/bitstreams/83f12bf0-44a84960-8bab-03c87b0aaf6b/content
- GSMA Intelligence (2019). Digital transformation in Tanzania the role of mobile technology and its impact on development goals.
 https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=39256224&file=2736-180319-Tanzania.pdf
- Iris News (2023). Burundi's Digital Leap: How Starlink's Satellite Internet Could Change the Game. Retrieved August 22, 2023 from https://en.irisnews.org/burundis-digital-leap-how-starlinks-satellite-internetcould-change-the-game/
- ITU (2016). Digital Financial Services: Regulating for financial inclusion an ICT Perspective. https://www.itu.int/dms_pub/itu-d/opb/pref/DPREF-BB.REG_OUT02-2016-PDFE.pdf
- ITU (2021). An overview of the state of digital development around the world based on ITU data. Retrieved June 27, 2023 from https://www.itu.int/en/ITU-D/Statistics/Dashboards/Pages/Digital-Development.aspx
- ITU (2021). Digital technologies to achieve the UN SDGs. Retrieved November 9, 2023, from https://www.itu.int/en/mediacentre/backgrounders/Pages/icts-to-achieve-theunited-nations-sustainable-development-goals. aspx

Lancaster, H. (2022). Burundi gains greater internet connectivity to neighboring countries. Retrieved August 20, 2023, from https://www.budde.com.au/Research/Burundi-Telecoms-Mobile- and-Broadband-Statistics-and-Analyses Lancaster, H. (2023). Burundi gains greater internet connectivity to neighboring countries: Telecoms, Mobile, and Broadband - Statistics and Analyses. Retrieved August 12, 2023 from

https://www.worlddata.info/africa/burundi/telecommunication.php

Legatum Prosperity Index (2023). Burundi. Retrieved from

https://www.prosperity.com/globe/burundi, Accessed on August 10, 2023 Logistics Cluster (2023). Tanzania Logistics Services. Retrieved June 27, 2023, from https://dlca.logcluster.org/34-tanzania

telecommunications#:~:text=There%20are%208%20telecommunication%20opera tors,Zanzibar%20Telecom%20Limited%20(Zantel)

Lu, G. (2017). Accelerating the Sustainable Development Goals (SDGs)
 Through Information and Communication Technology (ICT) Retrieved November
 9, 2023 from https://www.adecesg.com/resources/blog/accelerating-the-sustainable-development-goals-SDGs-through-information-and-communication-technology-ICT/

- Njoya, S. (2023). Le Burundi prévoit de lancer la 5G en juillet 2024. Retrieved September 14, 2023 from https://www.wearetech.africa/fr/fils/actualites/telecom/le-burundi-prevoit-d e-lancer-la-5g-en-juillet-2024
- Sachs et al. (2016). How Information and Communications Technology Can Accelerate Action on the Sustainable Development Goals. The Earth Institute Columbia University, Ericsson. Retrieved October 15, 2023 from https://www.ericsson.com/assets/local/news/2016/05/ict-sdg.pdf
- Shenglin, B., et al. (2017). Digital infrastructure: overcoming digital divide in emerging economies. Policy Brief, G20 Insights. Retrieved October 25, 2023.
- World Bank (2022). Tanzania Overview. Retrieved July 2, 2023 from https://data.worldbank.org/country/tanzania?view=chart

World Bank (2023). Burundi Overview. Retrieved July 2, 2023 from https://data.worldbank.org/country/burundi?view=chart

World data info (2023). Burundi Overview. Retrieved June 27, 2023 from https://www.worlddata.info/africa/burundi/telecommunication.php

World Population Review (2023). Richest African Countries.

https://worldpopulationreview.com/country-rankings/richest-africancountries

Worlddata.info (2021). Mobile communications and internet in Burundi. https://www.worlddata.info/africa/burundi/telecommunication.php

Zucchetti, A., et al. (2019). Bridging the Gap Between Digital Skills and Employability for Vulnerable Populations. G20 Insights. https://www.g20insights.org/policy_briefs/bridging-the-gap between-digital-skills-andemployability-for-vulnerable-populations

Reports

GSMA (2019). Digital transformation in Tanzania. The role of mobile technology and its impact on development goals. Retrieved October 11, 2023.

IISD (In SDG Knowledge Hub) (2017). ICT Report Showcases Role of ICTs in Accelerating SDG Achievement. Retrieved November 9, 2023, from https://sdg.iisd.org/news/ict-report-showcases-role-of-icts-inaccelerating-SDG-achievement/

Relief Web (2023). IOM Burundi - Thousands of people displaced by floods - May 2023. Retrieved November 2, 2023, from https://reliefweb.int/report/burundi/iom-burundi-thousands-people-displaced-floods-may-2023

Republic of Burundi (2020). Voluntary National Review. Retrieved October 20, 2023 from https://sustainabledevelopment.un.org/content/documents/26316RAPPORT DELAMISEENOEUVREDESODDsAUBURUNDI.pdf Republique du Burundi Deuxieme vice Presidence (2018). Resume du Rapport de priorisation des Objectifs de Developpement Durables au Burundi. Retrieved October 15, 2023, from https://www.undp.org/sites/g/files/zskgke326/files/migration/bi/UNDP-BIresume-prioritisation-ODD-fr-web.pdf

- Sustainable Development Report (2023). Burundi Overview. Retrieved August 7, 2023, from https://dashboards.sdgindex.org/profiles/burundi
- The United Republic of Tanzania (2023). Voluntary National Report on the Implementation of the 2030 Agenda for Sustainable Development.

