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Food Systems Transformation



Transforming Agrifood Systems in West and Central Africa Initiative (TAFS-WCA)

MAPPING CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES LANDSCAPE IN BURUNDI



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Executive summary

It is now widely accepted that rainfed agriculture is subject to instability due to climate variability. These changes result in heavy floods, high temperatures and severe droughts in some places. Developing countries such as Burundi are among the first victims, as more than 80% of production remains rainfed. Aware of the vulnerability of these farmers, The Alliance Bioversity and CIAT have decided to support these countries to better adapt by using digital technologies. Based on the fact that climatic and agronomic digital services are in their infancy on the continent, particularly in Burundi, the Bioversity Alliance and CIAT wish to matchmake users and providers of these innovations. In order to achieve this goal, many activities including reviews are done to gather enough evidences before any action. This review aims to:

- Identify the type of information these services generate, frequency, platforms used, analytical techniques used;
- Identify the financial models being used by the identified digital innovations;
- Identify the current and potential end-users;
- Assess the demand of the identified digital innovations;
- List the types of decisions made by users derived from the digital innovations;
- Identify the main challenges users and innovators are facing through this journey;
- Identify the benefits derivable from the Digital services;
- Assess the potential for Public Private partnerships (PPP).

In terms of results, this research revealed that more than 15 digital agriculture services are operating in Burundi. However, the Top 10 climatic and agronomic

in Burundi include *Weather Impact, Fieldy, Agri-Coach Burundi, INEZA Smart Farming, Olam Farmers Information Service, Green Climate fund, UMVA Agent, ONE ACRE FUND, Hamwe, Online seed verification system*. These innovations are reaching the farmers through SMS, Apps, USSD, IVRS and website. Social medias are leveraged for marketing reasons.

From the user's perspective, the digital innovations listed above are impactful especially *Weather Impact and Agri-Coach Burundi*. Indeed, farmers testified that by *Weather Impact* services, they now know really how the next month will be in terms of rain. Also, thanks to *Agri-Coach*, Burundian farmers know when and which crops to plant taking into account various parameters such as climate, soil quality and how to maintain the crops.

However, the tree should not hide the forest, as the saying goes. Indeed, Burundi has one of the poorest digital infrastructures according to World Bank Group and the GSMA. The internet access is among the lowest in Africa. The gender gap remains also high because women have less access to mobile phone and internet.

The key barriers of digital innovation in Burundi include Internet coverage (4G), Affordability and Digital literacy.

In order to matchmake users and climatic and agronomic providers, Burundi and its partners should address first the highlighted barriers especially the internet coverage.

In terms of recommendation, bundling the services including Weather forecasts, Pest managements, Farm operations good practices and Market information will reduce the cost and allow affordability for smallholder's farmers.

List of acronyms

Acronym	Meaning
4G	Fourth generation in mobile internet
AfDB	African Development Bank
BMZ	Federal Ministry for Economic Cooperation and Development
CIS	Climate Information Services
CSA	Climate Smart Agriculture
CTA	Centre technique de coopération agricole et rurale
DAG	Digital Agriculture
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GSMA	Group of Special Mobile Association
ICT	Information and Communications Technology
ITU	International Telecommunication Union (ITU)
MINEAGRIE	Ministère Agriculture et Elevage of Burundi
MIS	Market Information System
NGO	Non-Governmental Organization
PPP	Public Private Partnership
USD	US Dollar
USSD	Unstructured Supplementary Service Data
WMO	World Meteorological Organization

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1. INTRODUCTION

1.1. STUDY BACKGROUND

Accurate and reliable Information is vital to strengthen the food systems capacity to feed Africa in the context of climate variability. It is why the Alliance of Bioversity International and the International Centre for Tropical Agriculture (CIAT) is working to deliver research-based solutions to the food system stakeholders. To achieve this goal, the Alliance intends to leverage the potential given by the Digital era in Africa. Through its work package 2, “Informed Digital Agriculture for Climate Resilience – Managing Climate Risks and Accessing Services” from its the Regional integrated initiative - Transforming Agri-Food Systems in West and Central Africa (TAFS-WCA), the Alliance would like to matchmake digital services providers and users across the continent especially in Burundi. This study seeks to answers the following questions including: what are the Digital Agriculture Services available in Burundi? What type of services are they delivering? Are these services leading to better decisions for the end-users? Who are the targeted customers? Is it a scalable business? What is the readiness of each Digital Service providers for Partnerships?

1.2. OBJECTIVES

This study aims to:

- Conduct a literature review and synthesize results on the digital solutions in agriculture with focus on climate and environmental risk management;
- Produce a country-specific report of the existing climate and agronomic digital advisory services in the agri-food systems for Burundi.

1.3. EXPECTED RESULTS

The expected output of the review includes digital Climate Information Service, Agro-advisory and Risks. It focusses particularly on:

- The type of information these services generate, frequency, platforms used, analytical techniques used;

- how are they financially sustained;
- current and potential end-users;
- demand (current and desirable);
- how these services lead to better decisions regarding food system efficiency and resilience;
- capacity within the institutions to administrate, analyse, understand and use these systems for decision in the agri-food systems;
- Main challenges (e.g., costs, local capacity, languages, Digital literacy, lack of data harmonization, data privacy, etc.)
- Digital services and value chains with greatest potential;
- Whether benefits of the systems are distributed equitably;
- Services with the greatest potential to scale;
- Potential for Public Private partnerships (PPP).

1.4. AGRICULTURE SECTOR BACKGROUND

Burundi is a landlocked country in Central Africa, located in the Great Lakes region, with a long shoreline on Lake Tanganyika. The area is 27,834 km². Burundi borders Rwanda to the north, Tanzania to the east and South, and the Democratic Republic of Congo to the west, with Lake Tanganyika and the Ruzizi River serving as its natural border. Bujumbura is the capital of Burundi.

The population of Burundi is above 12.5 million in 2021 with an annual growth of 2.7% (World Bank, 2023). The same source highlights that the rural population represents 86%. According to FAO & ITU (2022), Burundi has 79.17% of agricultural land and its GDP is estimated to 2.9 billion USD (world bank, 2022) with 1.8% of annual growth.

Agriculture has a major contribution in the economy of Burundi (50% of the GDP), which is why the government is focusing on the investment on agriculture's infrastructure especially on coffee business (Cazenave-Piarrot, 2004). In Burundi, the Population economically active (PEA) in agriculture accounts for 43% in 2017. The female PEA and Male PEA accounted for 32% and 11% respectively (United States Agency for International Development , 2015).

1.4.1. CROPS AND CROPPING SYSTEM

According to the United States Agency for International Development (2015), Burundi has around 39% of arable land, 16% of permanent crops (tree crops), 19% of permanent pasture and 7% of forest. In terms of production systems, 87% of the arable land is under food crops including cassava, bananas, sweet potatoes, plantains, beans (dry), vegetable (fresh) and maize. The cash crops occupy around 7%. The major cash crops include coffee, cotton, tea, and palm oil, which accounts for 90% of Burundi's exports. The farm size is less than 0.5ha in the majority of households in Burundi. Table 1 presents the production trends from 2017 to 2021 in Burundi.

TABLE 1: AVERAGE AREA, YIELD AND PRODUCTION OF MAIN CROPS IN BURUNDI FROM 2017 TO 2021

Crops	Year					Grand Total
	2017	2018	2019	2020	2021	
Bananas						
Area (ha)	106 018	216 671	152 781	163 961	161 644	160 215
Yield (kg/ha)	78 379	76 381	77 219	78 150	79 081	77 842
Production(tonnes)	830 957	1 654 955	1 179 759	1 281 354	1 278 300	1 245 065
Coffee						
Area (ha)	16 500	14 509	15 298	19 734	18 760	16 960
Yield (kg/ha)	9 903	9 798	9 190	9 121	9 115	9 425
Production(tonnes)	16 340	14 216	14 059	18 000	17 100	15 943
Cotton						
Area (ha)	2 615	3 032	2 400	2 121	1 983	2 430
Yield (kg/ha)	7 017	6 814	7 256	7 675	7 744	7 301
Production(tonnes)	1 835	2 066	1 741	1 628	1 536	1 761
Tea						
Area (ha)	8 883	7 772	8 389	8 562	8 830	8 487
Yield (kg/ha)	52 122	63 690	59 006	57 229	57 030	57 815
Production(tonnes)	46 300	49 500	49 500	49 000	50 357	48 931
Beans (dry)						

Crops	Year					Grand Total
	2017	2018	2019	2020	2021	
Area (ha)	574 267	599 139	975 079	1 020 173	827 542	799 240
Yield (kg/ha)	6 464	6 563	6 350	6 159	5 945	6 296
Production(tonnes)	371 211	393 233	619 151	628 338	491 968	500 780
Maize						
Area (ha)	175 965	190 003	270 755	224 000	180 000	208 145
Yield (kg/ha)	12 977	15 289	10 002	11 607	15 556	13 086
Production(tonnes)	228 355	290 498	270 813	260 000	280 000	265 933
Cassava (fresh)						
Area (ha)	308 949	295 769	296 000	305 151	320 995	305 373
Yield (kg/ha)	73 969	80 695	81 384	80 042	78 757	78 969
Production(tonnes)	2 285 265	2 386 709	2 408 958	2 442 499	2 528 076	2 410 301
Sweet potatoes						
Area (ha)	58 303	62 364	93 578	84 610	66 165	73 004
Yield (kg/ha)	89 127	93 486	109 370	107 851	108 570	101 681
Production(tonnes)	519 637	583 019	1 023 458	912 524	718 351	751 398
Plantains						
Area (ha)	16 718	12 360	12 597	11 086	10 124	12 577
Yield (kg/ha)	133 170	169 211	184 337	208 020	231 702	185 288
Production(tonnes)	222 638	209 138	232 204	230 617	234 575	225 834
Riz						
Area (ha)	49 501	49 813	58 997	49 851	50 478	51 728
Yield (kg/ha)	17 838	17 926	40 886	30 089	23 773	26 102
Production(tonnes)	88 298	89 296	241 211	150 000	120 000	137 761
Taro						
Area (ha)	7 431	7 349	6 385	6 015	6 353	6 707
Yield (kg/ha)	167 854	241 131	340 658	169 434	185 641	220 944
Production(tonnes)	124 732	177 207	217 510	101 920	117 935	147 861

Source: (FAOSTAT, 2023)

The data (Table 1)) indicates an unstable trend in area, yield and production of the main crops. This instability may be explained by the climate variability, low mastery

of good agricultural practices and low adoption of technologies (Ndayiragije & Nkunzimana, 2022). According to MINEAGRIE1 (2018), the farmers were applying very small doses of fertilizers which resulted in low yield compared to the neighboring countries. In addition, the climate variability, pests, illiteracy, low access to agriculture extension are some of the key challenges that hinder the agriculture performance in Burundi (MINEAGRIE, 2018).

1.4.2. COUNTRY PROGRAMME TOWARD CLIMATE CHANGE EFFECT MITIGATION

Like other Central African countries, Burundi is not immune to the effects of climate change. According to the Ministry of Foreign Affairs of the Netherlands (2018), Burundi will be under high risk in the north and north-eastern part of the country, which are already vulnerable to rainfall deficiency and water shortages. In the western part, the country is at the risk of experiencing both rainfall shortages and floods. The consequences of such risks lead to food insecurity, especially during the long dry season (May to September). Also, extreme floods and droughts are estimated to result in a yield decline of 5-25% in the coming decades and reduce the long-term growth by 2.4% of GDP per year.

Burundi has undertaken/implemented the following action plans to mitigate the climate impacts on its agriculture. The first national strategy was developed in 2013 to serve as a guide until 2025 (Ministère de l'Eau, de l'Environnement, de l'Aménagement du Territoire et de l'Urbanisme , 2013). However, this strategy has been updated to take into account new challenges. The new strategy extends the previous one until 2027. In its national strategy from 2018 to 2027 (MINEAGRIE, 2018), Burundi has scheduled to take the follow actions toward the climate change:

- Develop strategies and technologies for adaptation to climate change;
- Produce information, educate and communicate on climate change for the benefit of farmers;

¹ "Ministère Agriculture et Elevage of Burundi"

- Establish an early warning system.

Despite the existence of the national strategy and the plan, the mobilization of financial resources for their implementation is rather slow.

1.5. CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES BACKGROUND IN BURUNDI

1.5.1. GENERAL BACKGROUND

The importance of Digital agriculture is well known especially in low-income countries such as Burundi. Despite this understanding, the digitalization in agriculture sector remains very low in Burundi. According to Bizimana (2020), the government is more concerned about its own readiness to digital than the economic sector. Indeed, the majority of the innovations are e-government oriented. For FAO & ITU (2022), the internet penetration rate is 9.9% in 2021 in Burundi. The same authors highlight the need of investment of infrastructure, human resources, policy regulation and business environment improvement to push the digital innovation in the country.

As illustrated in the figure 1, DATAREPORTAL (2023) shows that 61.9% of the population has mobile phone but only 13.3% are using internet. However, it should be noted that the country has made efforts in terms of optical fiber². Indeed, Burundi has been able to cover 70% of the country with optical fiber.

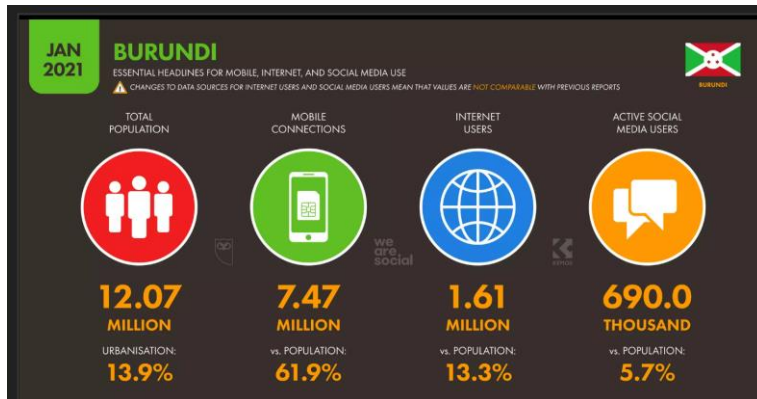
The country's optical fiber network is provided by a private company (Burundi Backbone System³: BBS), which is a consortium of Burundian telecoms operators supported by the World Bank. The company was launched in March 2013. The achievements of BBS can be summarized as follows:

- 1700 km of fibre cable at national level
- 600 km of fibre in Bujumbura (Metropolitan area network: MAN BBS)

² <https://burundi-agnews.org/economie/burundi-couverture-nationale-fibre-optique-a-plus-de-70-avec-taux-de-disponibilite-de-99/#:~:text=Burundi-,Burundi%20%3A%20Couverture%20nationale%20fibre%20optique%20%20C3%A0%20plus%20de%2070%25%20avec,taux%20de%20disponibilit%C3%A9%20de%2099%25>

³ <http://www.bbs.bi/?fr/sb7>

- 22 main sites including provinces and capital cities.
- 6 borders with neighbouring countries, allowing it to offer its customers redundant and 99.9% available services.



Source: (DATAREPORTAL, 2023)

FIGURE 1: ESSENTIAL HEADLINES FOR MOBILE, INTERNET AND SOCIAL MEDIA USE IN BURUNDI IN JANUARY 2021

1.5.2. PRINCIPAL CHALLENGES IN DIGITAL AGRICULTURE

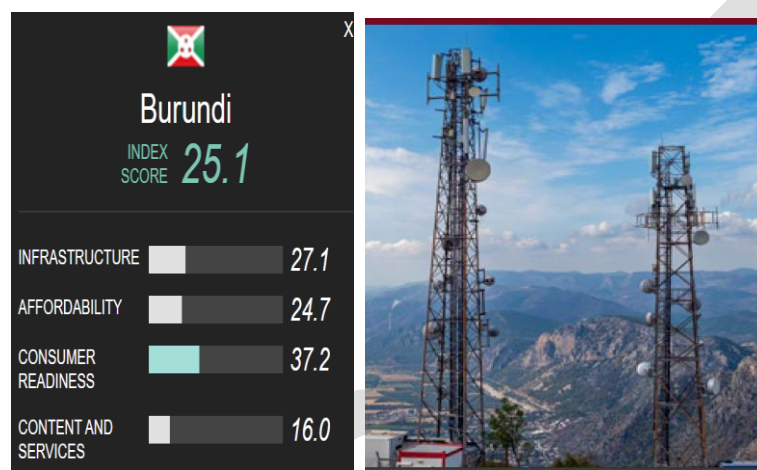
1.5.2.1. DIGITAL INFRASTRUCTURE

Without digital infrastructure, internet coverage and traditional communication networks will be weak. It is therefore important that this sector be taken care of with the utmost attention. So, what is the current situation of digital infrastructure in Burundi?

The digital infrastructure can be developed by both Government and private parties. Private parties comprise of Mobile network operators, which include Econet Leo, Onatel Burundi, Lacell SU and Viet Nam's Vietell Telecom. The Internet service providers include Cbinet, Spidernet, USAN, Lami wireless and NT Global. So, an appreciable effort has been made by the private sector in Burundi. As indicated by the figure below, the digital infrastructure status in Burundi can still be improved. From the digital index, Burundi is globally scored at 25.1. In terms of infrastructure, Burundi score is 27.1 (GSMA, 2023). Beyond the digital infrastructure, electricity is one of the essential infrastructures to complement the digital solutions supply in the

rural area. According to (FAO & ITU, 2022), only 3.09% of the population have access to electricity in rural areas.

In order to contribute to the country's digital infrastructure coverage, Burundi's Telecommunications Regulation and Control Authority (ARCT⁴) has officially launched the "Burundi Broadband" project. This project is supposed to cover the entire national territory with broadband connectivity, i.e. a total area of 27,834 square kilometres.



Source: (GSMA, 2023)

FIGURE 2: GSMA MOBILE CONNECTIVITY INDEX FOR BURUNDI

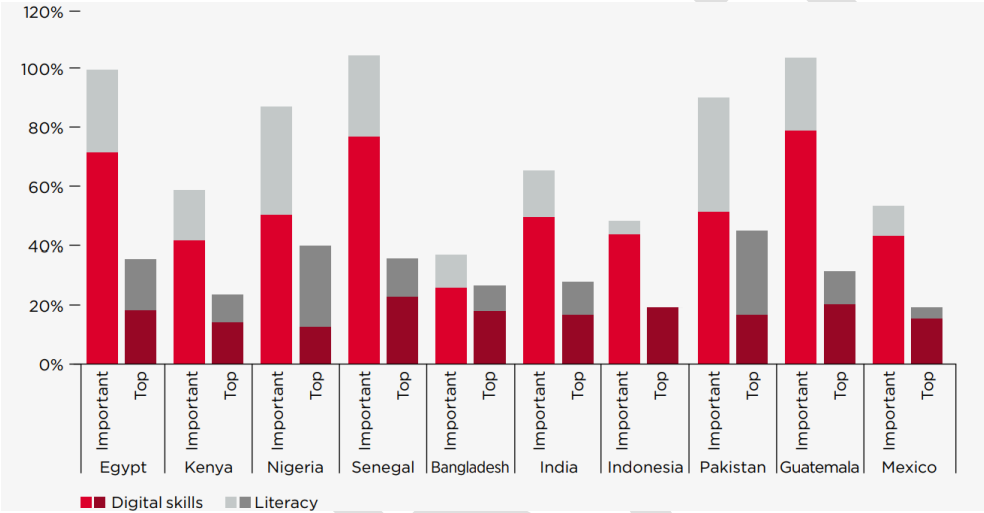
So, the main challenge on digital infrastructure in Burundi include electricity supply and optical fibre (GSMA Intelligence, 2022). For Tossou et al (2020), challenges can be seen in digital policy, digital infrastructure and digital financial. This is why the African Development Bank is supporting Burundi to improve its infrastructure through a global investment plan since 2008 (AfDB, 2009).

1.5.2.2. LITERACY

Digital literacy is the key to unlock climatic and agronomic potential for farmers. Without a clear understanding and use of the digital innovations, the farmers cannot benefit from it. Given that importance, what is the digital literacy rate in Burundi? What are the barriers for digital literacy?

⁴ <https://www.digitalbusiness.africa/burundi-larct-a-lance-projet-burundi-large-bande-destine-a-couvrir-pays-haut-debit/>

Literacy and digital skills are ranked as the top barrier to mobile internet adoption by both male and female mobile users in East Africa including Burundi. Reading and writing are the biggest concern for both male and female. The most affected by digital illiteracy tends to be poorer, women, living in rural areas and over 35 years old. The figure below illustrates both digital skills and literacy in some selecting countries. Of course, Burundi is not included but this trend seems to be similar in sub-Saharan Africa. It can be seen from this figure that digital skills (competencies) received high percentage than digital literacy (ability to read and write) in the African countries.

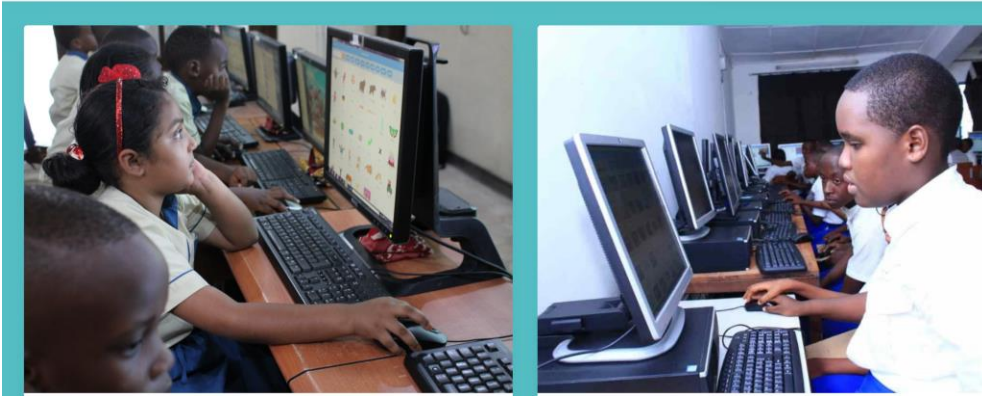


Source: (GSMA Intelligence, 2022)

FIGURE 3: PROPORTION OF MOBILE USERS AWARE OF MOBILE INTERNET WHO REPORT BARRIERS RELATED TO LITERACY AND DIGITAL SKILLS, 2021 (REPORTED AS AN IMPORTANT VERSUS TOP BARRIER)

Some innovators such BIHUB⁵ is trying to train youth in Burundi. The last three years, around 21 000 of students have been training on digital literacy, around 625 teachers trained, 110 schools and centres opened in Burundi.

⁵ <https://www.bihub-burundi.org/>



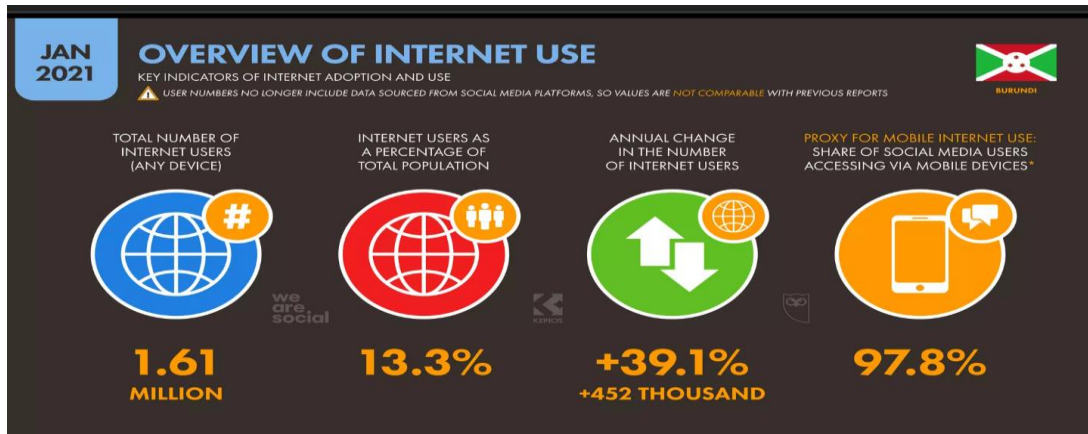
Source: <https://www.bihub-burundi.org/>

BUJAHUB⁶ is another platform with the mission to support digital entrepreneurship in Burundi especially for youth. Their mission is to identify and support talented individuals that have innovative solutions capabilities to resolve real community/market problems.

1.5.2.3. AVAILABILITY AND ACCESS TO INTERNET

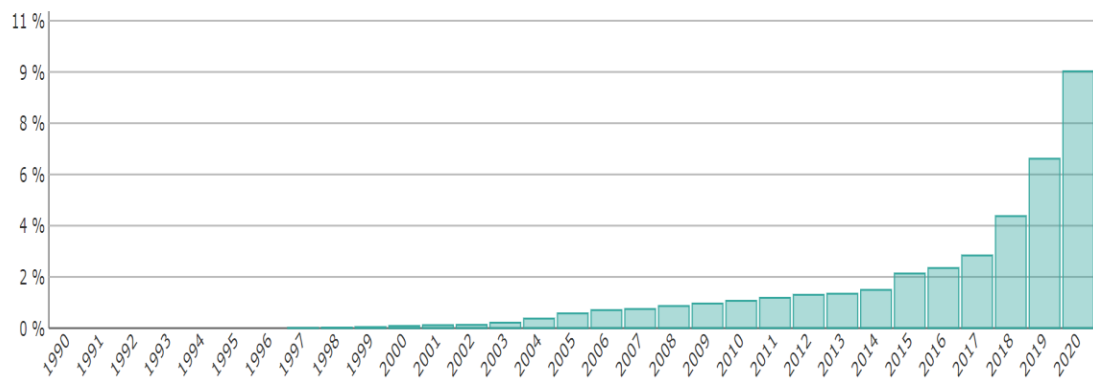
Figure 4 illustrates internet access in Burundi in January 2021. It can be seen that only 1.6 million of people have access to internet in Burundi which represents nearly 13.5%. but why the internet use remains low while efforts have been done by Burundi Backbone System (BBS) to expand optical fibre to all the country? According to (GSMA Intelligence, 2022), three main reasons explained this low adoption including digital literacy/ skills, affordability, safety and security. Internet access were improved the last three year in Burundi (World data, 2023). Figure 5 and 6 give the internet access rate and the browsers used in Burundi.

⁶ <https://bujahub.bi/about-us/>



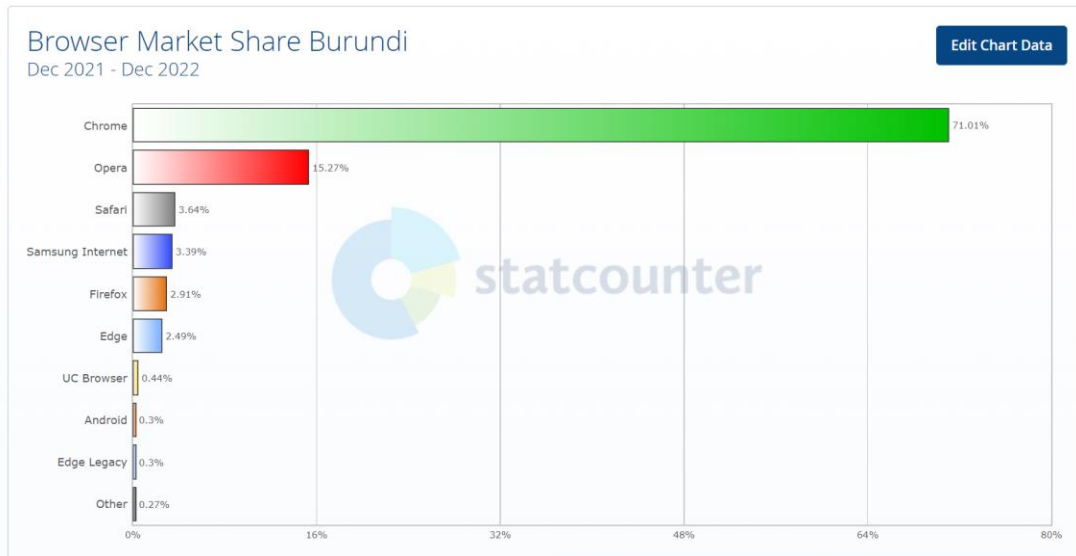
Source: (DATAREPORTAL, 2023)

FIGURE 4: INTERNET USE IN BURUNDI IN JANUARY 2021



Source: (Worlddata, 2023)

FIGURE 5: ACCESS TO THE INTERNET IN BURUNDI FROM 1990 - 2020



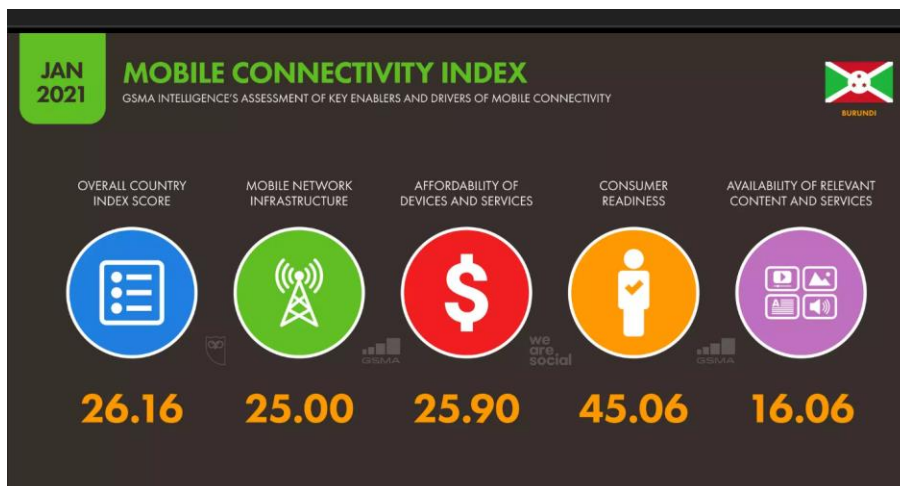
Source: GLOBALSTATS⁷, 2023

FIGURE 6: MOST USED BROWSERS IN BURUNDI FROM DECEMBER 2021 TO DECEMBER 2022

1.5.2.4. NETWORK CONNECTIVITY

As indicated in figure 7, mobile connection in Burundi was low compared to the other countries in East Africa. Indeed, the country is overall scored at 26%. Mobile network infrastructure is also scored at 25%. According to Worlddata (2023), Burundi is massively lagging behind in the development of telecommunications despite its 229 webhosts. The same source mention that the average download speed is nearly 5.0 Mb/second for fixed-network broadband internet, which leads to rank the country at 172nd in an international comparison (Worlddata, 2023)

⁷ <https://gs.statcounter.com/browser-market-share/all/burundi/#monthly-202112-202212-bar>



Source: (DATAREPORTAL, 2023)

FIGURE 7: MOBILE CONNECTIVITY IN BURUNDI IN JANUARY 2021

1.5.2.5. DIGITAL AGRICULTURE SERVICE NEEDS

In Burundi, the Digital agriculture service demand needs clarification. Indeed, the country is in the stage of promotion, awareness. The existing digital innovations are mainly promoted by the projects (MINEAGRIE, 2018). The Agricultural innovation is at its infancy in Burundi with low in-country R&D. (FAO & ITU, 2022). Furthermore, there is a lack of relevant content, products and services that meet users' needs and capabilities in Burundi (GSMA Intelligence, 2022). However, efforts have been made by the Ministry of Agriculture and Livestock to digitalize the sector (WorldBank , 2020). Indeed, the Ministry of Agriculture and Livestock is promoting digital agriculture through the following projects:

- **Agri-Coach**" helps Burundian farmers to know when and which crops to plant, taking into account various parameters such as climate, soil quality or slope, and how to maintain the crops.
- **Agri-Monitor** provides a snapshot of the main problems and opportunities in rural Burundi based on information provided by Agri-Coach/.

Beyond the digital agriculture services, the internet users focus in replay platforms, games. According to GSMA Intelligence (2022), the top 10 queries in Burundi include:

- 1) Instant Messaging;
- 2) Online Calls;
- 3) Video Calls;
- 4) Watching Free Online Videos;
- 5) Reading News;
- 6) Playing Gams;
- 7) Information To Support Education;**

- 8) Listen To Free Music;
- 9) Information on Products/Services**
- 10) Health services

***1.5.2.6. DIGITAL AGRICULTURE BARRIERS AND
PROJECTED CHANGES IN CAPACITY***

According to WorldBank (2020), the key barriers to digital agriculture in Burundi include poor quality of connection; low access to digital devices for farmers; poor rural infrastructure (electricity, roads and logistics), low capacity building for farmers and officials responsible for facilitating the digital transformation of the agricultural system. For FAO & ITU (2022), infrastructures and digital literacy are the main issues to tackle in Burundi. In East Africa, the top three main challenges in the digital economy include literacy/digital skills, affordability, safety/security (GSMA, 2022)

2. EXISTING DIGITAL AGRO-ADVISORY SERVICES FOR SMALL-SCALE FARMERS IN BURUNDI

2.1. CLIMATIC AND AGRONOMIC DIGITAL ADVISORY SERVICES FOR SMALLHOLDERS

From this review, eleven climatic and agronomic digital advisory services for farmers were identified. The most promising one include Weather Impact and Agri-Coach. Indeed, these two digital agriculture innovators seem to have the most relevant content for the farming because they supply already bundled services based on the weather forecasts.

TABLE 2: EXISTING CLIMATIC AND AGRONOMIC DIGITAL ADVISORY SERVICES IDENTIFIED IN BURUNDI

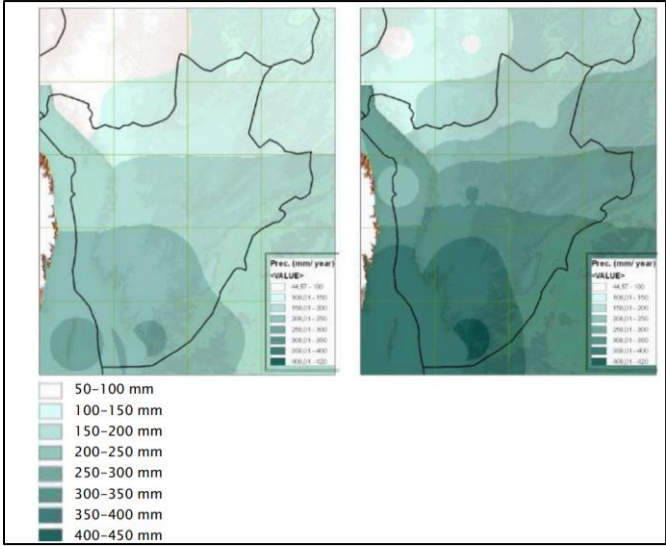
Innovation	Affiliation	Year of launch	Brief description of the innovation	Platforms used to reach the farmers
CAPAD	private	2000	Capacity building on agribusiness, ecological production	Website
INEZA Smart Farming	Private	2022	Farm monitoring, learning about crop facilities, long-term crop storage, online agricultural markets	App, Website
Olam Farmers Information Service	NGO	2014	Agricultural information (prices, weather, technical advice, training), Profiling, Supply Chain, Management, Traceability, Digital payments	Website, USSD
Green Climate fund	Public	2017	Investing in the environmental transition	Website
UMVA Agent	Private	2020	deposit withdrawals for farmers, orders and payments of agricultural inputs	App
ONE ACRE FUND	Private	2011	Access to finance, access to GAP and climate-smart agricultural practice, e-extension to small-scale farmer	Website, USSD
Hamwe	Private	2015	Agricultural information services, Advice, Weather data, Market prices	App, Website, USSD
Online seed verification system	Public	2019	Online seed verification system	Website
Weather Impact	Private		Weather forecasts, pest and diseases forecasts, extreme weather alert, start of rain season, seasonal forecasts	App, website, USSD, SMS

Innovation	Affiliation	Year of launch	Brief description of the innovation	Platforms used to reach the farmers
Fieldy	Private	2020	provision of crop and weather statistics by field and month, without cost or limit.	App, Website
Agri-Coach Burundi	Public	2019	Agri-coach Burundi provides farmers services like weather forecast, crop selection, activity timer while connecting them to financial institutions.	App, USSD

3. CHALLENGES

3.1. CLIMATE CHANGE RELATED CHALLENGES

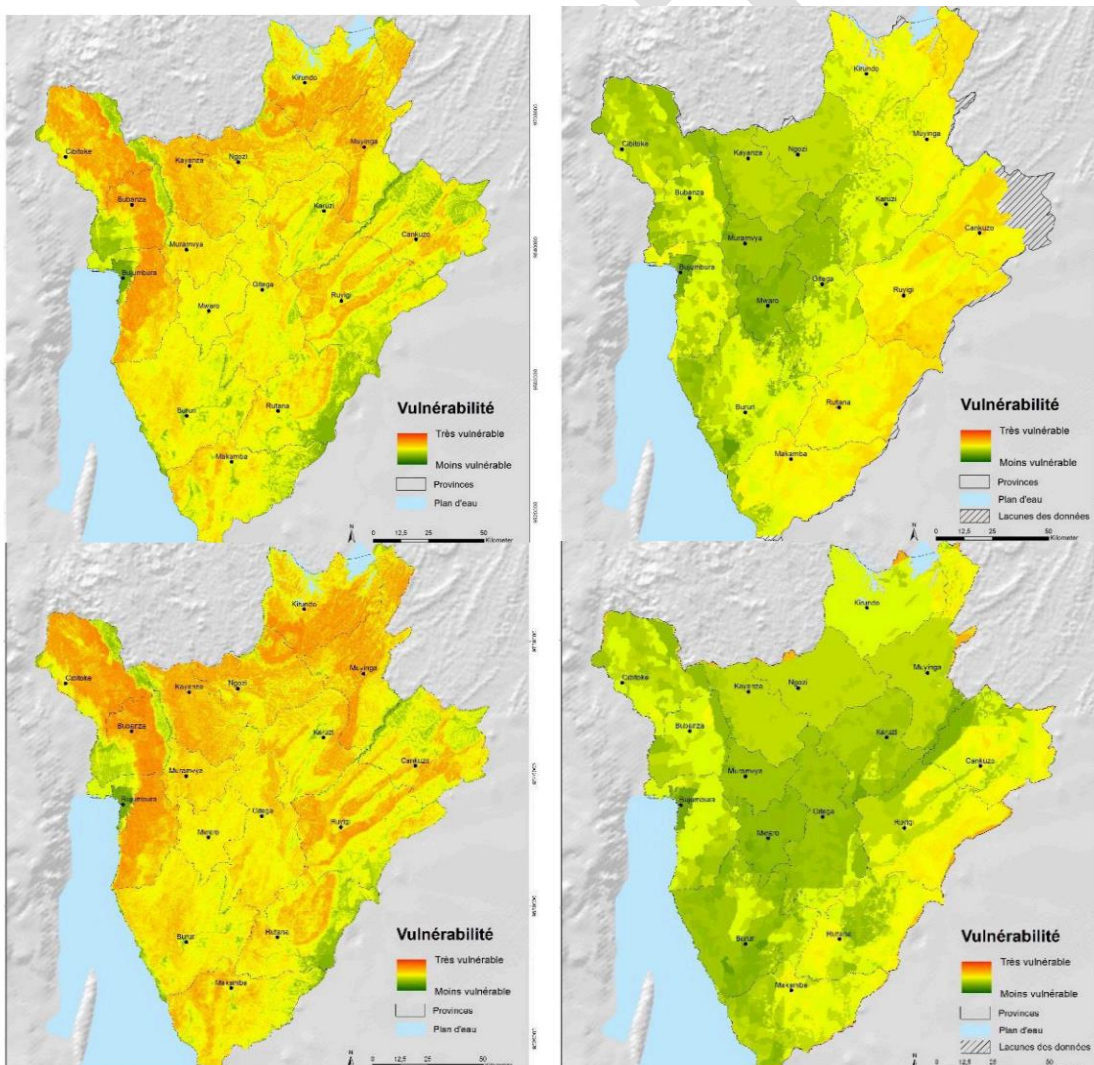
Like other East African countries, Burundi will experience the negative effects of climate change. According to Ndayiragije & Li (2022), Burundi is one of the most vulnerable countries to the effects of climate change events, because of two reasons: (1) it has low adaptive capacity; and (2) high dependence on rain-fed agriculture. Studying East Africa’s Climate Risks, USAID (2020) concluded that the region including Burundi will experience temperature increase 0.5°C–3°C by 2050. This increase in temperature will reduce crops yield such maize, which are very sensitive to high temperature. So, there is evidence that food security will be affected if nothing is done (USAID , 2020)



Source: (Ministry of Foreign Affairs of the Netherlands , 2018)

FIGURE 8: PROJECTED ANNUAL RAINFALL IN BURUNDI, 2031-2060 (LEFT) AND 2071-2099 (RIGHT)

The effects of climate change in Burundi will also affect soils that will suffer significant erosion. As the soil remains the support for agricultural production, it will lose its fertility and consequently, the country will lose yields. In addition, the frequency of drought will increase by 2099. Figures 9 and 10 show the impact of climate change on soils and the occurrence of droughts respectively (Ministry of Foreign Affairs of the Netherlands , 2018).



Source: (Ministry of Foreign Affairs of the Netherlands , 2018)

FIGURE 9: VULNERABILITY TO EROSION IN 2014 (TOP) AND 2071-2099 (BOTTOM). FIGURE 10: VULNERABILITY TO DROUGHT IN 2014 (TOP) AND 2071-2099 (BOTTOM)

3.2. DIGITAL LITERACY, GENDER GAP

It is recognized worldwide that women's access to mobile internet is low especially in the low-income countries (GSMA, 2022). Being aware of this technological gap, Burundi and its partners are working to reduce this difference.

Since 2020, UN Women supported the formation of about 3,000 cooperative groups with 900,000 women and girls. This initiative stemmed from the concern for a safe environment for women and girls to save money, develop income generating initiatives and access small loans (UN Women Africa, 2023).

access small loans.



Participants of the digital management of cooperative groups training. Photo: UN Women/Odette Kwizera

Similarly, the World Bank supports training initiatives in the country, especially for women. In 2021, she funded⁸ a training programme entitled "Women, Digital & Entrepreneurship in Burundi: issues, challenges and success stories".

Taking the case of the FACEBOOK platform as an example, we can see that the gap between women and men using this platform is significant (figure 11)



Source: (DATAREPORTAL, 2023)

FIGURE 11: GENDER DISPARITY IN FACEBOOK AUDIENCE IN BURUNDI FOR JANUARY 2021

3.3. POLICY LANDSCAPE, THE POLICY PERSPECTIVE

TABLE 3: POLICY RELATED TO THE DIGITAL ECONOMY IN BURUNDI.

Law	Content
National Policy for The Development of Information and Communication Technologies in Burundi (2010-2025)	This policy aims to create a favourable business environment for internal and external investors in Burundi.
Law N°1/10 of 26 March 2022 on the prevention and repression of cybercrime in Burundi: « Loi N°1/10 du 26 Mars 2022 portant prevention et repression de la cybercriminalité au Burundi. »	The purpose of this law is the prevention and repression of all cyber offences that are committed in Burundi or outside Burundi.
Decree-Law n°1/011 of 1997: "Décret-loi n°1/011 de 1997"	The role of this law is to control and regulate the telecommunications sector. It complements the work of the other regulatory authority in Burundi, the National Communication Council (CNC)

⁸ <https://www.banquemondiale.org/fr/events/2021/06/25/femmes-digital-entreprenariat-burundi-enjeux-defis-success-stories>

	created in 1992, which is specifically responsible for media regulation.
law n° 1/011 of 4 September 1997: <i>"loi n° 1/011 du 4 septembre 1997"</i>	This law authorises the licensing of private telecommunications companies.
Burundi Broadband Strategy 2025 (BLB 2025)	This strategy aims to enhance internet infrastructure coverage in Burundi.

Source: (WorldBank , 2020)

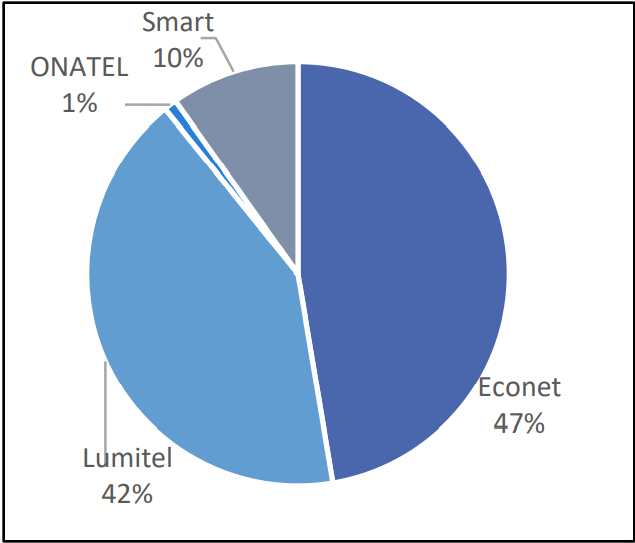
3.4. GLOBAL MARKETPLACE

In Burundi, the digital agricultural services are still growing. The climatic and agronomic digital services are under promotion by both public and private parties. The Digital agriculture market is estimated to be 2.3 million with 17% connected to Agri-Coach and Weather Impact (ClimateShot, 2023).

The majority of the innovation are mainly supported by project such as Gap4All⁹. With the support of Gap4All, some farmers testify that agriculture is becoming more fascinating and resilient. For example, Romwald from Ryagahene states *"It is very useful, as example, when I look at the Monthly Outlook I can select which culture I want to plant. If in April there is a lot of sun and not a lot of rain, I can plant soya so I know the crop will dry this month. But if there is a lot of rain in April, I can plant beans that resist humid conditions."*

So, to leverage the digital opportunity, Burundi should invest more in infrastructure and create more attractive environment for private parties to reach the 2.3 million of farmers. Currently, only four internet providers (one of the first input for digital development) are sharing the market in Burundi (figure 12).

⁹ <https://www.weatherimpact.com/products/burundi/>



Source: (WorldBank , 2020)

FIGURE 12: MARKET SHARE FOR MOBILE CONNECTION IN BURUNDI

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3.5. KEY BARRIERS HINDERING THE ACCESS OF ACTORS TO CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES

TABLE 4: KEY BARRIERS FROM SOME IDENTIFIED DIGITAL INNOVATIONS.

Innovation	Affiliation	Year of launch	Challenge related to costs of services	Challenge related to local capacity	challenge related to languages	challenge related to Digital literacy	Challenge related to lack of data harmonization	challenge related to data privacy
CAPAD	private	2000	Does cost directly farmers to benefit	Have only farmers organizational capabilities	All the services are in French	CAPAD cannot communicate with farmers who speak only Kirundi and Swahili	Has small website	Guaranteed by law
Olam Farmers Information Service	NGO	2014	The cost the services depends on the number the farmer is demanding.	Olam has the capacity to provide the services in timely manner	Olam provide information in local language	Farmers are trained before enrolling them in the system	Not harmonized with others	Guaranteed by law and Olam. However, the data can be used for agricultural products customers

Innovation	Affiliation	Year of launch	Challenge related to costs of services	Challenge related to local capacity	challenge related to languages	challenge related to Digital literacy	Challenge related to lack of data harmonization	challenge related to data privacy
Online seed verification system	Ministère du Commerce, de l'Industrie et du Tourisme	2019	There is no clear pricing sets	Has the capacity to provide what it promises	Only official languages are used	Not assured	Not harmonized	Guaranteed by law
Weather Impact	Private		The cost is function of farmers preferred services	Has the capacity to deliver accurately	Provide services through both local and official languages	Train users before the supply of the services	Not harmonized with other	Guaranteed by law and by the weather Impact
AgriCoach Burundi	Public	2019	lack of digital support for all farmers	Enable by weather Impact.	Use both local and official languages	Train farmers before the supply of the services	Not harmonized	Guaranteed by law

3.6. WHAT NEEDS DO YOU SEE TO ASSURE THAT THESE SYSTEMS ARE MORE FOCUSED ON USER AND DECISION MAKER'S NEEDS?

In order to supply relevant Climatic and Agronomic digital services to farmers, the following actions should be taken:

- Internet coverage specially for 4G should be improved;
- Services pricing strategy also need deep assessment to ensure sustainable sale;
- Digital innovations should consider local language;
- Marketing messages should focus on the benefits not the features;
- Add SMS and USSD as main spreading tool given the internet status

4. TARGET USERS | USER RESEARCH

4.1. WHO ARE THE USERS OF CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES AND WHAT ARE THEIR SPECIFIC INFORMATION NEEDS WITH REGARD TO CLIMATE?

The climatic and agronomic digital services users comprise 2.3 million of small farmers. Given that their production is rainfed based, having weather forecasts comprising of seasonal, weekly forecasts will be beneficial to them. Again, given that the digital literacy of the farmers remains low, it will be more useful to combine the relevant actions derivable from the forecasts and supply it once to the farmers. Weather Impact¹⁰ and Agri-Coach Burundi have understood this need.

4.2. DO END-USERS KNOW WHAT A CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES IS? HOW FAMILIAR ARE WE WITH THESE KINDS OF SYSTEMS?

With the support of projects such as Gap4All¹¹, 17% of farmers know about the existence and utility of climatic and agronomic digital services in Burundi. But why

¹⁰ <https://www.weatherimpact.com/products/burundi/>

¹¹ <https://www.weatherimpact.com/gap4all-project-officially-started-in-burundi/>

this low awareness and familiarity? First of all, they are not aware of it. Secondly, even if they are aware, the services are not available everywhere in Burundi. Thirdly, the climatic and agronomic services remain expensive with regard to the farmers income. In a nutshell, if we combine the project beneficiaries and the reviewed innovations users, the country counts around 1 281 028 farmers (table 5).

TABLE 5: NUMBER OF IDENTIFIED CLIMATIC AND AGRONOMIC USERS IN BURUNDI.

Innovation	Affiliation	Year of launch	Number of users
CAPAD	Private	2000	14 000
INEZA Smart Farming	Private	2022	
Olam Farmers Information Service	NGO	2014	500 000
Green Climate fund	Public	2017	200
UMVA Agent	Private	2020	100
ONE ACRE FUND	Private	2011	196 000
Hamwe	Private	2015	728
Online seed verification system	Public	2019	-
Weather Impact	Private		400 000 ¹²
Fieldy	Private	2020	
AgriCoach Burundi	Public	2019	170 000
TOTAL			1 281 028

4.3. WHAT IS THE MOTIVATION OF ACTORS TO CONTRIBUTE TO CLIMATE AN AGRONOMIC DIGITAL ADVISORY SERVICES?

The motivation to contribute depends on the type of actors. For public sector actors, including ministry of agriculture, ministry of telecommunication, they are regulation oriented. Also, they have crucial mission to invest on infrastructure because these are sovereign aspects. Setting up an attractive policy and enabling

¹² Beneficiaries from the implementation of Gap4All project in Burundi

environment for digital businesses is one of their role. As for private bodies, their main role is to sell digital innovations. End-users such as farmers are expecting to benefit from the use of such innovations. Their contribution can be the feedbacks for innovation to improve the supplied services.

4.4. HOW CLIMATE AGRONOMIC DIGITAL ADVISORY SERVICES ARE CURRENTLY USED IN DECISION-MAKING PROCESSES

Thanks to the Gap4All projects and the efforts made by innovators in the market, farmers have been able to experiment with digital innovations. They have even given feedback on their satisfaction after use in some cases. For example, Michel of Magamba¹³, one of user of Weather Impact service through the Gap4All state: *"I teach the seasonal forecast to group members; they find it very useful. Because it helps to know really how the next month will be in terms of rain. During the summer, I tell people to bring organic fertiliser to the field. The farmers should start with those preparations early. Also, during the dry season, the farmers should do harrowing so that when the rain starts, they are ready."*

4.5. ARE THESE CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES SYSTEMS NEEDED FOR DECISION MAKING?

The following statement from Mr. Bakoma Celeus¹⁴ from Kigabiro, one of the users: *"I use the AgriCoach weather forecast to plan my farming activities. I postponed the planting of my beans for 3 weeks until rain was forecast. The rain fell accordingly, so I am very happy with postponing the planting."* confirmed that the climatic and agronomic digital advisory services are needed for decision making. So, if the benefits of using the climatic and agronomic digital services can be proven and guaranteed by suppliers, this will facilitate also the user's commitment to buy such services.

¹³ <https://www.weatherimpact.com/products/burundi/>

¹⁴ <https://www.weatherimpact.com/crowd-sourced-rainfall-observations-in-burundi/>

5. BUNDLED DIGITAL PRODUCTS

5.1. WHAT SERVICE BUNDLES AND INCENTIVES DO AGRICULTURAL ACTORS AND FARMERS NEED TO ACCESS FOR IMPROVED DECISION MAKING

Bundling is an opportunity to reduce marketing cost while improving the relevance of the information to users because it's supplied in pack. From the review, we can state that Weather Impact and Agri-Coach are performing on the market because they provide bundled services to farmers. For example, *"Agri-Coach¹⁵ helps Burundian farmers to know when and which crops to plant taking into account various parameters such as climate, soil quality or slope, and how to maintain the crops.*

So, bundling weather forecasts with soil information and pest management advisory can improve the farmers' digital agriculture uptake in Burundi.

5.2. DO THE LOCAL PARTNERS HAVE THE CAPACITY WITHIN THEIR OWN SYSTEM TO, ANALYSE, UNDERSTAND AND TAKE ADVANTAGE OF THE POTENTIAL OF SUCH SERVICES TO MITIGATE CLIMATE AND ENVIRONMENTAL RISK

Apart from Weather Impact, the other innovations identified in this review would benefit from more support on their intrinsic capacities. Indeed, the majority is expecting external funds to run the business. Also, it can be seen that marketing efforts are not visible on the field (target farmers).

¹⁵ <https://jimber.org/agriculture-auxfin-netherlands-burundi-digital-ruralite-gitega-kayanza-karusi-climat/>

5.3. ARE THERE BUSINESS MODELS TO FINANCIALLY SUSTAIN OVER TIME THESE CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES?

TABLE 6: FINANCIAL BUSINESS MODELS

Innovation	Affiliation	Year of launch	Financial MODEL
CAPAD	private	2000	Grant
INEZA Smart Farming	Private	2022	Own capital
Olam Farmers Information Service	NGO	2014	Grant
Green Climate fund	Public	2017	Own capital
UMVA Agent	Private	2020	Own capital
ONE ACRE FUND	Private	2011	Own capital
Hamwe	Private	2015	Own capital
Online seed verification system	Public	2019	Grant & Subsidies
Weather Impact	Private		Own capital & Grants
Fieldy	Private	2020	Grant
AgriCoach Burundi	Public	2019	Subsidy

5.4. LEADERSHIP AND GOVERNANCE OF AGRICULTURE SECTOR

Weather Impact and Agri-Coach are leading the climatic and agronomic digital services market in Burundi. This can be seen from the number of users and also from the local media's platforms in Burundi. According to WorldBank (2020), Burundi does not have a clearly defined roadmap for the implementation of the adopted digital strategies, many of which therefore remain at the stage of ambition.

5.5. STRATEGY AND INVESTMENT. WHERE DID THE MAIN DIGAG SERVICES DRIVE COME FROM? WHERE IS MOST FUNDING/INVESTMENT MONEY COMING FROM?

In Burundi, three sources of funding are identified. Private bodies use their own capital to start the business while waiting grants to support them in the promotion and marketing at farmer's level. The public innovations are benefiting subsidy from government. They do not expect return on investment.

6. GENDER AND SOCIAL INCLUSION PERSPECTIVE

6.1. HOW CAN WE ASSURE THAT THE BENEFITS OF INCREASED INFORMATION AVAILABILITY ARE DISTRIBUTED EQUALLY

According to GSMA (2022) in its report on digital gender gap, the majority of low-income countries have the following issue to solve if they intend to reduce the gap between women and men:

- Affordability;
- Relevance;
- Literacy and Digital Skills;
- Safety and Security;
- Smartphone ownerships is low for women. If women do not have access to the right device, it will be challenging to access adequately to internet and therefore climatic and agronomic digital services;
- Women have less autonomy in paying for and selecting handsets;

If the challenges above are reduced, women can benefit as well as men to the potential of climatic and agronomic digital services in Burundi.

6.2. WHAT IS THE AWARENESS ABOUT THE LINK BETWEEN CLIMATE AN AGRONOMIC DIGITAL ADVISORY SERVICES AND GENDER AND SOCIAL INCLUSION

In terms of food production in Burundi, both men and women contribute equally. Indeed, women represent 51% of the population. In this perspective, it is clear that ignoring women in the climatic and agronomic digital advisory services will lead to low performance in agriculture given the role they play. Through this review, the identified innovations do not have evidence in gender awareness.

6.3. THE ROLE OF YOUTH

The youth has high digital skill and literacy compared to the adults (WorldBank , 2020). However, they have less access to productive resources such as land, capital etc. to impact agriculture. So, to leverage the youth, an enabling environment should be setup to facilitate their access to productive resources.

6.4. WHAT IS THE POTENTIAL OF CLIMATE AN AGRONOMIC DIGITAL ADVISORY SERVICE TO POSITIVELY IMPACT THE LIFE OF BENEFICIARIES

Innovation	Affiliation	Year of launch	Potential impacts
CAPAD	private	2000	CAPAD has farmers based-organisation database in a digital format. CAPAD can use this asset to share relevant information to farmers
INEZA Smart Farming	Private	2022	
Olam Farmers Information Service	NGO	2014	This platform provides multiservice but they are bundled. With this platform, the farmers can be connected while staying remote area.
ONE ACRE FUND	Private	2011	This platform training farmers on good agricultural practices and financial literacy. From that capacity building, the farmers become more useful in the market place and by then can raise money for his farming.
Online seed verification system	Public	2019	With Online seed System, the farmers are secured during seed purchase. This platform guarantee the quality and origin of the seed.

Weather Impact	Private		Weather Impact is an international digital firm with the capability to provide accurate and relevant information to farmers. Based on its experiences, this platform have shown that its services can improve farmers' yield by 15% and income by 45% in East Africa.
AgriCoach Burundi	Public	2019	Bundled weather forecasts promoted by Agri Coach has the potential the solve farmers' challenge because it guides the farmers from the forecasts. Also, the pack of information seems to be cheap than individual services

7. DATA HARMONIZATION

TABLE 7: DATA HARMONIZATION

Key questions	Answers
Where is the data is published or stored?	Given the low organization of the digital sector in Burundi, every firm is storing its data where they feel secured.
In the case the data is published, is metadata provided to facilitate the retrieval of information?	Only the public firms are providing metadata but they are not connected to any bigdata manager. The metadata is published through local newspapers.
Are guidelines for data standards	No standard exist for time being in Burundi.
Do you know about local, regional or national data sets that are underutilized?	KNOEMA ¹⁶ GLOBALSTATS ¹⁷ DATAREPORTAL FAOSTAT WORLDDATA ¹⁸
Any language issues faced when collecting or exchanging data? e.g. challenges in terms of data interpretation across the sectors: e.g., same word meaning something different between the sectors or a lack of understanding of a concept?	The majority of the climatic and agronomic digital services are using their own language.

¹⁶ <https://knoema.com/atlas/Burundi>

¹⁷ <https://gs.statcounter.com/>

¹⁸

<https://www.worlddata.info/africa/burundi/telecommunication.php#:~:text=Under%20the%20country%20code%20%2B257,the%20world's%20average%20by%20population.>

The Legal and regulatory framework in the country	Decree No. 100/112 of 5 April 2012 on the reorganisation and functioning of the telecommunications regulation and control agency "ARCT
How data privacy is usually managed?	By law, all digital the firms have to protect and secure the data of their clients. Not complying to that, is punished the Burundi's Regulation Laws.

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8. POTENTIAL AVENUES FOR CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES

TABLE 8: POTENTIAL AVENUES FOR CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES IN CÔTE D'IVOIRE

Domains	Answers
Minimizing barriers	Internet coverage Affordability Digital literacy
Considering user research	Preferences on services to be bundle with the weather forecasts Study the users segment (cash crops, sex, youth, adults)
Gender end social perspective	Improving women access to resources (land, inputs)
Data harmonization	Burundi should set a framework for all the digital firms. Harmonization will originate from that framework
Potential for Public Private partnerships (PPP)	The majority of the digital firms are aware that partnership will helps them achieve more results. However, they expect the partners to solve their market issue.
Bundled Climate and agronomic digital advisory services	From this review, the climatic and agronomic digital services to be bundled are: <ul style="list-style-type: none"> - Weather forecasts; - Pest managements; - Farm operations good practices; - Market information

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