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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:

Case of Democratic Republic of Congo
(DRC)

Alliance of Bioversity International & CIAT

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EXECUTIVE SUMMARY

DRC is 2nd country in the world, after Brazil, having vast agricultural potential. Agriculture and allied activities are of utmost importance to the DRC economy and for nation's food security. Increasing climatic variability in the region and having low adaptive capacity makes the agricultural sector, which is already rainfed, highly vulnerable. Extreme weather events (floods and heat waves) are expected in the future which may have direct consequences in terms of unstable yields, uncertain production, in a country already facing food insecurity and conflict. Digital climate and agronomic services play a key role in achieving food security in the developing countries. In order to do this, a thorough review of the existing situation was carried out. This review aims at (1) identifying the available digital services, their particularities, strengths and weaknesses, (2) analyzing the global environment in which these digital services evolve, to provide an appropriate response for the benefit of users and digital innovators, and (3) assessing the potential for Public Private partnerships. In total, DRC has about 31 digital services in the agricultural sector, of which only 13 platforms are related to climate and agronomy. Most of these platforms are developed by private individuals. They use SMS, IVRS, USSD, apps and websites as the service platforms. Unlike other service providers, E-Tumba and Fieldy provide bundled services, including the weather forecasts. In terms of impact, the users acknowledge that the current digital services have positively impacted their lives. Indeed, users recognized that their yield increased by the use of weather forecasts, and the digital tools for early detection of pests. Furthermore, the guidance provided by the climatic and agronomic digital services also strengthened their capacity of planning and decision-making related to the on-farm and off-farm activities. However, the user base of the technology is still very small. The main challenges in adoption of these services by the users include: (1) low internet access; (2) limited access to devices, especially to the women; (3) low awareness; (4) affordability; and (5) digital illiteracy. For digital innovators, the challenges include: (1) country's poor digital infrastructure coverage; (2) low literacy coupled with resistance in selling digital services to the farming population; and (3) unattractive digital policy for massive investment in this market.

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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
DRC	Democratic Republic of Congo
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)
MIS	Market Information System
NCCP	National Climate Change Plan
NGO	Non-Governmental Organization
PANA	National Climate Change Adaptation Plan
PNSD	Plan National Stratégique de Développement
PPP	Public Private Partnership
UEMOA	Union économique et monétaire ouest-africaine
USD	US Dollar
USSD	Unstructured Supplementary Service Data
WMO	World Meteorological Organization

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 Center 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” under 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 Democratic Republic of Congo (DRC). This study seeks to answer the following questions including: what are the climate and agronomic Digital advisory Services available in DRC? 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 report on the existing climate and agronomic digital advisory services in the agri-food systems for Democratic Republic of Congo.

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

First of all, it should be noted that the Democratic Republic of Congo (DRC) is a country with a potential of 80 million hectares of arable land with only 10% used. It is the second country after Brazil to have such an agricultural potential. If all the land in the DRC were developed, the country could feed nearly 2 billion people a year worldwide. Despite this potential, agriculture remains poorly modernized with the lowest yields on the continent. (Ministère Agriculture RDC, 2008).

In terms of potential, the DRC has a hydroelectric potential of 100,000 Megawatts, which represents 23% of the world's potential, 37% of Africa's potential and 52% of Africa's reserves (Agence Nationale pour la Promotion des Investissements, 2023). According to the same source, DRC has a variety of ecosystems covering nearly 145 million hectares. Also, the country has more than 150 million ha of forest land, which is 47% of African tropical forests and 6% of the world's tropical reserves. There are more than 1000 forest tree species. The wood production potential is estimated at 10,000,000 m³ per year.

According to FAO & ITU (2022), DRC has more than 95,894,118 inhabitants with 54.36% living in rural area. This rural population have 13.90% of total land as agriculture lands. The same source mentioned that DRC is one of the low-income countries, with 72% of the total population living in extreme poverty. However, the country has the largest forest in Africa covering roughly 55.6% of the total land (World bank, 2022). In 2021, the GDP of DRC was up to 53.96 billion USD with 5.7% annual growth (World bank, 2022). In DRC, only 13.9% of the total land area is suitable for agriculture. Cassava and maize are the main food crops. The main cash crops include coffee, cocoa, sugar and palm oil (FAO & ITU, 2022). Although agricultural land is only 13.9 % and internet penetration is 19% in 2020, the DRC is working to develop its infrastructure, human resources, policy and business environment for the proper use of Digital Agriculture Advisory Services in its economy (FAO & ITU, 2022). According to International Trade Administration (2023), DRC has 80 million hectares of arable land with 4 million hectares of irrigated land. DRC is also naturally endowed with many rivers¹, fishery resources. The agricultural sector employs over 60% of the Congolese and contributes 19.7% to the GDP. The main cash crops include coffee, palm oil, rubber, cotton, sugar, tea, and cocoa. The staple crops also include cassava, plantains, maize, groundnuts and rice. Despite this potential, the country is struggling to eliminate food insecurity.

To enhance the agricultural sector, many innovations are under development in DRC by both private and public bodies, however they are mainly forest oriented (Nsomwe-a-NFUNKWA, 2006).

1.4.1 CROPS AND CROPPING SYSTEM

As indicated above in the background, DRC is producing staple crops and commercial crops. The table below presents the area occupied by each crop, the average yield and the production from 2017 to 2021. Although the annual rainfall received in the DRC ranges from 1000 to 1500mm, often reaching 2000mm per year, majority of the crops grown in the region is still rainfed.

¹ *The Congo is the second-longest river on the African continent, having an approximate length of 4,700 kilometres*

TABLE 1: AREA, YIELD AND PRODUCTION OF KEY CROPS GROWN IN DRC FROM 2017- 2021.

Crops and indicators	Year					Grand Total
	2017	2018	2019	2020	2021	
Cassava, fresh	14137235	14575171	15016559	16033691	17119842	15376500
Area (ha)	4630301	4770999	4918130	5250148	5604580	5034832
Yield (kg/ha)	81420	81478	81434	81463	81493	81458
Production (tonnes)	37699983	38873036	40050112	42769463	45673454	41013210
Cocoa beans	15377	21113	24181	28076	32107	24171
Area (ha)	27770	40278	45652	52912	60752	45473
Yield (kg/ha)	4861	4 587	4832	4978	5027	4857
Production (tonnes)	13500	18475	22058	26337	30542	22182
Coffee, green	48966	62059	63961	64357	65246	60918
Area (ha)	102625	130753	135023	135843	137721	128393
Yield (kg/ha)	3931	3938	3921	3924	3927	3928
Production (tonnes)	40342	51485	52940	53303	54089	50432
Groundnuts, excluding shelled	315782	316492	324762	329183	333352	323914
Area (ha)	495000	495000	510000	513 000	515000	505600
Yield (kg/ha)	8957	9000	8929	9 074	9239	9040
Production (tonnes)	443388	445476	455356	465474	475817	457102
Maize (corn)	1675501	1673607	1636711	1673628	1718263	1675542
Area (ha)	2832465	2827032	2763430	2827000	2903683	2830722
Yield (kg/ha)	7719	7733	7740	7733	7726	7730
Production (tonnes)	2186318	2186055	2138962	2186150	2243379	2188173
Mangoes, guavas and mangosteens	159976	160542	161494	160670	160902	160717
Area (ha)	17366	17624	17526	17506	17552	17515
Yield (kg/ha)	169025	167971	169639	168876	168827	168868
Production (tonnes)	293536	296030	297318	295628	296326	295768
Natural rubber in primary forms	24546	25163	27661	27928	23810	25822
Area (ha)	58169	59608	65613	66275	56235	61180
Yield (kg/ha)	2269	2282	2297	2296	2294	2288
Production (tonnes)	13200	13600	15073	15214	12900	13997
Oil palm fruit	743866	747511	797650	835416	836283	792145
Area (ha)	285823	286584	307194	322259	322708	304914
Yield (kg/ha)	65775	65949	65756	65732	65707	65784
Production (tonnes)	1880000	1890000	2020000	2118258	2120433	2005738
Oranges	111150	110918	111107	110936	110764	110975
Area (ha)	10950	10897	10942	10906	10869	10913
Yield (kg/ha)	153935	154022	153936	153977	154018	153978
Production (tonnes)	168564	167835	168443	167924	167406	168034
Plantains and cooking bananas	1987291	1990373	1999910	2004354	2011686	1998723
Area (ha)	1093634	1094650	1099070	1102105	1106744	1099241
Yield (kg/ha)	44111	44145	44187	44159	44131	44147
Production (tonnes)	4824128	4832323	4856474	4866798	4884184	4852781
Rice	887549	904597	937322	935825	1011312	935321
Area (ha)	1441226	1417844	1423434	1320000	1442356	1408972
Yield (kg/ha)	8416	9076	9687	11184	10959	9864
Production (tonnes)	1213006	1286872	1378846	1476290	1580620	1387127
Sugar cane	849532	875902	884024	890435	896845	879348
Area (ha)	46457	46493	46 632	46862	47089	46707
Yield (kg/ha)	443190	456909	460061	461549	463036	456949
Production (tonnes)	2058948	2124304	2145380	2162895	2180410	2134388
Sweet potatoes	221868	222119	233727	239991	246434	232828
Area (ha)	102174	102370	108461	111550	114726	107856
Yield (kg/ha)	50228	50190	50035	50055	50076	50117
Production (tonnes)	513201	513796	542686	558367	574501	540510
Tea leaves	4704	12934	12991	13045	11938	11122
Area (ha)	12000	33063	33213	33356	30425	28411
Yield (kg/ha)	960	1333	1333	1333	1333	1258
Production (tonnes)	1152	4407	4427	4446	4055	3697
Grand Total	1260951	1291330	1322832	1388497	1460802	1344 882

Source: Calculation from FAOSTAT database, 2022

The overall performance of the crops productivity remains low in DRC. The main causes of this low performance can be explained by the low adoption of improved seed and other technologies. Ndeko et al (2022) pointed out that maize seed adoption is low in the region because the available seeds does not possess farmers' preferred attributes. In South-Kivu district for example, preferred attributes in a maize seed include, high yield potential, early maturity, taste, and pest/disease resistance. In terms of the quantity of chemical fertilizer used per hectare, DRC is ranked among the lowest in Sub-Saharan Africa (SSA). According to Statistica (2023), smallholder farmers in DRC is applying around 1.43 kg/ha whereas, the Egypt (country with highest usage of chemical fertilizers in SSA), is applying 415.31 kg/ha. In a nutshell, DRC has organizational issues (than potential) to develop its agriculture because it has the biggest potential in term of the availability of land and water resources.

1.4.2 COUNTRY PROGRAMME TOWARD CLIMATE CHANGE EFFECT MITIGATION

Although climate change is not clearly visible in the DRC at the moment, the country through its Ministry of Environment and Sustainable Development has developed a National Climate Change Adaptation Plan (PANA) covering the period 2022-2026. The National Climate Change Adaptation Plan states that the DRC will be affected by rainfall variations and vulnerable crops. DRC will experience (1) shortening of the rainy seasons and their variability, (2) an increase in average soil temperature (which affects crop growth), (3) harvests will be unreliable, and (4) people who depend on rainfed agriculture, will be extremely vulnerable (Ministère de l'Environnement et Développement Durable , 2021). Figure 1 presents the rainfall trends for DRC from 1990 to 2100 in five climatic zones. From this figure, it evident that the DRC will receive less rainfall in climatic zones Matadi, and Lubumbashi, and increased rainfall in others.

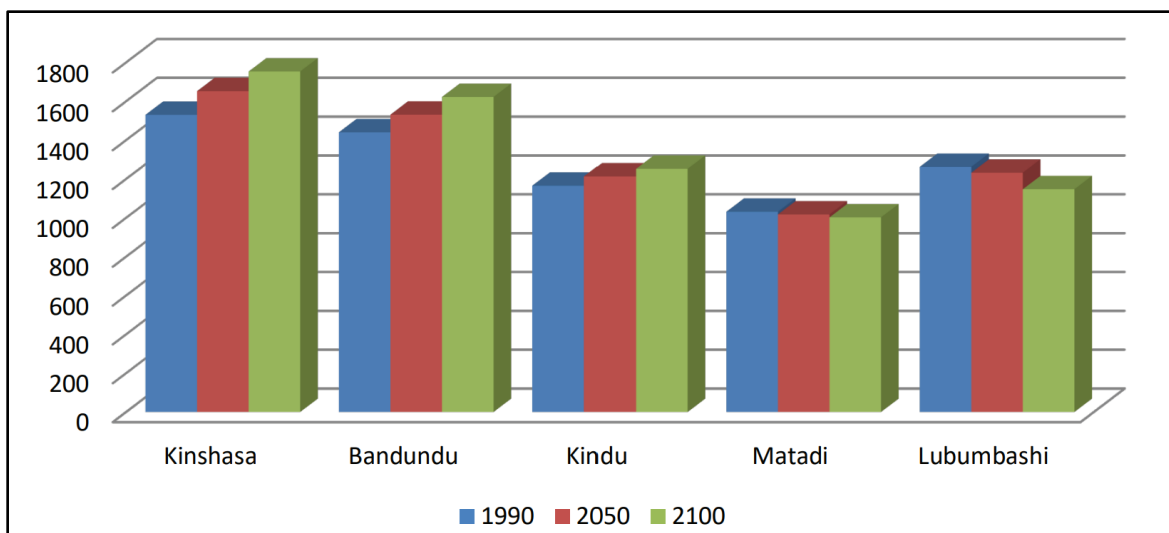


FIGURE 1. EVOLUTION OF RAINFALL (MM) IN 5 CLIMATIC ZONES OF THE DRC IN 1990 (P1), 2050 (P2) AND 2100 (P3) (PANA, 2006)

Source : (Ministère de l'Environnement et Développement Durable , 2021)

Similar trends have been presented by the world bank group in their DRC's Climatic Risk Profiling report. Indeed, more intense rainfall and rising temperatures are likely to occur. If these events occur, they will significantly hamper development goals in agriculture, as they will likely impact crop productivity and necessitate significant changes to the current farming practices. The vulnerable crops in DRC include maize, cassava, plantains, sweet potato, beans, groundnuts (world bank Group, 2021).

In order to reduce the impact of climate change in the agricultural sector in the DRC, the National Adaptation Plan provides for the following actions:

- The selection of resilient varieties at the level of agricultural research centres and universities;
- The establishment of a dynamic agricultural calendar for each crop with the involvement of agro-meteorologists and agronomists;
- The formulation of technical sheets and the installation of school fields for the training of farmers and others;
- The training of extension journalists in rural radio stations in the area of climate risks;
- the use of agro-meteorology to prevent climate risks.

1.5 CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES BACKGROUND IN DRC

1.5.1 GENERAL BACKGROUND

According to FAO & ITU (2022), it is estimated that DRC has an appreciable coverage of 4G (34%) and mobile ownership (42.7 %) in 2019. However, the access to secure internet from servers remained very low (3.85 per 1 million people). In terms of connectivity, the Mobile-cellular subscription was around 45.5%, and the active mobile broadband subscriptions was 19.53% in 2020. According to Jellason et al (2021), Sub-Saharan Africa have to address the knowledge, skills, finance and infrastructure gaps if it intends to leverage digital agriculture potential. In DRC, the mobile phone connections were estimated at 43.9% and the use internet was less than 17% (DATAREPORTAL, 2022). The figure below presents the digital headlines for February 2022 in DRC.



FIGURE 2. DIGITAL HEADLINES IN DRC FOR FEBRUARY 2022 (SOURCE: DATAREPORTAL, 2022)

In the DRC, internet service providers include Microcom, Global Broadband solutions, OrionCom, DHI, Raganet, Afrinet, PIWI and Standard Telecom. Mobile phone providers include Airtel, Vodacom, Orange DRC, Africell and Standard Telecom. Fibre optic deployment is provided by SCPT, SNEL and Liquid Telecom (Présidence de la République Démocratique du Congo, 2019). In order to regulate the digital sector,

the DRC has passed a number of laws and decrees to facilitate business in the industry. The table below presents the key laws in DRC related to digital business.

TABLE 2: LAWS RELATED TO DIGITAL BUSINESS IN DRC.

Laws related to Digital business in DRC	Content
Framework law n°013/2002 of 16 October 2002 on telecommunications in the DR Congo « Loi-cadre n°013/2002 du 16 octobre 2002 sur les télécommunications en RDCongo »	Organisation of operators' schemes in : Public Operator's Public Operator's Network, Concessionary Networks (licences and authorisations) and Independent Networks (declarations),
Law n°014/2002 of 16 October 2002 establishing the Postal Regulatory Authority of the Autorité de Régulation de la Poste and Telecommunications, ARPTC in acronym "Loi n°014/2002 du 16 octobre 2002 portant création de l'Autorité de Régulation de la Poste et des Télécommunications, ARPTC en sigle"	Competition promotion missions focused on consumer rights, management of scarce telecom resources (radio frequencies and numbering), examining applications for licences and authorisations and authorisations, drawing up specifications, definition of interconnection principles, regulation of voice and SMS services, advice on the evolution of ICT legislation
Law n°18/019 of 9 July 2018 on Payment Systems and Payment and Securities Settlement Systems "Loi n°18/019 du 9 juillet 2018 relative aux Systèmes de paiement et Règlement-Titres"	Regime relating to the operation of electronic payment systems and instruments (remote financial services and electronic money) and electronic money)

Source : (Présidence de la République Démocratique du Congo, 2019)

Aware of the potential offered by the digital technology, the DRC has adopted a digital development plan for 2025 (Présidence de la République Démocratique du Congo, 2019). This plan recognises that improvements are needed and should focus on the following areas:

- Broadband infrastructure
- Data centres and related equipment

- Incentives for access to the connected revolution
- Human capital and leadership
- Megadata (Big Data, Open Data)
- e-Administration
- Securing uses
- Interregulation
- Cybersecurity

1.5.2 PRINCIPAL CHALLENGES IN DIGITAL AGRICULTURE

This review identified several challenges for the development, availability and adoption of digital climate and agronomic services in DRC.

1.5.2.1 DIGITAL INFRASTRUCTURE

In central Africa, DRC is ranked at 15 (out of 16 countries) in terms of the digital infrastructure (Centre for Coordination of Agricultural Research and Development for Southern Africa, 2022). For the Mobile Connectivity Index, DRC is scored globally at 30.5. The Digital Infrastructure, the affordability, the consumers readiness scores are presented in the figure 4. The direct consequence of this low endowment in digital infrastructure is that the deployment of climatic and agronomics digital advisory especially in rural area will suffer for a while.

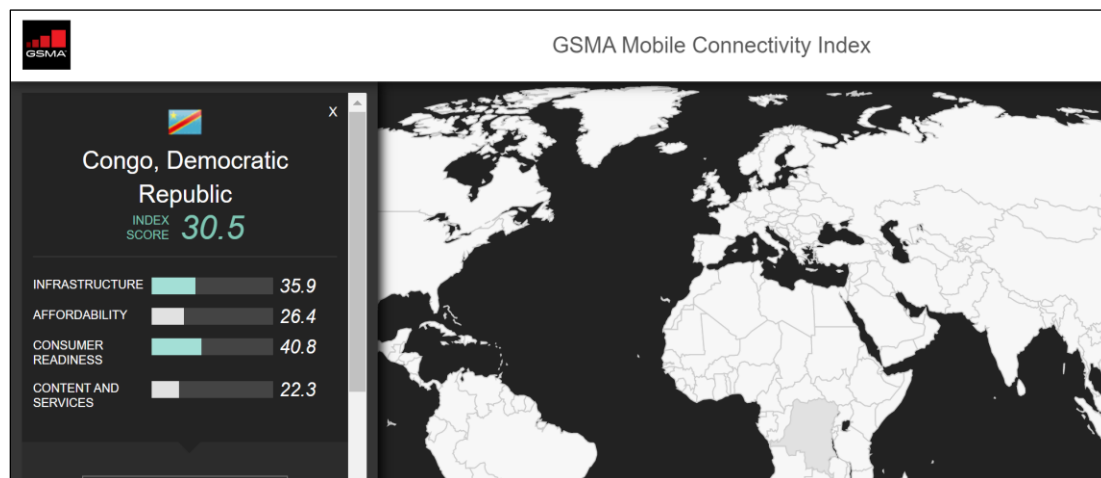


FIGURE 3. DRC' S CONNECTIVITY INDEX (SOURCE: GSMA, 2023)

In the National Plan related to Digital technology, DRC recognized that the country is low-endowed in infrastructure. The figure below highlighted this situation.

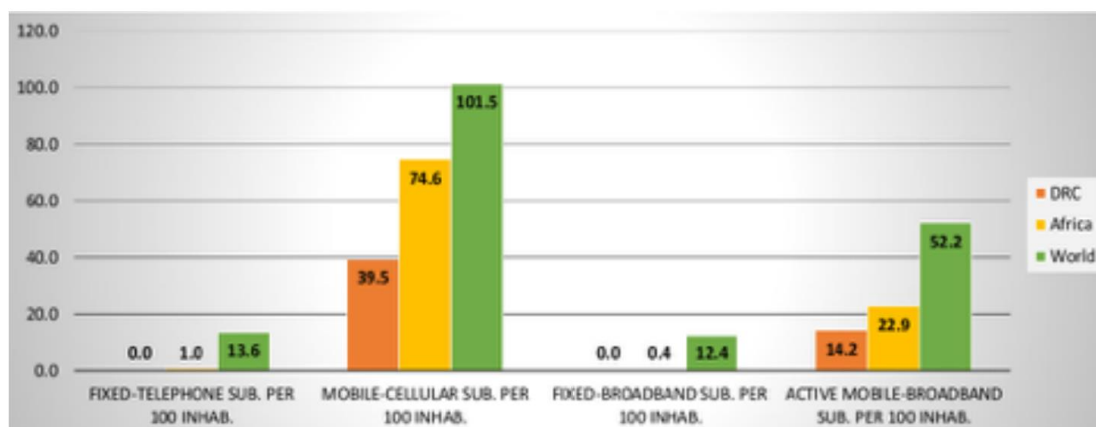


FIGURE 4. SUBSCRIPTIONS TO ICT SERVICES PER 100 INHABITANTS (SOURCE : (PRESIDENCE DE LA REPUBLIQUE DEMOCRATIQUE DU CONGO, 2019)

1.5.2.2 LITERACY

According to FAO & ITU (2022), digital literacy in the country remains low. Indeed, it was estimated to be 2.8 in the index ranking 1-7. However, the digital literacy among the adults is above 77%. The youth's digital literacy is even bigger than the adults one (84.99%). The number of digitally competent staff in the DRC is low and often misaligned with market demand. Also, there are almost no training programmes for digital literacy. Young people seem to have more digital skills but they are not active in the economy to reverse the trends (World Bank , 2020). It should be noted that the digital innovators² themselves are trying to train the users of their services. For example, Schoolap and VODA EDUC are providing digital education to Congolese.

1.5.2.3 AVAILABILITY AND ACCESS TO INTERNET

Although infrastructure is the major challenge in the DRC, internet access and penetration is appreciable. The figure below highlights this increasing trend in internet use in DRC. According to DATAREPORTAL (2022), DRC registered 16.5 million of internet users while they were only 815,000 users in 2012.

² <https://disrupt-africa.com/2018/10/01/drc-ed-tech-platform-schoolap-targets-20-market-share-by-2020/>

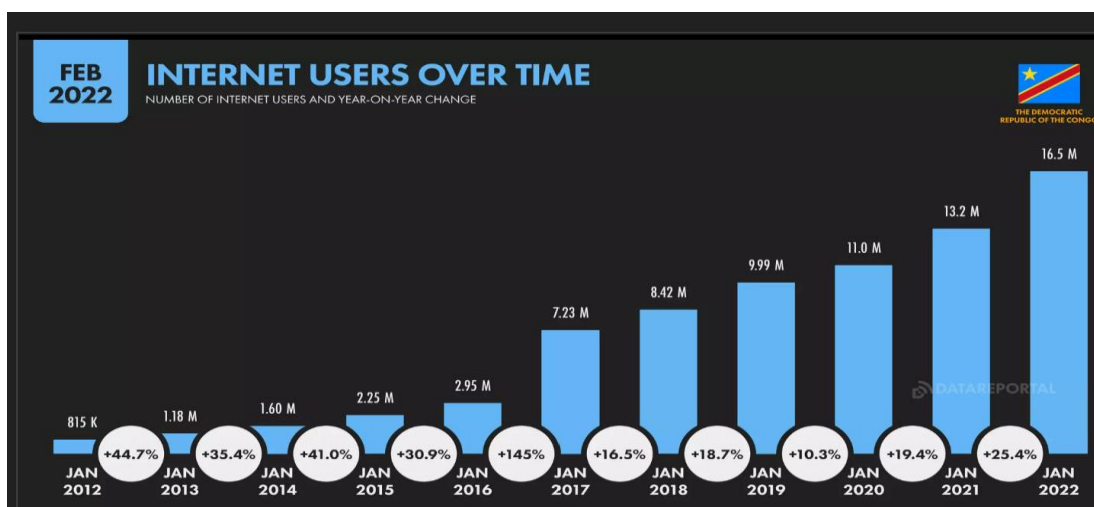


FIGURE 5. INTERNET USERS OVER TIME FROM JANUARY 2012 TO JANUARY 2022 (SOURCE: DATAREPORTAL, 2022)

While internet access is increasing in the DRC, the cost of access remains high compared to Central African countries. So, internet cost is still very high compared to the neighbouring countries such as Rwanda, Burundi, Uganda and Tanzania. This high cost of internet can impact the adoption of Climatic and agronomic digital advisory uptake.

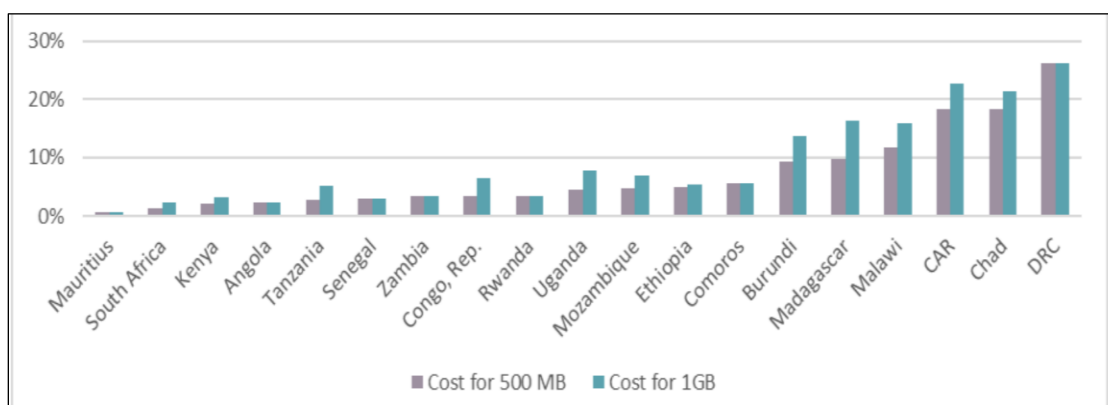


FIGURE 6. COST OF MOBILE BROADBAND AS A PERCENTAGE OF GNI PER CAPITA, Q1 2020 (SOURCE: WORLD BANK)

1.5.2.4 NETWORK CONNECTIVITY

In February 2022, , more than 43 million were connected to the internet in DRC. This does not include Internet of Things (IoT). Globally, more than 46% of Congolese are connected to Internet.

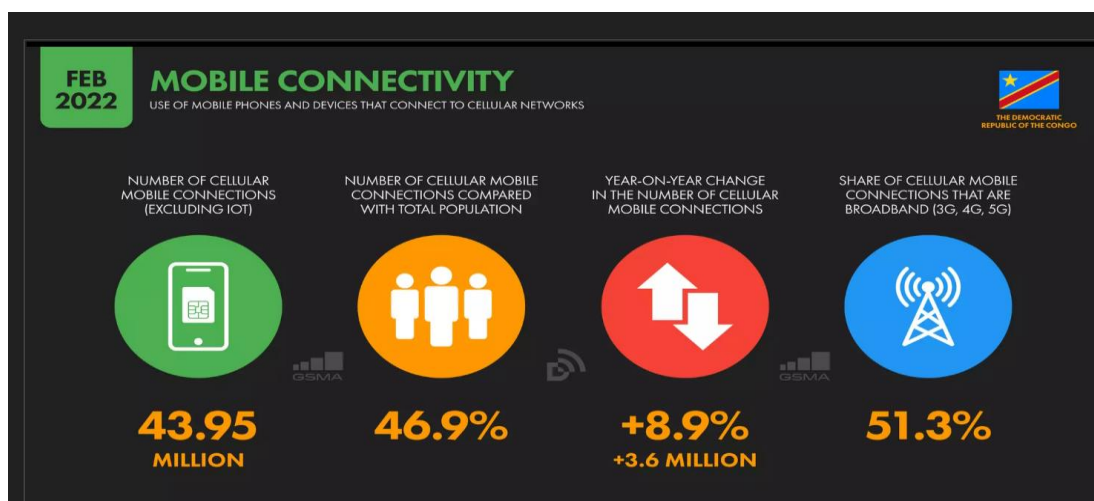


FIGURE 7. INTERNET USERS OVER TIME FROM JANUARY 2012 TO JANUARY 2022 (SOURCE: DATAREPORTAL, 2022)

1.5.2.5 DIGITAL AGRICULTURE SERVICE NEEDS

In terms of digital agriculture in DRC, the number of innovations remains low compared to other countries in central Africa (Centre for Coordination of Agricultural Research and Development for Southern Africa, 2022). Previous empirical research shows that agro-advisory innovations were dominant. No innovation in digital climatic had been identified (figure 8). Why Climatic digital services still missing? Maybe this is due to the fact that climate variability is not yet severe to generate a creditworthy demand.

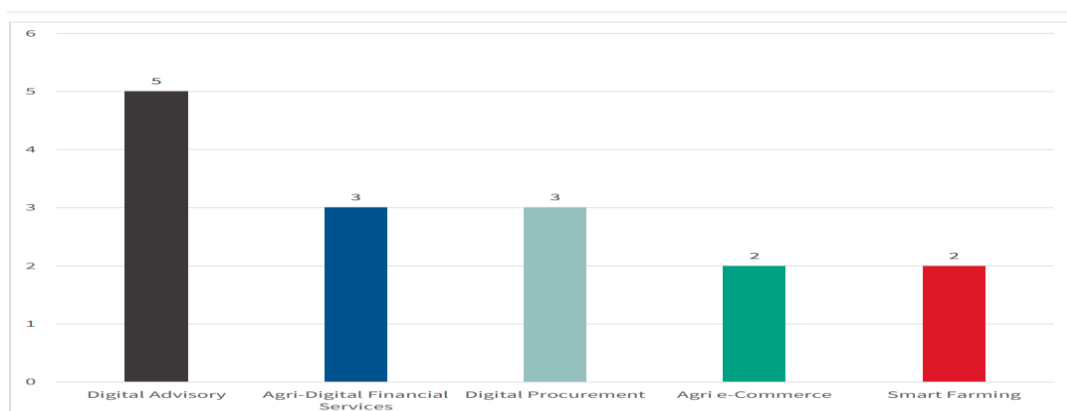


FIGURE 8. IDENTIFIED DIGITAL AGRICULTURE INNOVATIONS IN THE DR CONGO (SOURCE: CENTRE FOR COORDINATION OF AGRICULTURAL RESEARCH AND DEVELOPMENT FOR SOUTHERN AFRICA, 2022)

Based on the fact that the innovations presented were certainly created on the basis of market research by the promoters, it can be concluded that the current demand includes more agronomic digital advisory, financial for electronic payments as presented in the figure above.

1.5.2.6 DIGITAL AGRICULTURE BARRIERS AND PROJECTED CHANGES IN CAPACITY

In DRC, the key barriers that should be addressed to unlock the digital potential include: (1) incentives to increase access and secure data centres; (2) content (includes leveraging Big Data and open data, and stimulating local digital industry); (3) applications (include e-Government, norms and standards and a digital culture); (4) and governance on data protection, cybersecurity, and the legal and regulatory framework (Centre for Coordination of Agricultural Research and Development for Southern Africa, 2022). The other barriers include the lack of mobile network coverage, the digital literacy, farmer uptake and use, and access to devices.

2. EXISTING CLIMATIC AND AGRONOMIC DIGITAL ADVISORY SERVICES IN DRC

2.1 CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES FOR SMALLHOLDERS

This review has identified digital services related to climate and agronomy. The table below presents the innovations identified, their year of creation and a brief description of them.

TABLE 3: TOP 10 CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES

Innovation	Affiliation	Year of launch	Brief description of the innovation
Olam Farmers Information Service	NGO	2014	Agricultural information (prices, weather, technical advice, training), Profiling, Supply Chain, Management, Traceability, Digital payments
FAMEWS	FAO	2019	FAMEWS is a digital app provided by FAO to help in early detection of FAW (Pests management). This app should be used whenever the field is

			surveyed and pheromone traps are checked for FAW
GeoFarmer	Private	2017	Geofarmer is a digital tool to complement extension services and foster active farmers participation and knowledge exchange
Online seed verification system	Private	2019	Online seed origin verification especially imported seed. With this tools, farmers can check the quality of the seed and get information on the origin as well.
Viamo platform	Private	2017	VIAMO is a platform dedicated to the world disconnected from the Internet. With this platform, extension and weather services can reach the most remote farmers. The farmer just needs a simple phone to benefit from agricultural services.
AFROAGRIPRE NEURS NETWORK	Private	2021	One of the Afroagriprenuers Network service is to help small-scale farmers organize into business groups, improving their knowledge, credit access, and negotiating power and train farmers how to improve the quality and yields of their crops and earn higher prices.
Jaunecongo	Private	2014	JauneCongo Promotes organic farming and products
AgriCongo	Private	2018	AgriCongo provides mainly agricultural advisory to smallholder farmers. AgriCongo is an open platform of support NGOs active in the agricultural sector in the DRC, which aims to build a shared vision and approaches and to unite means for the promotion of the peasant movement in the DRC.
E-tumba	Private	2015	E-tumba provides solutions for facilitating and optimising personalised agronomic support for all African farming areas where sustainable co-construction is being developed. E-tumba deliver customized technical itinerary, extension, weather
Fieldy	Private	2020	Fieldy provides essentially: weekly field level crop progress and Weather forecasts

3. CHALLENGES

3.1 CLIMATE CHANGE RELATED CHALLENGES

Studying the climate risk country profile, the World Bank Group (2021) found that DRC will experience temperature change between +1.7°C to 4.5°C by the end of this century. DRC will then experience an increase in hot days (ranging between 13% to 58%) and hot nights (ranging between 33% and 86%). The global change from 2005 to 2099 can be seen in the maps below (Figure 9).

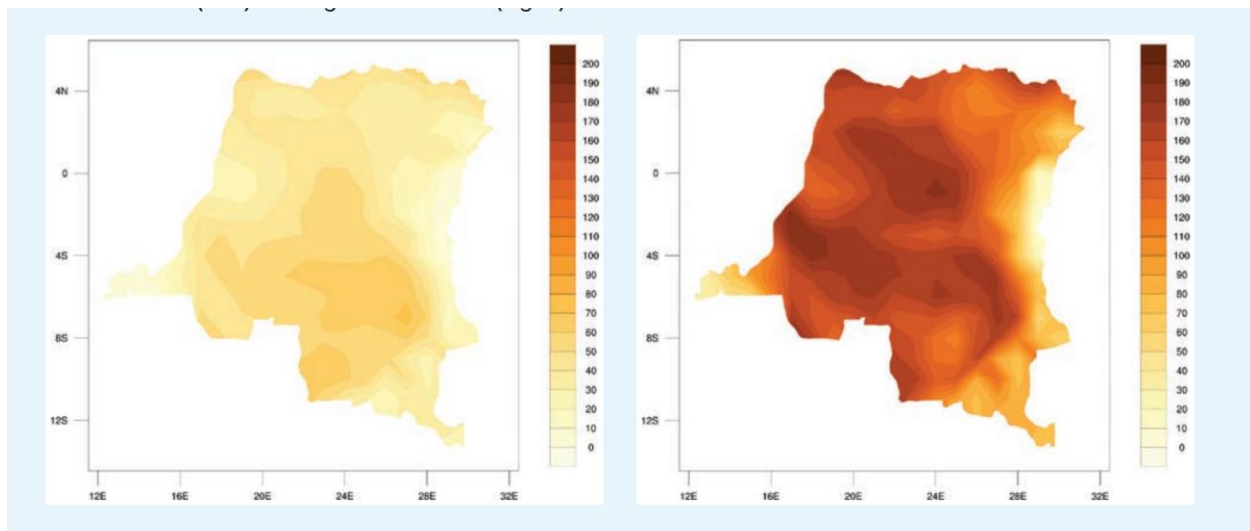


FIGURE 9. MAPS SHOWING SPATIAL VARIATION OF THE CHANGE IN THE NUMBER OF HOT DAYS (>35°C) BY 2040–2059 (LEFT) AND BY 2080–2099 (RIGHT), RELATIVE TO THE 1986–2005 BASELINE UNDER RCP 8.5

Source: (world bank Group, 2021)

In terms of precipitation, there is no significant change in annual rainfall. However, DRC will experience variable rainfall, with likely increase in the frequency and intensity of extreme events. The variation is projected to reach 27%. Of course, these variations will have an impact on crops' yields and performance, especially maize, cassava, groundnuts etc. Given that agriculture is sensitive to climate variability and given its high reliance on rainfall, the performance of agricultural production in DRC will suffer. As a reminder, agriculture is the main contributor to GDP (with 40% contribution) and employs over 70% of the population. The maps below presents the occurrence of flood and wildfire (Figure 10).

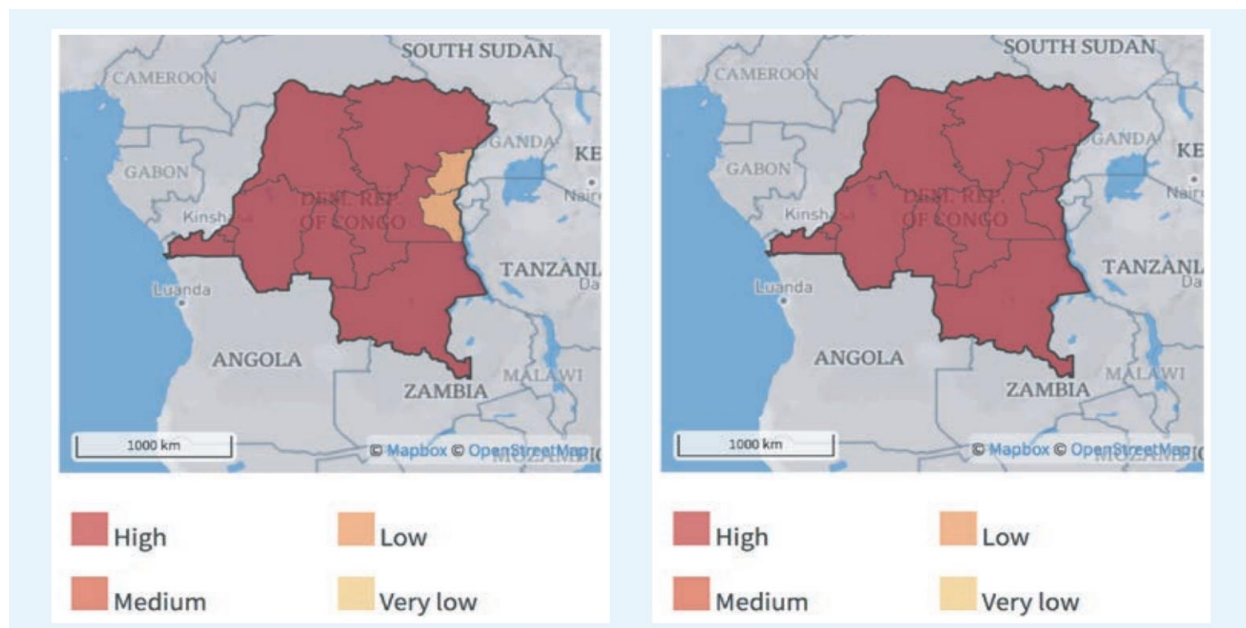


FIGURE 10. RISK OF RIVER FLOOD (LEFT)³⁸; RISK OF WILDFIRE (RIGHT) (SOURCE: (WORLD BANK GROUP, 2021)

3.2 DIGITAL LITERACY, GENDER GAP

The identified innovations above do not segment the users in terms of gender. The main focus is the issue farmers are facing. However, empirical studies have shown that the digital literacy level remains low in DRC. According to World Bank (2020), the formal digital skills training offered in DRC are limited and fragmented. Nascent informal training structures play an ever-important role and need to be further supported because there were few formal training opportunities in DRC. The same source highlights that there was a significant gap between the urban and rural areas in terms of basic infrastructure access, including access to electricity, high cost and coverage of internet, and access to digital devices. There is also a misalignment between available skills and market demand. There is then a real need to redefine training content and curriculum to meet the market demand.

In its report on the Mobile Gender Gap Report, GSMA (2022) indicates that literacy is among the top three barriers for female and male. Lack of literacy and digital skills are the top barriers preventing both male and female mobile users, who are aware of mobile internet, from adopting it. According to DEVCO (2020), the gap between males and females is in terms of the access to formal education where females were

heavily excluded from the system. In addition to this gap, there is the inequitable access of financial and productive resources to the females.

3.3 POLICY LANDSCAPE, THE POLICY PERSPECTIVE

Policy is one of the most important enablers to develop the economy. Indeed, it regulate and facilitate the business among suppliers and users in the country. Given that importance, DRC government decided to set up some policies and plans which are supposed to guide all the stakeholders in the digital industry. According to DEVCO (2020), the current policies and laws available in the DRC include the following:

- Freedom of Information and Communication Law no. 8-2001 (2001)
- Regulation of Electronic Communications Sector, Law no. 9- 2009
- Establishment of the Regulatory Agency of Postal and Electronic Communications, Law no. 11-2009 (2009)
- Plan National Stratégique de Développement (PNSD, 2017-2021)
- Plan National Numérique (Horizon 2025)

3.4 GLOBAL MARKETPLACE

The digital marketplace in DRC includes farmers, digital innovators, NGOs, project and government as well (Présidence de la République Démocratique du Congo, 2019). The main role of the government is to set up the policy environment to enable a fair business between stakeholders. Also, government plays a key role in setting up some basic and sovereign infrastructures (energy, optical fibre). The digital innovators, on the other hand, focus on delivering services to the end-users. Given that many factors hinder the uptake of the digital innovations, projects and NGOs come in to educate and create awareness towards the digital innovation.

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

First of all, it is important to note that in DRC, the supply of climatic and advisory digital advisory is still underdeveloped. This can be seen in the identified innovation

list. So, the topmost issue hindering the access to the digital agriculture service is the supply. Of course, we can assume that the lack of supply may mean lack of low demand of climatic and agronomic digital services in DRC. From empirical research perspective, the low supply of climatic and agronomic digital services is linked to the low supply of digital infrastructure (Digital Impact Alliance, 2020). Also, the fact that the DRC is well-watered is a factor that impacts the current climatic and agronomic demand as farmers are not yet experiencing significantly the negative impacts of climate variability.

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

From the review coupled with the interviews, the need for farmers can be summarized as follow:

- The evidence of climatic and agronomic digital services' impacts on their income and well-being still needs to be demonstrated. Indeed, without a clear outcome from the use of these digital solutions, it may be challenging to convince the farmers to adopt widely and easily;
- To introduce successfully the climatic digital service which is missing in DRC, the innovators can start with the extreme events forecasts. Given that DRC is known to experience extreme floods and wildfires, farmers and others value chain actors may need that information to mitigate the negative effects of climatic variability.

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?

Depending on the services provided by the innovators, the users are a bit different. Of course, the majority of farmers can use the digital services because most of them are growing several crops including maize, rice, cassava, cotton and tree crops (coffee, cocoa).

TABLE 4: TARGET USERS OF THE IDENTIFIED CLIMATIC AND AGRONOMIC DIGITAL SERVICES IN DRC

Innovation	Affiliation	Year of launch	Users (target)
Olam Farmers Information Service	NGO	2014	Coffee
FAMEWS	FAO	2019	Cereals including maize, rice, sorghum
GeoFarmer	Private	2017	All crops
Online seed verification system	Private	2019	All farmers purchasing seed
Viamo platform	Private	2017	All crops
AFROAGRIPRENEURS NETWORK	Private	2021	All crops
Jaunecongo	Private	2014	All crops
AgriCongo	Private	2018	All crops
E-tumba	Private	2015	Cacao, coffee, cotton, rice
Fieldy	Private	2020	All crops

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

Considering the available statistics and reports, it becomes clear that the current users of climatic and agronomic digital services still requires awareness about it. Only “Olam Farmers Information Service” has 500,000 users which represents barely 0.96% of the rural population. The other innovations are far from having a significant figure (table 5).

TABLE 5: NUMBER OF USERS OF THE CLIMATIC AND AGRONOMIC DIGITAL SERVICES IN DRC

Innovation	Affiliation	Year of launch	Number of users
Olam Farmers Information Service	NGO	2014	500 000
FAMEWS	FAO	2019	10 000
GeoFarmer	Private	2017	-
Online seed verification system	Private	2019	-
Viamo platform	Private	2017	2 600
AFROAGRIPRENEURS NETWORK	Private	2021	-
Jaunecongo	Private	2014	2 500
AgriCongo	Private	2018	1 300
E-tumba	Private	2015	168 (22060 hectares covered)
Fieldy	Private	2020	100

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

In the DRC, weather conditions appear to be stable for the time being. Therefore, digital service providers are focused on agronomic services and market access for agricultural products. The motivation of service providers' is primarily financial, as they believe that farmers need these services to manage pests, to improve access to seed, and fertilizer.

From the State's point of view, access to climate and agronomic services is of paramount importance as it is a part of its digital development plan for 2025. As for projects and NGOs, they play an awareness-raising role with regard to climate risks and the vulnerability of rural populations' livelihoods

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

TABLE 6: USE OF CLIMATIC AND AGRONOMIC DIGITAL SERVICES BY FARMERS IN DRC

Innovation	Affiliation	Use of the climatic and agronomic digital services by farmers
Olam Farmers Information Service	NGO	Although Olam offers several services, the review revealed that agricultural advice and product marketing are the most requested by farmers. Weather forecasting remains in low demand by farmers. The agricultural advice they seek enables them to meet the production standards required by Olam when purchasing products
FAMEWS	FAO	farmers use FAMEWS when they sense that pests are attacking crops. FAMEWS can be said to be a digital farm advisory as it allows them to detect pests and recommended treatments
GeoFarmer	Private	Farmers use Geofarmer to exchange knowledge and experiences. By using this platform, farmers learn on through their pairs (positive or negative experiences). This way of learning help them to avoid mistakes and improve their production system than the classic learning and extension advisory
Online seed verification system	Private	Farmers and extension service agents use this platform to check the origin of the seed they are buying. If there no information on the seed after checking, it means the quality of that seed is questionable. From the result of the verification, users can decide to use or to reject of the seed.
Viamo platform	Private	Viamo is mainly used by innovator such as weather and extension service agents to share information and knowledge to farmers in remote areas. They conceive the message to be broadcast and use Viamo to share it.
AFROAGRIPR ENEURS NETWORK	Private	Trainings on CSA and agronomics have been organized online for groups of farmers to improve their production processes. The ultimate goal to improve yield and products quality for processing units.
Jaunecongo	Private	Farmers use our trainings and good agronomics practices in organic farming.
AgriCongo	Private	Through AgriCongo's vision peasant farmers are becoming aware of the importance of knowledge and the role they should play in the sector.
E-tumba	Private	e-tumba assist farmers with weather forecasts and appropriate actions to be taken. Also, e-tumba helps farmers to keep record on all actions they have taken.
Fieldy	Private	Through its services including weekly field level crop progress and Weather forecasts, farmers leverage them to make decisions

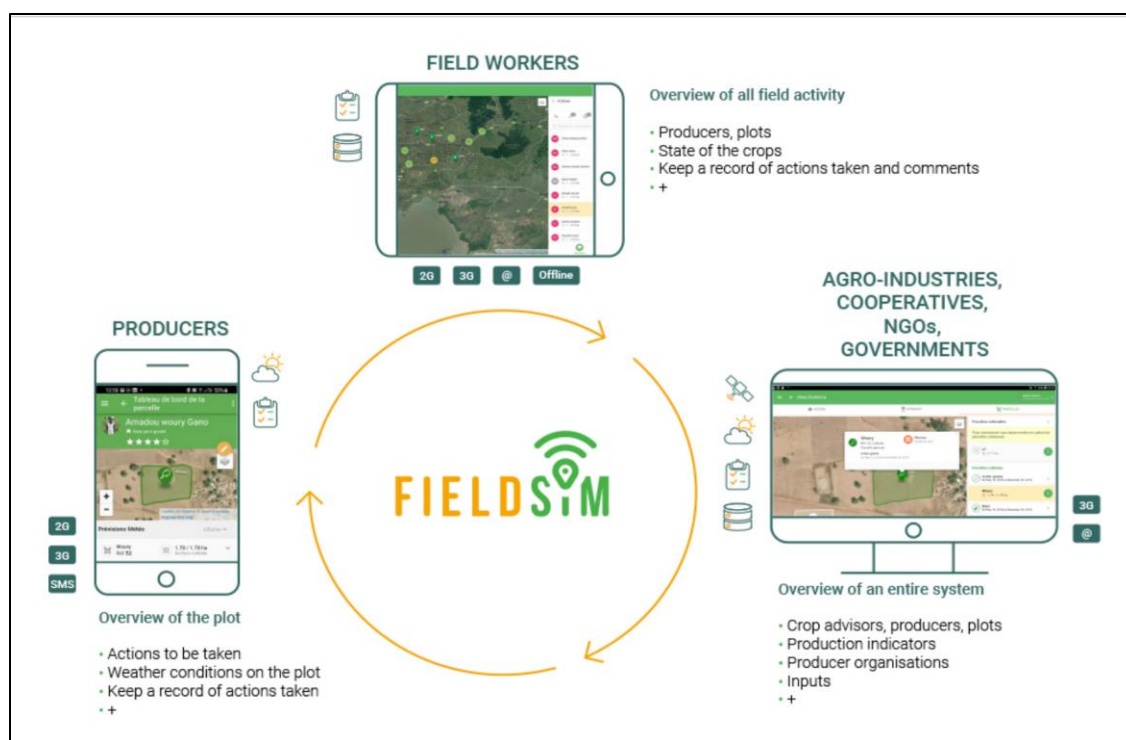


FIGURE 11. E-TUMBA BUSINESS MODEL WITH FARMERS

Source: <https://e-tumba.com/en/solutions-2/fieldsim/>

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

Although majority of farmers are not in a habit of accessing the weather forecast, however, those who use it seems more confident than the non-users. For agronomic advice, its usage has been made mandatory if the farmer wants to take advantage of the market promoted by digital innovators. In fact, farmers are required to follow a minimum process accepted by other parties in order for their products to be accepted in the market.

5. BUNDLED DIGITAL PRODUCTS

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

According to some actors, bundling pest management, early detection tools, and Good Agronomic Practices are few of the options needed. Also, information related to inputs (prices, availability) and market (especially prices) are other bundling options. For the time being, it seems that the awareness on weather information utility remains very low. This can be understood by the fact that the country is well-watered. There is a need to work on farmers' awareness on weather information.

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

As it can be seen on the identified climatic and agronomic digital services list, the climate mitigation remains under-developed in DRC. However, some of innovators including fieldy, e-tumba, viamo have the capacity to improve and leverage on it.

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

The majority of the climatic and agronomic digital services suppliers have used their own capitals to set up the businesses. This way of financing is considered to be sustainable because the entrepreneur will do his best to get back his investment compared to those who rely on subsidy and grants.

TABLE 7: FINANCIAL BUSINESS MODELS USED BY DRC CLIMATIC AND AGRONOMIC DIGITAL SERVICES

Innovation	Affiliation	Year of launch	Financial MODEL
Olam Farmers Information Service	NGO	2014	Own capital
FAMEWS	FAO	2019	Grant
GeoFarmer	Private	2017	Grant
Online seed verification system	Private	2019	Grant & subsidy
Viamo platform	Private	2017	Own capital
AFROAGRIPRENEURS NETWORK	Private	2021	Own capital

Jaunecongo	Private	2014	Own capital
AgriCongo	Private	2018	Grants, subsidy
E-tumba	Private	2015	Own capital
Fieldy	Private	2020	Own capital

5.4 LEADERSHIP AND GOVERNANCE OF AGRICULTURE SECTOR

Based on the number of users, we can say that FAMEWS, Olam Farmers Information Service, Viamo are the market leaders in climate and agronomic services in DRC. Of course, the sector is governed by the National Regulation Authority of the Post and Telecommunications of DRC³.

The National Regulation Authority mission include:

- Legal regulation, i.e. ensuring the application of laws and accompanying regulations and helping to adapt them;
- Technical regulation, through the allocation of scarce resources such as numbers and frequencies, and also the determination of interconnection mechanisms, which presuppose a knowledge of the functioning of telecommunications networks;
- Economic regulation by analysing market situations, monitoring tariffs and assessing the cost of universal service;
- Social regulation by taking into account the interests of consumers.

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

For the time being, it is difficult to conclude that innovators are able to sell massively given the number of users of these digital technologies. Given also that the majority are from the private sector (i.e. having used their own funds), we can deduce that the sector is mostly privately funded. Certainly, some infrastructures such as optical fibre are the responsibility of the State.

³ <https://arptc.gouv.cd/presentation/>

6. GENDER AND SOCIAL INCLUSION PERSPECTIVE

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

To solve the issue of equal access to all potential clients of digital climate and agronomic services, it would first be necessary to solve the issue of equal access to productive resources and internet access terminals. Indeed, there is already an inequality between men and women. The figure below illustrates that fact with the case of social media use.

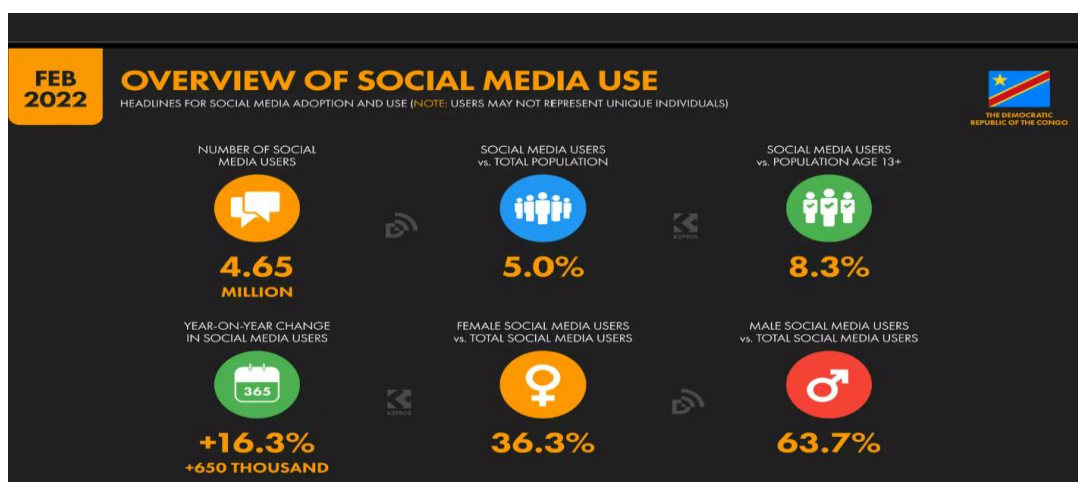


FIGURE 12. OVERVIEW OF SOCIAL MEDIA USE (SOURCE: DATAREPORTAL, 2022)

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

For the time being, innovations are not well known to the majority of farmers. The few farmers who use these technologies do so with the support of NGOs and projects. With the support of "accessnow"⁴, a humanitarian organisation, the Congolese people are being made aware of their digital access rights. Access to all without exclusion is one of the rights defended by this organisation. According to GSMA (2022), the digital awareness starts by awareness of internet. There were 16.50 million internet users in the DRC in January 2022 which represented

⁴ <https://www.accessnow.org/democratic-republic-congo-orders-orange-cameroon-slow-internet-capacity/>

around 17.6% of the total population at the start of 2022. From this statistic, we can derive the number of non-users in DRC. So, more than 82% of the population remain offline (DATAREPORTAL, 2022).

6.3 THE ROLE OF YOUTH

The youth play a huge role in digital economy because the uptake of the technology is high for this segment of consumer. In DRC, the youth (18 to 34 years) represent 26% of the population (DATAREPORTAL, 2022). The majority of them are connected to internet. However, they have less access to the productive resources needed in agriculture.

In their study entitled "Understanding secondary school youth perceptions of agricultural careers in the Democratic Republic of Congo", Mulei et al (2020) concluded that 86% of the students attended agricultural courses and 54% identified agriculture as having a place in their future, but often not as their highest career ambition. Livestock, field cropping, small animal production, and horticulture were the most viable enterprises for the youngsters. Nearly half (46%) were averse to agriculture as a career path based their decision upon excessive labour requirements (30%), difficulties in securing land (25%), and low returns to effort (20%). It can therefore be said that the right entry point for the adoption of digital climate and agronomy services should not ignore young people in DRC.

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

TABLE 8: POTENTIAL IMPACTS OF DIGITAL CLIMATE AND AGRONOMIC SERVICES IN DRC

Innovation	Affiliation	Potential Impacts of the climatic and agronomic digital services for farmers
Olam Farmers Information Service	NGO	• Increase in yield • Access to market which lead to increase in income • Access to weather which can change the cropping pattern
FAMEWS	FAO	FAMEWS saves farmers through rapid pest detection. This reduces the loss of production. Crops are produced with less caterpillar attack.
GeoFarmer	Private	When farmers share their practices with each other, it increases their belief in their ability to achieve similar results to their peers. The visible impact is the adoption of good practices and technology because it comes from other farmers. In contrast, advice from extension agents is taken with caution as farmers see them as theorists and not practitioners.
Online seed verification system	Private	Online seed verification allows farmers to seek the origin and the quality as well. It is scientifically proven that seed contribute up to 40% of yield. This is true if the quality of seed is guaranteed. So, Online seed verification system is quality guarantee.
Viamo platform	Private	Given that Viamo is able to share weather and knowledge without internet, the platform impacts offline farmers lives in remote areas where internet remain a challenge.
AFROAGRIPRENEURS NETWORK	Private	CSA is known to mitigate climate negative effects on yield. So, the users of AFROAGRIPRENEURS NETWORK have the opportunity to apply these knowledge and maintain at least their yield.
AgriCongo	Private	AgriCongo assists Pesant farmers to play a role in the food system by increasing their awareness. Pesant farmers will impact the availability of food when they become aware that they have a mission to provide food to Congolese. The direct consequence is that they will earn more income.
E-tumba	Private	e-tumba is a bundled CIS because it provides weather information and suggest the appropriate action given the forecasts. The bundle provided contributes to reduces production costs as the farmer would have to purchase each service separately with no guarantee of success. The farmer is expected to make more good decisions; therefore, he should get more utility (more yield, income and margin).
Fieldy	Private	With Fieldy, the farmer can monitor his crops weekly progress and forecast is production. Field Again, from the weather information provided, he can decide for the relevant actions to take.

7. DATA HARMONIZATION

TABLE 9: DATA HARMONIZATION IN DRC

Key questions	Answers
Where is the data is published or stored?	In the DRC, innovators store their data at their convenience. There is no common data storage platform at the moment. The majority of the innovations publish the information via play store, USSD, SMS and websites. Olam⁵ for example is publishing on play store and USSD depending to location. FAMEWS⁶ and Viamo also publish on google play. Geofarmer is using it own website⁷ (Geofarmer is supported by CIA as well).
In the case the data is published, is metadata provided to facilitate the retrieval of information?	Metadata cannot be seen from the different innovations.
Are guidelines for data standards	In DRC, digital agriculture is nascent. The country is yet to organize the initiatives through legal framework, policy incentives and investment plan.
Do you know about local, regional or national data sets that are underutilized?	Datareportal⁸; GSMA BASIS⁹ ITU¹⁰ STATISTICA
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 identified innovations are using their own concepts and terminology. Due to marketing reasons, every innovation is trying to use specific word and terminology to get its audience attention.
The Legal and regulatory framework in the country	The legal and regulatory framework in DRC include the following:

⁵ <https://play.google.com/store/apps/details?id=com.olam.fsp.farmer&hl=fr&gl=US>

⁶ <https://play.google.com/store/apps/details?id=org.fao.famews&hl=fr&gl=US>

⁷ <https://home.geofarmer.org/>

⁸ <https://datareportal.com/reports/digital-2022-democratic-republic-of-the-congo>

⁹ <https://www.basis.cloud/>

¹⁰ <https://www.itu.int/en/Pages/default.aspx>

Key questions	Answers
	1) Framework law n°013/2002 of 16 October 2002 on telecommunications in the DR Congo 2) Law n°014/2002 of 16 October 2002 establishing the Postal Regulatory Authority. 3) Law n°18/019 of 9 July 2018 on Payment Systems and Payment and Securities Settlement Systems
How data privacy is usually managed?	By law, users' privacy is preserved. All the identified innovations are trying to preserve users' privacy. For example, Olam preserves all its clients data¹¹. FAMEWS states that <i>"Safety starts with understanding how developers collect and share your data. Data privacy and security practices may vary based on your use, region, and age. The developer provided this information and may update it over time."</i> Viamo¹² complies with the privacy and data protection regulations of the countries covered.

8. POTENTIAL AVENUES FOR CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES

The market for climatic and agronomic digital services in the DRC remains primary and will continue to grow at a low rate as the country still seems to be well watered in the minds of farmers. This is also reflected in the low sales of digital services according to the promoters interviewed.

We therefore recommend:

- that Alliance Bioversity and CIAT accompany the actors to review the general policy of digital in relation to agriculture;
- Also, awareness-raising activities on climate events and available solutions should be promoted by innovators in collaboration with the DRC Ministry of Agriculture;
- by facilitating a bundling, Alliance Bioversity and CIAT could help to solve the affordability issue

¹¹ <https://www.olamgroup.com/privacy.html>

¹² <https://viamo.io/fr/legal/>

TABLE 10: POTENTIAL AVENUES FOR CLIMATE AND AGRONOMIC DIGITAL ADVISORY SERVICES IN DRC

Domains	Answers
Minimizing barriers	Low awareness of farmers on digital agriculture solutions, digital literacy issue, low access to internet, cost for internet remain the key challenges in DRC. Also, climatic digital solutions are quite absent in the economy while climatic risks especially extreme events such floods are expected in the future. The country should focus on these areas by investing at least on digital infrastructure and digital education. Given the natural endowment of DRC in natural resources and lands, an attractive policy will enable investors to contribute in the digital economy
Considering user research	Without a deep assessment on users, especially a deep profiling, the digital innovations will struggle to sell their services in DRC. The majority of the current sales is supported by NGOs and the CGIAR. Also, the derivable benefits on the available innovations need to be well highlighted rather than promoting the features only. Indeed, farmers buy benefits not features.
Gender end social perspective	The rural area remains low endowed by digital infrastructure. Also, women and youth have limited access to productive resources in rural area. So, an inclusive policy combined with education on business opportunities will enhance the digital innovations uptake.
Data harmonization	As stated above, the climatic and agronomic digital services in DRC need a common guideline to harmonize some aspects. This harmonization can be easily organized by Postal Regulatory Authority.
Potential for Public Private partnerships (PPP)	The majority of the climatic and agronomic digital innovations have marketing issue. They literally struggle to sell their services and this can be seen on the number of users. Building Partnerships with market researchers and specialized business in sales will enhance the uptake in DRC.
Bundled Climate and agronomic digital advisory services	In the DRC, as elsewhere in sub-Saharan Africa, digital solutions for farmers are promoted separately. This business model is not sustainable because it costs the farmer more to buy several innovations with the risk that they will not work. Also, innovators would benefit from combining their solutions into one package to avoid paying for each marketing effort while the customer remains the same person. Bundling allows to deliver all the preferred digital solutions in one pack at a reduced cost for the farmer who is struggling to buy them.

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